DEPARTMENT OF THE NAVY UNITED STATES OF AMERICA

Final

Environmental Impact Statement

GUAM AND CNMI MILITARY RELOCATION

Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force

Reader's Guide

July 2010

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Guam and CNMI Military Relocation EIS

Reader's Guide

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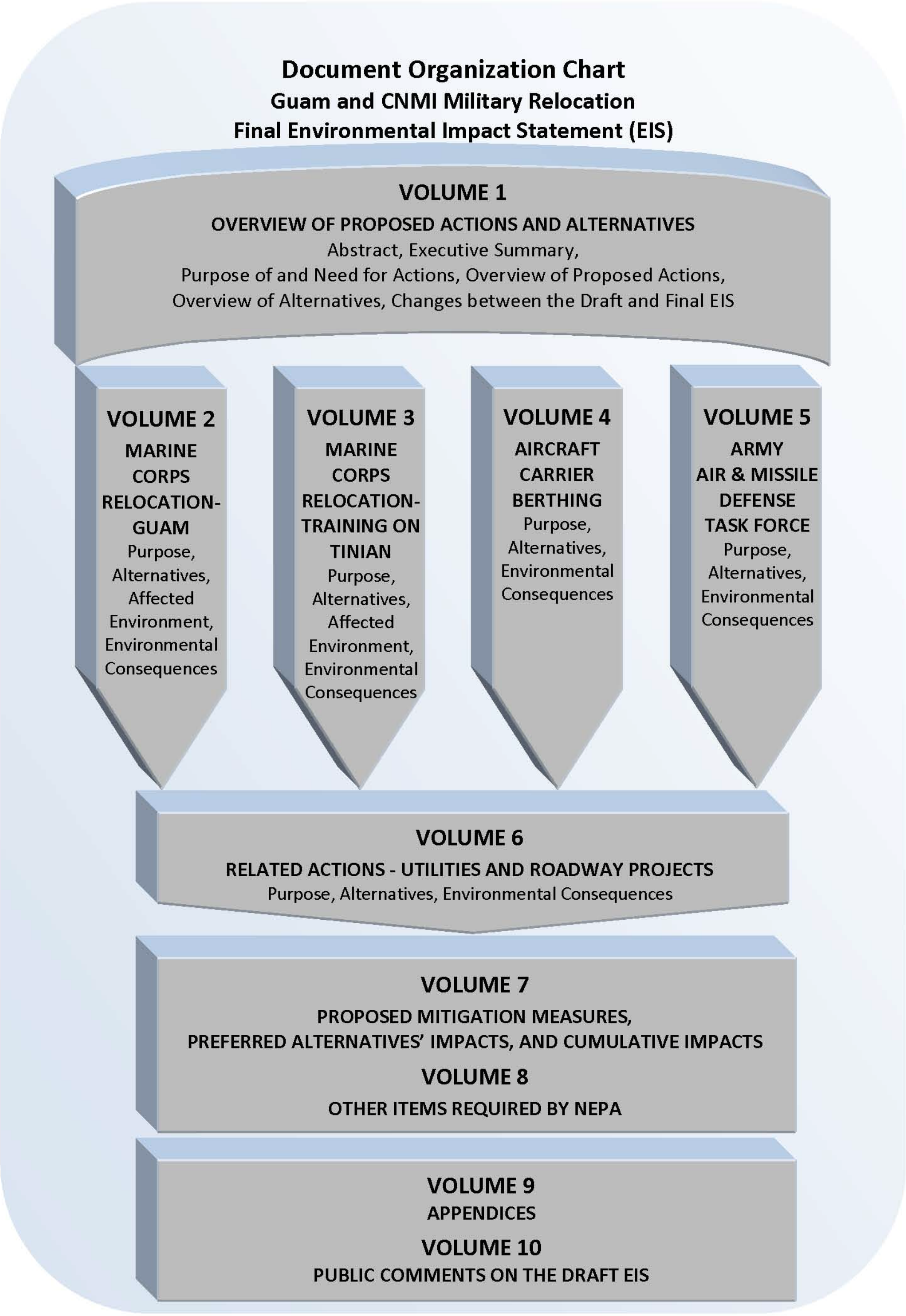

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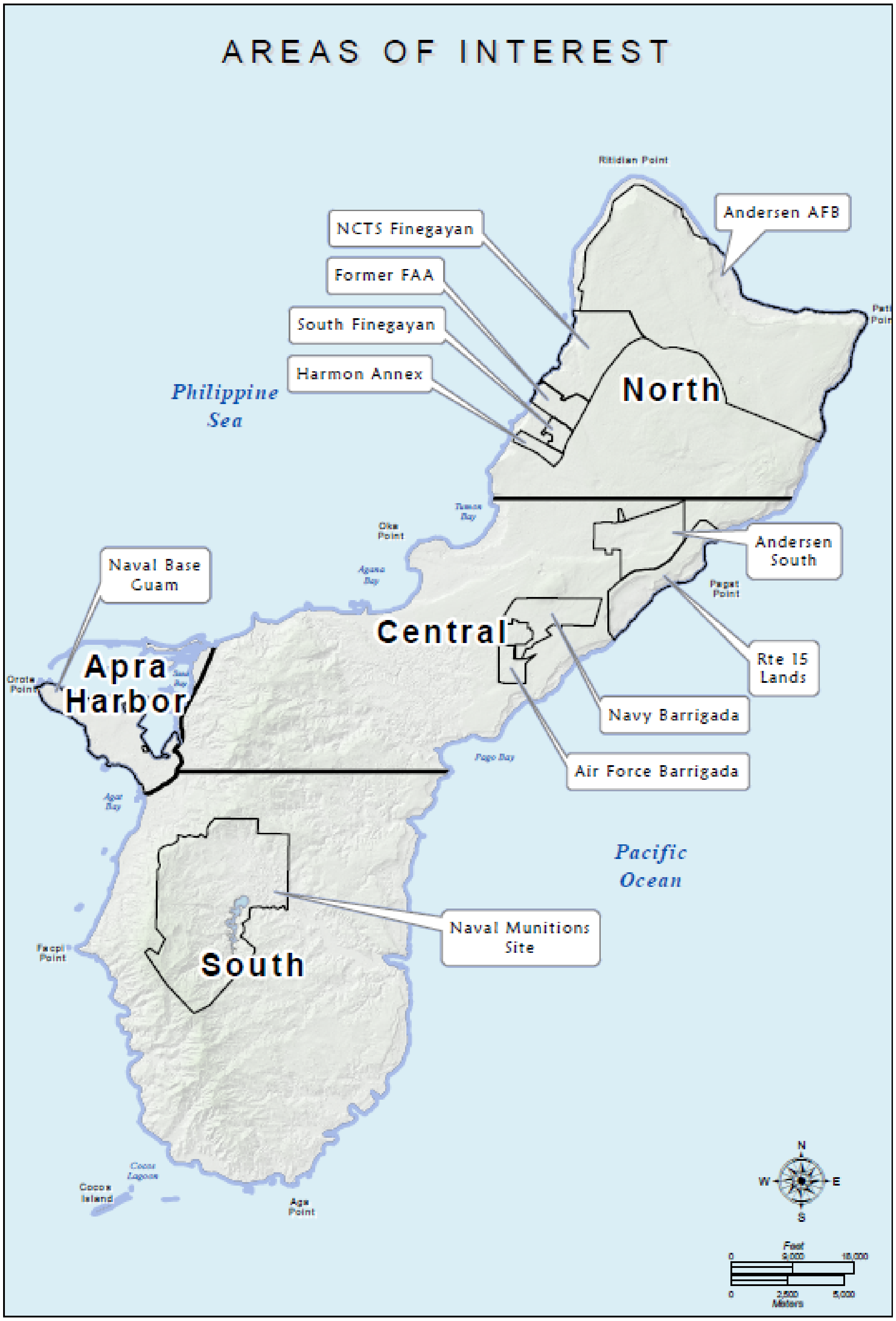

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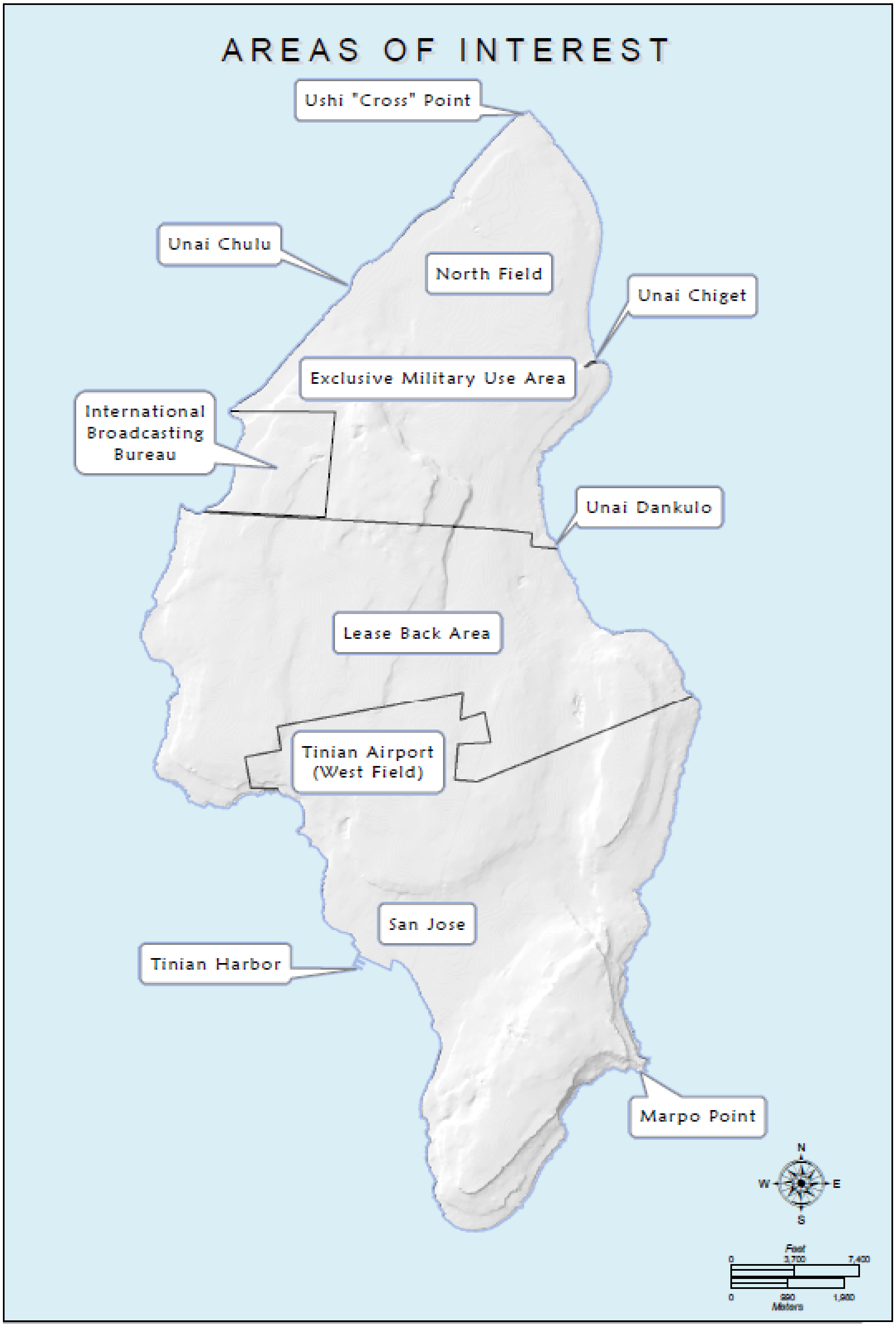
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Unai Chulu
North Field
Unai Chiget
Exclusive Military Use Area
International Broadcasting Bureau
Unai Dankulo
Lease Back Area
Tinian Airport (West Field)
San Jose
Tinian Harbor
Marpo Point
N
W
E
S
Feet
0
3,700
7,400
0
990
1,980
Meters

CHAPTER 4.
GLOSSARY

Access—the right to transit to and from and to make use of an area.

Activity—an individual scheduled training function or action such as missile launching, bombardment, vehicle driving, or Field Carrier Landing Practice.

Air Traffic Control Assigned Airspace (ATCAA)—Federal Aviation Administration-defined airspace not over an Operating Area (OPAREA) within which specified activities, such as military flight training, are segregated from other Instrument Flight Rules air traffic.

Airfield—usually an active and/or inactive airfield, or infrequently used landing strip, with or without a hard surface, without Federal Aviation Administration-approved instrument approach procedures. An airfield has no control tower and is usually private.

Airport—usually an active airport with hard-surface runways of 3,000 feet or more, with Federal Aviation Administration-approved instrument approach procedures regardless of runway length or composition. An airport may or may not have a control tower. Airports may be public or private.

Airspace, Controlled—airspace of defined dimensions within which air traffic control service is provided to Instrument Flight Rules flights and to Visual Flight Rules flights in accordance with the airspace classification. Controlled airspace is divided into five classes, dependent upon location, use, and degree of control: Class A, B, C, D, and E.

Airspace, Special Use—airspace of defined dimensions identified as the space or portion thereof over an area on the surface of the earth wherein activities must be confined because of their nature and/or wherein limitations may be imposed upon non-participating aircraft.

Airspace, Uncontrolled—airspace, or Class G airspace, refers to airspace not otherwise designated and operations below 1,200 feet above ground level. No air traffic control service to either Instrument Flight Rules or Visual Flight Rules aircraft is provided other than possible traffic advisories when the air traffic control workload permits and radio communications can be established.

Airspace—the space lying above the earth or above a certain land or water area (such as the Pacific Ocean); more specifically, the space lying above a nation and coming under its jurisdiction.

Amphibious Craft Laydown— location for storing, maintaining and deploying amphibious vehicles.

Army Air and Missile Defense Task Force (AMDTF)—a ground force that includes command and control, missile field teams, maintenance, and logistics/supplies support. They also include Weapons Emplacement Sites that would accommodate Terminal High-Altitude Area Defense (THAAD) and Patriot Missile operations.

Base load power—the minimum load over a given time period. The generation capacity needed to meet the continuous (24/7) demand for the system.

Battalion—in general, a battalion is a group of 5 companies, approximately 960 individuals.

Biosecurity Risk Assessment—a risk assessment to evaluate the proposed actions described in this EIS to determine the potential for invasive species to cause harm to ecological or economic systems on Guam or at locations where they may be inadvertently exported.

Biosecurity Plan—a plan that includes an invasive species risk assessment (biosecurity risk assessment) and management of risks and damage from invasive plant and animal species.

Biosecurity—a multi-level, multi-disciplinary, collaborative program to prevent the introduction and establishment of new invasive species.

Booster—an auxiliary or initial propulsion system that travels with a missile or aircraft and that may not separate from the parent craft when its impulse has been delivered; may consist of one or more units. Boosters contain high explosives sensitive enough to be detonated by a small initiator and powerful enough to set off a less sensitive main explosive charge.

Carrier Vessel Nuclear (CVN)—a nuclear powered aircraft carrier.

Coastal Zone—a region occupying the area near the coastline in depths of water less than 538.2 ft (164.0 m). The coastal zone typically extends from the high tide mark on the land to the gently sloping, relatively shallow edge of the continental shelf. The sharp increase in water depth at the edge of the continental shelf separates the coastal zone from the offshore zone. Although comprising less than 10% of the ocean's area, this zone contains 90% of all marine species and is the site of most large commercial marine fisheries. This differs from the way the term "coastal zone" is defined in the Federal Coastal Zone Management Act where "coastal zone" typically extends from the low tide mark to several hundred feet upland.

Continental United States (CONUS)—the United States and its territorial waters between Mexico and Canada, but excluding Alaska, Hawaii, U.S. territories, and possessions.

Company—in general, a company is a group of 4 platoons, approximately 192 individuals.

Controlled Access—area where public access is prohibited or limited due to periodic training operations or sensitive natural or cultural resources.

Controlled Airspace—airspace of defined dimensions within which air traffic control service is provided to Instrument Flight Rules flights and to Visual Flight Rules flights in accordance with the airspace classification. Controlled airspace is divided into five classes, dependent upon location, use, and degree of control: Class A, B, C, D, and E.

Controlled Firing Area—area where ordnance firing is conducted under controlled conditions so as to eliminate hazard to aircraft in flight.

Council on Environmental Quality (CEQ)—established by the National Environmental Policy Act, the CEQ consists of three members appointed by the President. A CEQ regulation (Title 40 Code of Federal Regulations 1500-1508, as of July 1, 1986) describes the process for implementing the National Environmental Policy Act, including preparation of environmental assessments and environmental impact statements, and the timing and extent of public participation.

Cumulative Impact—the impact on the environment which results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Discarded Military Munitions—military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations.

Distance X—the maximum distance a projectile (including guided missiles and rockets) will travel when fired or launched at a given quadrant elevation with a given charge or propulsion system.

Economic Adjustment Committee (EAC)—established by Executive Order 12788 (as amended), the EAC coordinates Federal interagency and intergovernmental assistance to support the Defense Economic Adjustment Program and help communities respond to economic impacts caused by significant Defense program changes. The EAC is chaired by the Secretary of Defense. The Secretaries of Labor and Commerce serve as the Vice Chair men and there are a total of twenty-two federal agencies and departments represented on the EAC.

Encroachment (per Navy instruction)—any non-Navy action planned or executed that inhibits, curtails, or possesses the potential to impede the performance of Navy activities. Additionally, the lack of action by the Navy to work proactively with local communities, to monitor development plans, or to adequately manage its facilities and real property could also impact the Navy mission and thereby result in encroachment." Therefore, encroachment may stem from both internal (Navy) and external (civilian) sources.

Explosive Ordnance Disposal (EOD)—the detection, identification, field evaluation, rendering-safe recovery, and final disposal of conventional, nuclear, and chemical/biological ordnance. EOD activities are performed by specially trained active duty military personnel.

Explosive Safety Quantity-Distance (ESQD)—for a given quantity of explosive material, the distance separation relationships providing defined types of protection based on levels of risk considered acceptable. The size of the ESQD arc is proportional to the net explosive weight present.

Facilities—physical elements that can include roads, buildings, structures, and utilities. These elements are generally permanent or, if temporary, have been placed in one location for an extended period of time.

Fleet Area Control and Surveillance Facility (FACSFAC)—Navy facility that provides air traffic control services and controls and manages Navy-controlled off-shore operating areas and instrumented ranges.

Hardfill—a disposal facility for demolition debris (e.g. reinforced and non-reinforced concrete, asphalt, brick, block, tile, stone, roofing material, drywall, wood, and metal) that is not contaminated with solid waste, infectious waste, or hazardous waste.

High Explosive (HE)—an explosive substance designed to function by detonation (e.g., main charge, booster, or primary explosive). High Explosives when initiated change from basic form at a velocity greater than that of sound throughout the material exploding. The reaction, which generates a large volume of gas at high temperature and results in intense shattering effect, is usually referred to as a detonation. Examples: RDX, TNT, dynamite, and HBX.

Impact Area—the identified area within a range intended to capture or contain ammunition, munitions, or explosives and resulting debris, fragments, and components from various weapons systems (e.g., the ground and associated airspace within the training complex) A weapon system impact area is the area within the surface danger zone used to contain fired, or launched ammunition and explosives, and the resulting fragments, debris, and components. Indirect fire weapon system impact areas include probable error for range and deflection. Direct fire weapon system impact areas encompass the total surface danger zone from the firing point or position downrange to distance X.

Instrument Flight Rules (IFR)—regulations and procedures for flying aircraft by referring only to the aircraft instrument panel for navigation.

Major Exercise—a significant operational employment of live, virtual, and/or constructive forces during which live training is accomplished. A Major Exercise includes multiple training objectives, usually occurring over an extended period of days or weeks. An exercise can have multiple training operations (sub-events each with its own mission, objective and time period. Examples include C2X, JTFEX, SACEX, and CAX. Events [JTFEX] are composed of specific operations [e.g., Air-to-Air Missile], which consist of individual activities [e.g., missile launch]).

Maneuver Element—basic element of a larger force independently capable of maneuver. Normally, a Marine Division recognizes its infantry battalions, tank battalion, and light armored reconnaissance (LAR) battalion as maneuver elements. A rifle (or tank/LAR) battalion would recognize its companies as maneuver elements. A rifle (or tank/LAR) company would recognize its platoons as maneuver elements. Maneuver below the platoon level is not normally possible since fire and movement can be combined only at the platoon level or higher. The Army and National Guard recognize a squad and platoon as maneuver elements.

Maneuver—employment of forces on the battlefield through movement in combination with fire, or fire potential, to achieve a position of advantage with respect to the enemy in order to accomplish the mission.

Marine Air-Ground Task Force (MAGTF)— This is how the Marine Corps is set up to perform all types of their military actions. It insures that ground forces and air forces are working together under single leadership and a clear goal.

Marine Expeditionary Force (MEF)—A MEF is the largest MAGTF group, and is comprised of a MEF Headquarters Group, Marine Division, Marine Air Wing and Marine Logistics Group.

Marine Expeditionary Brigade (MEB)—A MEB is larger than a Marine Expeditionary Unit (MEU) but smaller than a Marine Expeditionary Force (MEF). It is comprised of a reinforced infantry regiment, a composite Marine aircraft group, and a brigade service support group. It can function as part of a joint task force, as the lead echelon of the MEF, or alone.

Marine Expeditionary Unit (MEU)—A MEU is the smallest MAGTF group, and is comprised of an air and ground combat team, and combat service support. The specific makeup of the MEU can be customized with additional artillery, armor, or air units.

Marine Corps Ground Unit—Marine Expeditionary Unit Ground Combat Element, or Battalion Landing Team, composed of an infantry battalion of about 1,200 personnel reinforced with artillery, amphibious assault vehicles, light armored reconnaissance assets and other units as the mission and circumstances require.

Material Potentially Presenting an Explosive Hazard (MPPEH)— material owned or controlled by the Department of Defense that, prior to determination of its explosives safety status, potentially contains explosives or munitions (e.g., munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or disposal; and range-related debris) or potentially contains a high enough concentration of explosives that the material presents an explosive hazard (e.g., equipment, drainage systems, holding tanks, piping, or ventilation ducts that were associated with munitions production, demilitarization, or disposal operations). Excluded from MPPEH are munitions within the DoD-established munitions management system and other items that may present explosion hazards (e.g., gasoline cans and compressed gas cylinders) that are not munitions and are not intended for use as munitions.

Munitions and Explosives of Concern (MEC)—this term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks means: (A) Unexploded Ordnance (UXO), as defined in 10 U.S.C. 101(e)(5)(A) through (C): (B) Discarded military munitions (DMM), as defined in 10 U.S.C. 2710(e)(2): or (C) munitions constituents (e.g., TNT, RDX) present in high enough concentrations to pose an explosive hazard.

National Environmental Policy Act (NEPA)—42 U.S.C. 4321, et seq passed by Congress in 1969. The Act established a national policy designed to encourage consideration of the influences of human activities, such as population growth, high-density urbanization, or industrial development, on the natural environment. The NEPA procedures require that environmental information be made available to the public and the decision-makers before decisions are made. Information contained in the NEPA documents must focus on the relevant issues in order to facilitate the decision-making process.

Outside the Continental United States (OCONUS)—the areas of Alaska, Hawaii, U.S. territories, and possessions and their territorial waters excluding the U.S. and its territorial waters between Mexico and Canada.

Operation—A combination of activities accomplished together for a scheduled period of time for an intended military mission or task. An operation can range in size from a single unit exercise to a Joint or Combined event with many participants (e.g., aircraft, ships, submarines, troops).

Operational Range—a range that is under the jurisdiction, custody, or control of the Secretary of Defense and is used for range activities; or although not currently being used for range activities, that is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities per 10 U.S.C. 101(e)(3).

Ordnance—broadly encompasses all weapons, ammunition, missiles, shells, and expendables (e.g., chaff and flares).

Peak load—the maximum load consumed or produced by a unit or group of units in a stated time period. It may be the maximum instantaneous load or the maximum average load over a designated period of time. The peak system demand during a period of time (peak demand for a day, hour, month).

Platoon—in general, a platoon is a group of 42 individuals.

Range—a land or sea area designated and equipped for firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access, exclusionary areas. Also includes airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration [10 U.S.C. 101 (e)(3)].

Range Activity—an individual training or test function performed on a range or in an Operating Area. Examples include missile launching, bombardment, and vehicle driving. Individual RDT&E functions are also included in this category.

Range Complex—a geographically integrated set of ranges, operational areas, and associated special use airspace, designated and equipped with a command and control system and supporting infrastructure for freedom of maneuver and practice in munitions firing and live ordnance use against scored and/or tactical targets and/or Electronic Warfare tactical combat training environment.

Range Operation—a live training exercise, a research, development test and evaluation (RDT&E) test, or a field maneuver conducted for a specific strategic, operational or tactical military mission, or task. A military action. Operations may occur independently, or multiple operations may be accomplished as part of a larger event. One operation consists of a combination of activities accomplished together. The type of operation can include air, land, sea, and undersea warfare training or testing. Participants can include a specific number and type of aircraft, ships, submarines, amphibious or other vehicles and personnel.

Range Safety Zone—area around air-to-ground ranges designed to provide safety of flight and personnel safety relative to dropped ordnance and crash sites. Land use restrictions can vary depending on the degree of safety hazard, usually decreasing in magnitude from the weapons impact area (including potential ricochet) to the area of armed overflight and aircraft maneuvering.

Readiness—the ability of forces, units, weapon systems, or equipment to deliver the outputs for which they were designed (includes the ability to deploy and employ without unacceptable delays).

Regiment—a Regiment is a unit of three Battalions, approximately 2,880 individuals.

Restricted Area—a designated airspace in which flights are prohibited during published periods of use unless permission is obtained from the controlling authority.

Safety Zone—administratively designated/implied areas designated to limit hazards to personnel and the public, and resolve conflicts between operations. Can include range safety zones, ESQDS, surface danger zones, special use airspace, hazards of electromagnetic radiation to ordnance/hazards of electromagnetic radiation to personnel areas, etc.

Scoping—a process initiated early during preparation of an Environmental Impact Statement to identify the scope of issues to be addressed, including the significant issues related to the Proposed Action. During scoping, input is solicited from affected agencies as well as the interested public.

Sortie—a single operational training or RDT&E event conducted by one aircraft in a range or operating area. A single aircraft sortie is one complete flight (i.e., one take-off and one final landing).

Special Use Airspace—consists of several types of airspace used by the military to meet its particular needs. Special use airspace consists of that airspace wherein activities must be confined because of their nature, or wherein limitations are imposed upon aircraft operations that are not a part of these activities, or both. Special use airspace, except for Control Firing Areas, are charted on instrument flight rules or visual flight rules charts and include hours of operation, altitudes, and the controlling agency.

Stakeholder—those people or organizations that are affected by or have the ability to influence the outcome of an issue. In general, this includes regulators, the regulated entity, and the public. It also includes those individuals who meet the above criteria and do not have a formal or statutorily defined decision-making role.

Submerged Lands—the areas in coastal waters extending from the Guam coastline into the ocean 3 nautical miles (nm) (5.6 kilometers [km]).

Surface Danger Zone (SDZ)—the area surrounding a range that allows for the probability of a munition not landing within the designated target or impact area within which access is controlled for safety during firing.

Sustainable Range Management—management of an operational range in a manner that supports national security objectives, maintains the operational readiness of the Armed Forces, and ensures the long-term viability of operational ranges while protecting human health and the environment.

Targets—earthwork, materials, actual or simulated weapons platforms (tanks, aircraft, EW systems, vehicles, ships, etc.) comprising tactical target scenarios within the range/range complex impact areas.

Uncontrolled Airspace—airspace of defined dimensions in which no air traffic control services to either instrument flight rules or visual flight rules aircraft will be provided, other than possible traffic advisories when the air traffic control workload permits and radio communications can be established.

Unexploded Ordnance (UXO)—military munitions that (A) have been primed, fused, armed, or otherwise prepared for action; (B) have been fired, dropped, launched, projected or placed in such a manner as to constitute a hazard to operations, property, installations, personnel or material; and (C) remained unexploded either by malfunction, design or any other cause [10 U.S.C. 101 (e)(5)(A) through (C)].

Ungulate—any animal having hoofs such as deer, pigs, cattle, etc.

Upland—an area of land of higher elevation.

U.S. Territorial Waters—sea areas within 12 nm of the U.S. coastline, normally measured from the low water mark on the shoreline.

Visual Flight Rules (VFR)—regulations which allow a pilot to operate an aircraft in weather conditions generally clear enough to allow the pilot to see where the aircraft is going.

Wholly Inert—ordnance with no explosive, propellant, or pyrotechnic component (non-reactive); example: BDU-50, BDU-56 (both are non-reactive heavy-weights with no explosive charges).

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CHAPTER 5. ACRONYM AND ABBREVIATION LIST

°F	degrees Fahrenheit
36 WG	36th Wing
III MEF	Third Marine Expeditionary Force
AAV	Amphibious Assault Vehicle
AADT	Average Annual Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ac	acre(s)
ACE	Air Combat Element
ACHP	Advisory Council for Historic Preservation
ACM	asbestos-containing material
A.D.	Anno Domini
AD/ADFM	Active Duty/Active Duty Family Members
ADA	Americans with Disabilities Act
ADAAG	Americans with Disabilities Act Accessibility Guidelines
ADNL	A-weighted Day Night Average Level
ADT	Average Daily Traffic
AFB	Air Force Base
AFI	Air Force Instruction
A-G	air-to-ground
AGL	above ground level
AICUZ	Air Installation Compatible Use Zone
AIDS	Acquired Immune Deficiency Syndrome
AIP	Agreed Implementation Plan
ALPCD	Alien Labor Processing and Certification Division
AMC	Air Mobility Command
AMDTF	Air and Missile Defense Task Force
AMVOC	Advanced Motor Vehicle Operators Course
AOC	Area of Concern
AOR	Area of Responsibility
APC	Areas of Particular Concern
APCSR	Air Pollution Control Standards and Regulations
APE	Area of Potential Effect
APZ	Accident Potential Zone
ARG	Amphibious Readiness Group
APHIS	Agricultural Animal Plant and Health Inspection Service
ARPA	Archaeological Resource Protection Act
A-S	air-to-surface
ASHRAE	American Society of Heating Refrigeration and Air Conditioning Engineers
ASN	Assistant Secretary of the Navy
AST	Aboveground Storage Tank
ASTM	American Standards Society for Testing and Measurements
ATARA	Alliance Transformation and Realignment Agreement
ATC	Air Traffic Control
ATCAA	Air Traffic Control Assigned Airspace
AT/FP	Antiterrorism/Force Protection
AUPM	Above and Underground Storage Tank and Pesticide Management
B	billion
BA	Biological Assessment
BACT	Best Available Control Technology
BASH	Bird Airstrike Hazard Plan
B.C.	Before Christ
BCD	Base Command Officer
BCDC	Bureau of Communicable Disease Control
BDDT	BASH Detection and Dispersal Team
BEQ	Bachelor Enlisted Quarters
BFHNS	Bureau of Family Health and Nursing Services
BFR	Basic Facility Requirements
BHC	Bird Hazard Condition
BI	Beneficial Impact
BMD	Ballistic Missile Defense
BMDTF	Ballistic Missile Defense Task Force
BMP	Best Management Practice
BMUS	Bottomfish Management Unit Species
BO	Biological Opinion
BOD	biological oxygen demand
BOMBEX	Bombing Exercise
BOQ	Bachelor Officer Quarters
BOW	Bilge Oily Waste
BOWTS	Bilge Oily Waste Treatment System
B.P.	Before Present
BPC	Bureau of Primary Care
BFR	Basic Facility Requirements
BQ	Bachelors Quarters
BRAC	Base Realignment and Closure
BRD	Biological Resources Discipline
BRS	Biennial Reporting System
BRSA	Biological Resource Study Area
BS 0	Battle Site Zero
BSP	Bureau of Statistics and Plans
BSTF	Battle Staff Training Facility
BSTS	Battle Staff Training and Simulation
BTS	brown tree snake
Btu	British Thermal Units
BUMED	Bureau of Medicine and Surgery
C&D	Construction and Demolition
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CAL	Confined Area Landings
CAST	Combined Arms Staff Trainer

CATEX	Categorical Exclusion
CBOD$_5$	Chemical Biological Oxygen Demand – Five Day
CCU	Consolidated Commission on Utilities
CDC	Center for Disease Control
CDF	Confined Disposal Facility
CDL	Clandestine Drug Labs
CDNL	C-weighted DNL
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Act Information Systems
CESQG	Conditionally Exempts Small Quantity Generators
CEQ	Council on Environmental Quality
CFA	Controlled Firing Area
CFR	Code of Federal Regulations
cfs	cubic feet per second
CG	Guided Missile Cruiser
CGC	Coast Guard Cutter
CGP	Construction General Permit
CH$_4$	methane
CHC	Community Health Clinic
CHCRT	Currently Harvested Coral Reef Taxa
CIP	Capital Improvements Program
CLOMR	Conditional Letter of Map Revision
CLTC	Chamorro Land Trust Commission
cm	centimeter(s)
cm/s	centimeters per second
CMCC	Civil-Military Coordination Council
CMP	Coastal Management Program
CMUS	Crustacean Management Unit Species
CNM	Commander Navy Region Marianas
CNMI	Commonwealth of the Northern Mariana Islands
CNO	Chief of Naval Operations
CO	carbon monoxide
CO$_2$	carbon dioxide
COFA	Compact of Free Association
COMNAV	Commander Navy Region
COMPACFLT	Commander, U.S. Pacific Fleet
COMSCINST	Commander, Military Sealift Command Instruction
CONOPS	Concept of Operations
CONSENT	Superfund Consent Decrees
CONUS	Continental United States
CORRACTS	Corrective Action Sites
CPA	Commonwealth Ports Authority
CPF	Commander U.S. Pacific Fleet
CPI	Consumer Price Index
CQC	Close Quarters Combat
CREMUS	Coral Reef Ecosystem Management Unit Species
CRM	Coastal Resources Management
CRMO	Coastal Resources Management Office
CRMP	Coastal Resources Management Program
CRRC	Combat Rubber Raiding Craft
CSA	Customer Service Agreement
CSAR	Combat Search and Rescue
CSG	Carrier Strike Group
CSS	Commander Submarine Squadron
CT	Combustion Turbine
CUC	Commonwealth Utilities Corporation
CVN	Carrier Vessel Nuclear
CVW	Carrier Air Wing
CWA	Clean Water Act
CWCS	Comprehensive Wildlife Conservation Strategy
CY	cubic yard(s)
CZ	Clear Zone
CZMA	Coastal Zone Management Act
DAMOS	Disposal Area Monitoring System
DAR	Defense Access Road
dB	decibel(s)
dBA	A-weighted decibel(s)
dBC	C-weighted decibel(s)
DD	Destroyer
DDESB	Department of Defense Explosive Safety Board
DDESS	Dependent Elementary and Secondary Schools
DDG	Guided Missile Destroyer
DEH	Division of Environmental Health
DELISTED NPL	National Priority List Deletions
DEQ	Division of Environmental Quality
DERP	Defense Environmental Restoration Program
DISID	Department of Integrated Services for Individuals with Disabilities
DLM	Department of Land Management
DLNR	Department of Lands and Natural Resources
DM	Defensive Maneuvers
DMHSA	Department of Mental Health and Substance Abuse
DMM	Discarded Military Munitions
DMR	Discharge Monitoring Report
DNL	Day-Night Sound Level
DO	dissolved oxygen
DoC	Department of Corrections
DoD	Department of Defense
DoDEA	Department of Defense Education Activity
DOE	Department of Energy
DOI	Department of the Interior
DOJ	Department of Justice
DoN	Department of the Navy
DOPAA	Description of Proposed Action and Alternatives
DOT	Department of Transportation

DOT OPS	Department of Transportation Office of Pipeline Safety Incident and Accident Data
DPHSS	Department of Public Health and Social Services
DPL	Department of Public Lands
DPRI	Defense Policy Review Initiative
DPS	Department of Public Safety
DPW	Department of Public Works
DRMO	Defense Reutilization and Marketing Office
DRS	Demand Response Service
DSAY	Discount Service Acre Year
DSMOA	DoD & State/Territorial Memorandum of Agreement
DU	dwelling unit
DU/ac	dwelling units per acre
DYA	Department of Youth Affairs
E&ECR	Erosion and Sediment Control Regulation
EA	Environmental Assessment
EAC	Economic Adjustment Committee
EC	Electronic Combat
ECM	earth-covered magazine
ECO	Environmental Compliance Officer
EC-OPS	Electronic Combat Operations
ECHO	Enforcement and Compliance History Online
ECP	entry control point
EDR	Environmental Data Resources
EET	Energy Efficient Transport
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EJ	Environmental Justice
EMI	Electromagnetic Interference
EMR	Electromagnetic Radiation
EMUA	Exclusive Military Use Area
ENSO	El Niño Southern Oscillation
EO	Executive Order
EOD	Explosive Ordnance Disposal
EPACT	Energy Policy Act of 2005
EPCRA	Emergency Planning & Community Right-To-Know Act
EPP	Environmental Protection Plan
ERA	Ecological Reserve Area
ERNS	Emergency Response Notification System
ER-L	Effects Range-Low
ER-M	Effects Range-Median
ESA	Endangered Species Act
ESAL	Equivalent Single Axle Loading
ESG	Expeditionary Strike Group
ESQD	Explosive Safety Quantity Distance
ESS	Explosive Safety Submission
FAA	Federal Aviation Administration
FACSFAC	Fleet Area Control and Surveillance Facility
FAM	Familiarization and Instrument Flight
FARP	Forward Arming and Refueling Point
FAS	Freely Associated States of Micronesia
FCLP	Field Carrier Landing Practice
FDC	Fire Direction Center
FDM	Farallon de Medinilla
FEMA	Federal Emergency Management Agency
FEP	Fishery Ecosystem Plan
FEPCA	Federal Pesticide Control Act
FFCA	Federal Facilities Compliance Act
FHWA	Federal Highway Administration
FINDS	Facility Index System
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
FIP	Flight Information Public
FIREX	Firing Exercise
FIRM	Flood Insurance Rate Map
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
FOC	Full Operational Capability
FPPA	Farmland Protection Policy Act
FR	Federal Register
FSM	Federated States of Micronesia
ft	foot/feet
ft^2	square foot/feet
FTA	Federal Transit Administration
FTE	full time equivalent
FTTS	FIFRA/TSCA Tracking System
FTX	Field Training Exercise
FUDS	Formerly Used Defense Sites
FWCA	Fish and Wildlife Coordination Act
FY	Fiscal Year
GAIN	Guam Animals in Need
GALC	Guam Ancestral Lands Commission
GAR	Guam Administrative Regulations
GBB	Gershman, Brickner, & Bratton, Inc.
GBSP	Guam Bureau of Statistics and Plans
GCA	Guam Code Annotated
GCC	Guam Community College
GCE	Ground Combat Element
GCMP	Guam Coastal Management Plan
GCR	General Conformity Rule
GCWCS	Guam Comprehensive Wildlife Conservation Strategy
GDAWR	Guam Division of Aquatic and Wildlife Resources
GDISID	Guam Department of Integrated Services for Individuals with Disabilities
GDLM	Guam Department of Land Management
GDMHSA	Guam Department of Mental Health and Substance Abuse
GDoC	Guam Department of Corrections
GDoL	Guam Department of Labor
GDP	Guam Police Department
GDPHSS	Guam Department of Public Health and Social Services

GDPR	Guam Department of Parks and Recreation
GDPW	Guam Department of Public Works
GDYA	Guam Department of Youth Affairs
GEDA	Guam Economic Development Authority
GEPA	Guam Environmental Protection Agency
GFD	Guam Fire Department
GHG	greenhouse gas
GHMP	Guam Hazard Mitigation Plan
GHPO	Guam Historic Preservation Office
GHRA	Guam Hotel and Restaurant Association
GIAA	Guam International Airport Authority
GIMDP	Guam Integrated Military Development Plan
GIP	Gross Island Product
GIS	Geographic Information System
GJMMP	Guam Joint Military Master Plan
GLUC	Guam Land Use Commission
GLUP	Guam Land Use Plan
GMH	Guam Memorial Hospital
GMHA	Guam Memorial Hospital Authority
GNWR	Guam National Wildlife Refuge
GoJ	Government of Japan
GovGuam	Government of Guam
GPA	Guam Power Authority
gpcd	gallons per capita per day
gpd	gallons per day
GPD	Guam Police Department
GPLS	Guam Public Library System
gpm	gallons per minute
GPSS	Guam Public School System
GRHP	Guam Register of Historic Places
GRN	Guam Road Network
GRT	Gross Receipts Tax
GSCSCR	Government of Guam Soil Erosion And Sediment Control Regulations
GSF	gross square feet
GSM	gross square meters
GTP	2030 Guam Transportation Plan
GTR	Ground Threat Reaction
GUNEX	Gunnery Exercise
GVB	Guam Visitors Bureau
GW	groundwater
GWA	Guam Waterworks Authority
GWMPZ	ground water management protection zone
GWP	global warming potential
GWQS	Guam Water Quality Standards
GWUDI	groundwater under the direct influence of surface water
ha	hectare(s)
HACCP	Hazard Analysis and Critical Control Points
HAP	Hazardous Air Pollutant(s)
HAPC	Habitat Area of Particular Concern
HC	hydrocarbon
HCF	hydroflurocarbon

HCM	Highway Capacity Manual
HDPE	high-density polyethylene
HDD	Horizontal Directional Drilling
HE	high explosive
HEA	Habitat Equivalency Analysis
HERO	Hazards of Electromagnetic Radiation to Ordnance
HERP	Hazards of Electromagnetic Radiation to Personnel
HFC	hydrofluorocarbons
HIE	Helicopter Insertion/Extraction
HIV	Human Immunodeficiency Virus
HMIRS	Hazardous Materials Information Reporting System
HMMP	Hazardous Materials Management Plan
HMMWV	High Mobility Multi-Purpose Wheeled Vehicle
HMU	Habitat Management Unit
HPO	Historic Preservation Office(r)
HPV	high-priority violation
HQ	Headquarters
hr	hour(s)
HSC	Helicopter Sea Combat Squadron
HSIP	Highway Safety Improvement Program
HSV	High Speed Vessel
HSWA	Hazardous and Solid Waste Amendments
HUBZone	Historically Underutilized Business Zone
HVAC	heating, ventilation, and air conditioning
HWMP	Hazardous Waste Management Program
Hz	hertz
IAP	International Airport
IAS	invasive alien species
IBB	International Broadcasting Bureau
ICC	information coordination central
ICIS	Integrated Compliance Information System
ICRMP	Integrated Cultural Resources Management Plan
IGPBS	Integrated Global Presence and Basing Strategy
IFR	Instrument Flight Rules
IMP	Integrated Management Practice
IMS	invasive marine species
in	inch(es)
INRMP	Integrated Natural Resources Management Plan
INST CONTROLS	Sites with Institutional Controls
IOC	Initial Operational Capability
IPCC	Intergovernmental Panel on Climate Change
IPMP	Integrated Pest Management Plan
IPP	Independent Power Producers
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
ISA	Inter-Service Agreement
ISO	International Organization for Standardization
ISR	Intelligence, Surveillance, and Reconnaissance
ISWMP	Integrated Solid Waste Management Plan

ITC	International Trade Center
IWPS	Island-Wide Power System
JBIC	Joint Bank of International Cooperation
JGPO	Joint Guam Program Office
JSDF	Japanese Self-Defense Force
JRC	Joint Region Commander
JRM	Joint Region Marianas
KD	known distance
kg	kilogram
kg/day	kilograms per day
km	kilometer(s)
km^2	square kilometer(s)
knots	nautical miles per hour
kph	kilometers per hour
kV	kilovolts
kW	kilowatt(s)
kW/hr	kilowatts per hour
L	liter(s)
LAER	Lowest Achievable Emission Rate
LandGEM	Landfill Gas Emissions Model
LAV	Light Armored Vehicle
lb	pound(s)
LBA	Leaseback Area
LBP	lead-based paint
LCAC	Landing Craft Air Cushion
LCE	Logistic Combat Element
LCU	Landing Craft Utility
LEDPA	Least Environmentally Damaging Practicable Alternative
LEED	Leadership in Energy and Environmental Design
L$_{eq}$	equivalent sound level
LF	linear feet
LFG	Landfill Gas
LHA/LHD	Amphibious Assault Ship
LID	Low Impact Development
LIDAR	Light Detection and Ranging
LLDP	linear low-density polyethylene
L$_{max}$	Maximum Sound Level
LNG	Liquefied Natural Gas
LOS	Level of Service
LPD	Amphibious Transport Dock
lpm	liters per minute
LQG	large quantity generator
LSD	Dock Landing Ship
LSI	Less than significant impact
LUCIS	Land Use Control Information Systems
LZ	Landing Zone
m	meter(s)
m^2	square meter(s)
m^3	cubic meters(s)
M	million
MAGC	Marine Air Control Group
MAGTF	Marine Air Ground Task Force
MALS	Marine Aviation Logistics Squadron
MAP	Military Access Point
Marine Corps	United States Marine Corps
MARFORPAC	Marine Forces Pacific
MAW	Marine Aircraft Wing
MBP	Micronesia Biosecurity Plan
MBTA	Migratory Bird Treaty Act
MCB	Marine Corps Base
MCMEX	Mine Counter Measures Exercise
MC	Munitions Constituents
MCCS	Marine Corps Community Service
MCL	Maximum Concentration Level
MCMEX	Mine Counter Measures Exercise
MCO	Marine Corps Order
MCP	Mariana Islands Concept Plan
MCTL	Marine Corps Task List
MDA	Missile Defense Agency
MEB	Marine Expeditionary Brigade
MEC	Munitions and Explosives of Concern
MEF	Marine Expeditionary Force
MEU	Marine Expeditionary Unit
MFP/CPF	Marine Forces Pacific/Commander Pacific Fleet
MFR	multi-family residential
MG	million gallons
mg/cm^2	milligrams per square centimeter
MGd	million gallons per day
mg/L	milligrams per liter
mi	mile(s)
mi^2	square miles
MILCON	Military Construction
MIP	Medically Indigent Program
MIRC	Mariana Islands Range Complex
MISSILEX	Missile Exercise
ML	million liters
MLA	Military Lease Area
MLd	million liters per day
MLG	Marine Logistic Group
MLLW	mean lower low water
MLTS	Material Licensing Tracking System
mm	millimeter(s)
MMPA	Marine Mammal Protection Act
MMR	Military Munitions Rule
MMRP	Military Munitions Response Program
MMT	Marine Monitoring Team
MOA	Memorandum of Agreement
MOS	Military Occupational Specialty
MOU	Memorandum of Understanding
MOUT	Military Operations in Urban Terrain
MP	Military Police
MPA	microscopic particulate analyses
MPA	Marine Protected Area
mph	miles per hour
MPLA	Marianas Public Land Authority
MPPEH	material potentially presenting an explosive hazard
MPRSA	Marine Protection, Research, and Sanctuaries Act

MRA	Munitions Response Area
MRC	Marine Research Consultants
MRP	Marine Resource Preserve
MRS	Munitions Response Sites
MSA	Munitions Storage Area
M-SA	Magnuson-Stevens Fishery Conservation and Management Act
MSAT	Mobile Source Air Toxics
MSC	Military Sealift Command
msl	mean sea level
MSM	modular storage magazine
MSWLF	Municipal Solid Waste Landfill Facility
MTVR	Medium Tactical Vehicle Replacement
MUS	Management Unit Species
MUSE	Mobile Utilities Support Equipment
MUTCD	Manual on Uniform Traffic Control Devices
MVA	mega volt ampere
MW	megawatts
MWDK	Military Working Dog Kennel
MWR	Morale, Welfare, and Recreation
N_2O	nitrous oxide
NA	not applicable
NAA	Non-Attainment Area
NAAQS	National Ambient Air Quality Standards
NAC	Noise Abatement Criteria
NATA	National Air Toxics Assessment
NAV	Navy Ashore Vision
NAVCAMS	Naval Communication Area Master Station
NAVFAC	Naval Facilities Engineering Command
NC	New Construction
NCP	National Contingency Plan
NCTMS	Naval Computer and Telecommunications Main Station
NCTS	Naval Computer and Telecommunications Station
ND	Neighborhood Development
NDAA	National Defense Authorization Act
NDWWTP	Northern District Wastewater Treatment Plant
NELHA	National Energy Laboratory of Hawaii Authority
NEO	Noncombatant Evacuation Operations
NEPA	National Environmental Policy Act
NEW	net explosive weight
NEXRAD	Next Generation Weather Radar
NFIP	National Flood Insurance Program
NFRAP	No Further Remedial Action Planned List
NGL	Northern Guam Lens
NGLA	Northern Guam Lens Aquifer
NGO	Non-Governmental Organization
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NHP	National Historic Park
NI	No impact
NIOSH	National Institute for Occupational Safety and Health
NISC	National Invasive Species Council
NITTS	Noise Induced Temporary Threshold Shift
NLNA	northern land navigation area
nm	nautical mile(s)
nm^2	square nautical mile(s)
NMC-DET	Navy Munitions Command Detachment
NMFS	National Marine Fisheries Service
NMS	Naval Munitions Site
NNPP	Naval Nuclear Propulsion Program
NO_2	nitrogen dioxides
NO_X	nitrogen oxides
NOA	notice of availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOPH	notice of public hearing
NOSSA	Naval Ordnance Safety and Security Activity
NOTAM	Notice to Airmen
NOTMAR	Notice to Mariners
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NRC	Nuclear Regulatory Commission
NRCHC	Northern Region Community Health Center
NRCS	Natural Resources Conservation District
NRHP	National Register of Historic Places
NRMC	Navy Regional Medical Center
NSR	New Source Review
NSV	North San Vitoris
NTU	nephelometric turbidity unit
NW	nearshore waters
NWF	Northwest Field
NWI	National Wetland Inventory
NWR	National Wildlife Refuge
O_3	ozone
O&M	Operations and Maintenance
ODMDS	Ocean Dredged Material Disposal Site
OEA	Overseas Environmental Assessment
OEIS	Overseas Environmental Impact Statement
OHA	Overseas Housing Allowance
OIA	Office of Insular Affairs
OPA	Oil Pollution Act
OPNAVINST	Office of the Chief of Naval Operations Instruction
OSD	Office of the Secretary of Defense
OSHA	Occupational Safety and Health Administration
OTEC	Ocean Thermal Energy Conversion
P2	Pollution Prevention
PA	Programmatic Agreement
PAC-3	Patriot Advanced Capability-3

PACAF	Pacific Air Forces
PACOM	U.S. Pacific Command
PAG	Port Authority of Guam
PAH	polynuclear aromatic hydrocarbon
Pb	lead
PCB	polychlorinated biphenyl
PCE	perchloroethylene
PE	private entity
PFC	perfluorocarbon
PHCRT	potentially harvested coral reef taxa
PHL	Potential Hearing Loss
PI	potential impact
PK-15	Unweighted Peak, 15% Metric
PL	Public Law
PLS	Public Library System
PM	particulate matter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PM_{10}	particulate matter less than 10 microns in diameter
PMO	Personnel Management Office
PMUS	Pelagic Management Unit Species
POL	petroleum, oil, and lubricants
POV	privately-owned vehicle
PPA	Pollution Prevention Act
PPE	personal protective equipment
ppm	parts per million
ppt	parts per thousand
PSD	Prevention of Significant Deterioration
psi	pounds per square inch
PUC	Public Utilities Commission
pv	photovoltaic
PVC	polyvinyl chloride
PYE	person years of employment
PWC	Public Works Center
QDR	Quadrennial Defense Review
QOL	Quality of Life
RA	Restricted Area
RAATS	RCRA Administrative Action Tracking System
RAB	Restoration Advisory Board
RADINFO	Radiation Information Database
RCRA	Resource Conservation and Recovery Act
RCRIS	Resource Conservation and Recovery Act Information System
REA	Rapid Ecological Assessment
REC	Regional Environmental Coordinator
REDHORSE	Rapid Engineer Deployable Heavy Operations
Req'd	required
RHA	Rivers and Harbors Act
RHIB	Rigid Hull Inflatable Boat
RIA	Regulatory Impact Analysis
RO	reverse osmosis
ROD	Record of Decision
ROI	region of influence

RORO	roll-on roll-off
ROW	right-of-way
RPM	revolutions per minute
RSE	Repair Squadron Engineer
RTA	Range Training Area
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act – A Legacy for Users
SAIA	Sikes Act Improvement Act
SARA	Superfund Amendments and Reauthorization Act
SAR	Second Assessment Report
SARNAM	Small Arms Range Noise Assessment Model
SAS	Special Aquatic Sites
SAT	Stationary Armor Target
SBHSR	Ship-Borne Hazardous Substance Regulations
SCC	Security Consultative Committee
SCH	school
SCR	Selective Catalytic Reduction
SCS	Soil Conservation Service
SCUBA	self-contained underwater breathing apparatus
SDWA	Safe Drinking Water Act
SDZ	Surface Danger Zone
SEABEE	Construction Battalion
SECNAV	Secretary of the Navy
SEI	Sea Engineering Inc.
SEL	Sound Exposure Level
SF_6	sulfur hexafluoride
SFR	single-family residential
SHSP	Strategic Highway Safety Plan
SHPO	State Historic Preservation Office
SI	Significant impact
SIAS	Socioeconomic Impact Assessment Study
SI-M	Significant impact mitigable to less than significant
SINKEX	Sink Exercise
SIP	State Implementation Plan
SIT	Stationary Infantry Target
SLAMRAAM	Surface-Launched Advanced Medium-Range Air-to-Air Missile
SLC	Submarine Learning Center
SMMP	Site Management and Monitoring Plan
SNC	Significant Non-Compliance
SNU	Skilled Nursing Unit
SO	stipulated order
SO_2	sulfur dioxide
SOC	species of concern
SOFA	Status of Forces Agreement
SOGCN	Species of Greatest Conservation Need
SOP	Standard Operating Procedure
SPAWAR	Space and Naval Warfare Systems Command
SPCC	Spill Prevention, Control and Countermeasure

SPE	Special Purpose Entity
SPS	Sewage Pump Station
SQG	small quantity generator
SRBM	Short-range Ballistic Missile
SRCHC	Southern Region Community Health Center
SRF	Ship Repair Facility
S-S	surface-to-surface
SSTS	Section Seven Tracking System
STD	sexually transmitted disease
STOM	Ship-to-Objective Maneuver
STP	sewage treatment plant
SUA	Special Use Airspace
SW	surface water/stormwater
SWMD	Solid Waste Management Division
SWMP	Stormwater Management Plan
SWMU	solid waste management unit
SWPPP	Stormwater Pollution Prevention Plan
T&D	Transmission and Distribution
T-AKE	Auxiliary Dry Cargo/Ammunition Ship
T-AKR	Sealift Ship
TAOC	Tactical Air Operations Center
TB	tuberculosis
TBD	To Be Determined
TBP	To Be Provided
TBT	tribulyl tin
TCE	trichloroethylene
TCP	Training Concept Plan
TDS	total dissolved solids
TEC JV	TEC Inc. Joint Venture
TERF	Terrain Flights
THAAD	Terminal High-Altitude Area Defense
TJS	Tactical Jamming System
TMDL	Total Maximum Daily Load
TMP	Traffic Management Plan
TNAP	Traffic Noise Abatement Policy
TNM	Traffic Noise Model
TOC	total organic carbon
TORPEX	Torpedo Exercise
TPFD	Time-Phased Force Deployment
TPY	tons per year
TRIS	Toxic Release Inventory System List
TSCA	Toxic Substance Control Act
TSS	total suspended solids
TTIP	Territorial Transportation Improvement Plan
TTLC	total threshold limit concentration
UAV	Unmanned Aerial Vehicle
UD	unknown distance
UF	usage factor
UFC	Unified Facilities Criteria
UFW	Unaccounted for Water
µg/L	micrograms per liter
UoG	University of Guam
UNFCC	United Nations Framework Convention on Climate Change
U.S.	United States
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USCG	U.S. Coast Guard
USCRTF	U.S. Coral Reef Task Force
USDA	U.S. Department of Agriculture
USDA-APHIS	U.S. Department of Agriculture Animal and Plant Health Inspection Service
USDA-WS	U.S. Department of Agriculture-Wildlife Services
US ENG CONTROLS	Engineering Controls Site List
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGBC	U.S. Green Building Council
USGS	U.S. Geological Service
USLE	Universal Soil Loss Equation
UST	underground storage tank
UXO	unexploded ordnance
v	volt(s)
VA	Veterans Affairs
v/c	volume to capacity
VCO	Volunteer Conservation Officer
VCP	vitrified clay pipe
VFR	Visual Flight Rules
VHF	very high frequency
VHT	vehicle hours traveled
VIF	Vehicle Inspection Facility
VMT	vehicle miles traveled
VOC	volatile organic compound
vpd	vehicles per day
VQCF	Vehicle Queuing Control Facility
VWP	Visa Waiver Program
WA	Warning Area
WPC	Watershed Planning Committee
WPCP	Water Pollution Control Program
WPRFMC	Western Pacific Regional Fisheries Management Council
WQC	Water Quality Certification
WQMP	Water Quality Monitoring Plan
WRDA	Water Resource Development Acts
WRMP	Water Resources Master Plan
WTE	Waste-to-Energy
WTP	Water Treatment Plant
WWII	World War II
WL	wetlands
WWTP	Wastewater Treatment Plant
yd	yard
ZID	zone of initial dilution

DEPARTMENT OF THE NAVY
UNITED STATES OF AMERICA

Final

Environmental Impact Statement

GUAM AND CNMI MILITARY RELOCATION

Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force

Volume 6: Related Actions – Utilities and Roadway Projects

July 2010

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Guam and CNMI Military Relocation EIS

Volume 6: Related Actions – Utilities and Roadway Projects (Guam)

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CHAPTER 1.
PURPOSE OF AND NEED FOR ACTIONS

Volume 6 of the Guam and Commonwealth of the Northern Mariana Islands (CNMI) Military Relocation Environmental Impact Statement (EIS) evaluates proposed utilities and roadway improvements on Guam.

The proposed military relocation on Guam for the United States (U.S.) Marine Corps (Marine Corps), the Navy aircraft carrier berthing, and the Army Air and Missile Defense Task Force (AMDTF) would increase the demand for power, potable water, and wastewater utilities. The military relocation would also affect the remaining life of existing solid waste facilities and the demand for the new Government of Guam (GovGuam) Layon Landfill in Dandan. The proposed actions would also require roadway improvements.

For utilities, the Navy conducted several studies to identify the Guam utility improvements required to accommodate the proposed action. These studies were for power, potable water, wastewater, and solid waste and sought to quantify the increased Department of Defense (DoD) demand that would result from the military relocation and to develop utility solutions to meet those projected demands. The populations on which these utility studies were based are summarized in the individual utility studies (Naval Facilities Engineering Command (NAVFAC) Pacific 2008, 2010a, b, c, d). These studies accounted for projected increases in DoD personnel and their dependents, increases in the on base civilian workforce required to support the military relocation, construction worker demands, induced civilian growth, and expected normal civilian population growth from the socioeconomic studies cited within this EIS. These studies were updated since issuing the Draft EIS, thus the supplementary analysis letter reports (as referenced in the Draft EIS as NAVFAC Pacific 2009a, b, c) cited in the Draft EIS are no longer necessary or pertinent. Those supplementary analysis letter reports were prepared to document the changes between the power, potable water, and wastewater utility discussions presented in the Draft EIS and the original studies. Therefore, only the updated utility studies are referenced in this Final EIS.

The utility and roadway alternatives are tied to the alternatives for the main NEPA actions: the Marine Corps Relocation, the Marine Corps Relocation CNMI, the Aircraft Carrier Berthing, and the Army Air & Missile Defense Task Force. The utility and roadway alternatives are evaluated as options for the best approach considering their impacts to the various resource categories, but are not independent alternatives themselves. Since the utilities are related actions, the “no action” alternative is not really pertinent to their analyses and presentation. Thus, in Volume 6, “no action” is not evaluated for utilities. However, Volume 6, Chapters 3 and Chapter 4, Affected Environment, characterize the existing utility and roadways conditions that would likely continue in the absence of the proposed Marine Corps, Navy, and Army actions.

During production of the EIS and on a continuing basis, DoD representatives have been meeting regularly with Guam Power Authority (GPA) and Guam Waterworks Authority (GWA) to discuss the utility needs both on and off base related to the proposed military relocation. Discussions have centered on defining needed utility upgrades, identifying the best technical solutions for these upgrades, and developing business options to implement the technical solutions and lead toward viable utility solutions both on base and off base. These meetings have resulted in significant progress. Draft Memoranda of Understandings (MOUs) have been developed to solidify cooperative arrangements discussed for the future utility needs of DoD and to address GWA utility shortfalls related to the proposed military relocation. The following summarizes the discussions to date.

Power:

- Concurrence has been obtained from GPA on the proposed reconditioning of existing GPA generating facilities for reliability/reserve power, capacity, and upgrades to the GPA transmission and distribution system to meet increased power demand from the proposed military relocation. This was accompanied by a reassessment of current power demands on the GPA system and estimated new power demand associated with the proposed military relocation.
- Discussions continue on the best business approach to facilitate the required power system upgrades. The approach could involve a Special Purpose Entity (SPE), which would likely be a private business entity formed to finance and refurbish and upgrade the GPA utility systems. It is anticipated that this SPE would utilize Government of Japan (GoJ) financing provided in accordance with the Realignment Roadmap (see Volume 1 Executive Summary for more details on the Realignment Roadmap and GoJ funding). Alternatively, GoJ financing could be provided to GPA to conduct the refurbishment and upgrades. The precise manner in which these SPE business entities would operate is under development, and therefore is not known at this time.
- The power facilities associated with the military relocation may be operated by the SPE or by GPA. Fees generated through utilities service contracts could be used to repay financing costs. The DoD rate structure would reflect current rates adjusted for inflation.
- It is anticipated that a transient aircraft carrier and its escort ships would rely on shoreside utility infrastructure for water, wastewater, and solid waste after 2015. Electric power would be provided in accordance with customer service agreements between GPA and the U.S. Navy. Any GPA commitments for additional power to support the aircraft carrier and its escort ships will be determined by future CSA modifications. Any required changes in the shoreside power infrastructure or their operations to meet the requirements for the aircraft carrier and its escort ships may require additional NEPA review.

Water:

- GWA and DoD have agreed to develop a joint management team to manage the use of the Northern Guam Lens aquifer (NGLA). This team would include experts from DoD, GWA, GEPA, USEPA Region 9, the U.S. Geological Service, and the University of Guam Water and Environmental Research Institute. The draft MOU between DoD and GWA includes provisions related to this joint management team and the cooperative management of the NGLA.
- Discussions continue on the best business approach to facilitate the required water system upgrades. This approach could involve an SPE, which would likely be a private business entity formed to finance, develop, upgrade, operate and manage on and off base potable water infrastructure associated with the military relocation. It is anticipated that this SPE would utilize GoJ financing provided in accordance with the Realignment Roadmap. The precise manner in which these SPE business entities would operate is under development, and therefore is not known at this time.
- DoD is proposing to transfer currently available excess water capacity and additional excess water capacity from newly developed wells, from DoD-operated systems to GWA. This action would alleviate water shortages in the GWA system during the construction phase of the proposed military relocation that may result from civilian population growth and the

construction workforce accompanying the military relocation. The draft MOU between DoD and GWA includes provisions related to the cooperative use of water resources on Guam.

- DoD is proposing to expedite the installation of new DoD water extraction wells to assist GWA in alleviating water shortages in the GWA system during the construction phase of the proposed military relocation.

Wastewater:

- Discussions continue on the best business approach to facilitate the required wastewater system upgrades. This approach could involve an SPE, which would likely be a private business entity formed to finance, operate, manage, upgrade, or develop wastewater infrastructure. It is anticipated that this SPE would utilize GoJ financing provided in accordance with the Realignment Roadmap. Alternatively, GoJ financing could be provided to GWA to conduct the upgrades. The precise manner in which these SPE business entities would operate is under development, and therefore is not known at this time.
- The Northern District Wastewater Treatment Plant (NDWWTP) may be operated by the SPE and fees generated through utilities service contracts could be used to repay financing costs. The DoD rate structure would reflect current rates adjusted for inflation.
- Although the U.S. Government has not yet ordered the implementation of secondary treatment for Guam's wastewater treatment plants, DoD, USEPA Region 9, and GWA have agreed in principle to the upgrades required at the NDWWTP to achieve secondary treatment standards. Discussions regarding technical solutions and financing for other GWA wastewater treatment plants requiring secondary treatment and collection system upgrades, including the Hagatna WWTP, are on-going.

DoD will continue to coordinate with relevant GoJ agencies, Guam Consolidated Commission on Utilities, and other local authorities who are involved in the process of finalizing business structures and technical solutions to meet these program requirements.

The roadway improvements sections have been prepared jointly by the Federal Highway Administration (FHWA) as a federal cooperating agency, the Navy's Joint Guam Program Office as the federal lead agency for the Guam and CNMI military relocation, and the Guam Department of Public Works (GDPW) as a participating agency.

The utilities and off base roadway improvements are considered "related actions," in that they would be implemented only to satisfy the increased demand directly caused by the overall proposed actions. Therefore, the purpose of and need for the utilities and roadway improvements support the purpose of and need for each of the three major action components described in the following Volumes:

- Volume 2 (Marine Corps Relocation Guam)
- Volume 4 (Aircraft Carrier Berthing)
- Volume 5 (Army AMDTF)

The purpose of and need for each major action component is described in Chapter 1 of each of those Volumes. The purpose of and need for the utilities are to provide for the essential increased utility demands from the military relocation and induced growth. The purpose of and need for roadway improvements is described later in this chapter.

1.1 PURPOSE OF AND NEED FOR ROADWAY IMPROVEMENTS

1.1.1 Introduction

The Guam Road Network (GRN) is proposed to become Guam's nonmilitary roadway system. Construction of the GRN is required to provide mission-critical transportation infrastructure as part of the planned construction, training, and operations associated with the three proposed military actions (Figure 1.1-1). First, the GRN must accommodate increased traffic from the island's military relocation of approximately 8,600 Marines from the III Marine Expeditionary Force and their dependents from Okinawa by 2014. Aviation and waterfront operations; training; construction of the main cantonment, family housing, and associated utilities; and infrastructure improvements represent the scope of activities to be conducted in support of Marine Corps projects on the island. Roadway improvements are needed to support both construction of the facilities and the ensuing traffic related to the military relocation on Guam. Roadway improvements are also related to construction of operational facilities, the main cantonment, and family housing on Guam, and training to support the Marine Corps' defensive mission.

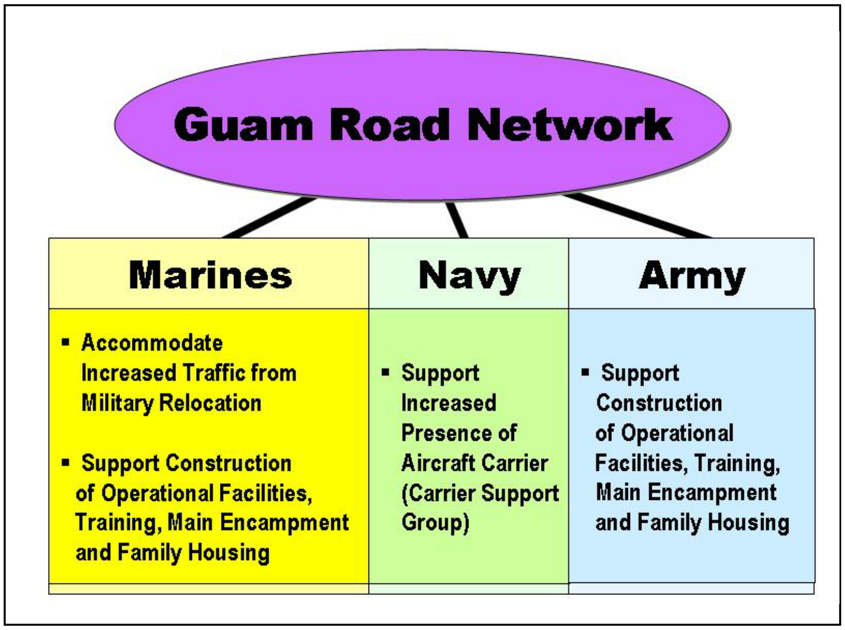

Figure 1.1-1. Connectivity of the Guam Road Network

Second, the roadway improvements are related to Navy initiatives associated with an increase in aircraft carrier presence to support engagement and deterrence consistent with the global shift of trade and transport. A new deep-water wharf at Apra Harbor is needed to support the increased Navy presence and port visits associated with a carrier support group.

Third, the roadway improvements are related to construction of operational facilities, training, and construction of the main cantonment and family housing on Guam, and training to support the AMDTF and its defensive mission.

1.1.2 Project Purpose

The purpose of the proposed construction of the GRN is to improve the existing network through the Defense Access Road (DAR) program, or other funds, and provide mission-critical transportation infrastructure as part of the planned military relocation. The improvements proposed for the GRN would result in strengthened roadways, bridge replacements, increased roadway capacity, roadway realignment (Route 15), new access, and enhanced roadway safety on Guam as a response to construction for the military relocation and growth.

1.1.3 Project Need

An improved network of roads on Guam is needed as part of the mission-critical infrastructure to support planned relocation of Marines and their dependents, as well as to accommodate ongoing growth on the island. The island of Guam is experiencing a variety of roadway problems: inadequate bridges; flooding roads; poor lane visibility as a result of tight corners; poor lane striping, lighting, and lane geometry; locations with a significant number of accidents; landslides; eroding embankments; and inadequate intersection traffic control. The existing roadways connecting the population centers and DoD lands on Guam are shown in Figure 1.1-2.

Because the existing roadway network is deficient, traffic problems on Guam would be worsened and traffic impacts would occur as a result of the planned relocation of Marines and their dependents. Without improved roads and bridges, the movement of people, materials, equipment, and waste associated with construction and operations would result in severe congestion in many locations. If these roadway and bridge projects are not implemented, the resultant wear and tear on existing roads could severely limit the construction schedule.

To meet these needs, the proposed GRN improvements would include roadway widening, intersection improvements, bridge replacements, and pavement strengthening at specific locations islandwide, as well as the realignment of Route 15. These improvements are needed to reduce traffic congestion during the construction period from 2010 through 2016, with peak construction and peak population in 2014, and the ensuing traffic increase from full military relocation combined with projected organic growth. The transportation network should become an integral component for fulfilling the U.S. defense strategy and alliance requirements. The network would also enhance the ability of the AMDTF to defend critical military assets on Guam. The need for the proposed action is explained in further detail in Section 2.5.1.

1.1.4 Project Location, Funding, and Setting

The locations of the GRN projects are islandwide as shown in Figure 2.5-6. The off base roadway projects may be funded through the DAR program and annual allocations through the U.S. Department of Transportation FHWA and/or other DoD/FHWA special funding allotments. The DAR program provides the means for the DoD to pay a fair share for public highway improvements required as a result of a sudden or unusual defense-generated traffic impact or unique defense-related public highway requirement[1].

For the DoD to obtain funding of off base roadway improvements, any of the following DAR criteria must be met:

- A new access road to a facility is needed.
- A defense action would cause traffic to double.
- A new or improved access road is needed to accommodate a temporary surge in traffic associated with a defense action.
- A new or improved road is needed to accommodate special military vehicles.
- A road is needed to replace one closed for defense needs.

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[1] An unusual impact could be a significant increase in personnel at a military installation, relocation of an access gate, or the deployment of an oversized or overweight military vehicle or transporter unit.

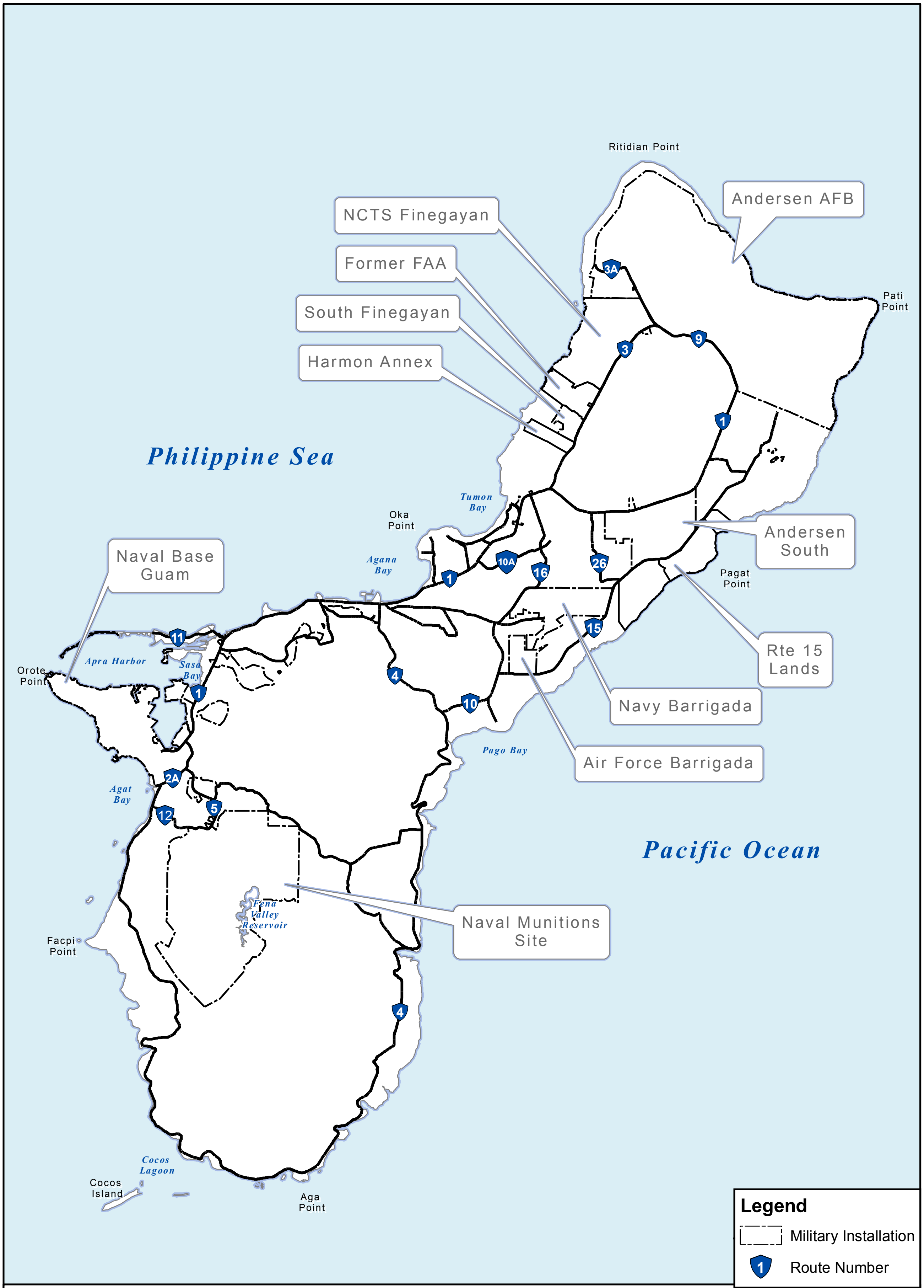

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Figure 1.1-2
Roadways Connecting Military Lands on Guam

To initiate a DAR project, the local military base identifies the access or mobility needs and brings these deficiencies to the attention of the Military Surface Deployment and Distribution Command. The Surface Deployment and Distribution Command determines whether the proposed work/project/improvements are eligible for DAR funds and can certify the road as important to the national defense. Then, the military service requests funds for the project through their normal budgeting processes. Once the funds are provided by Congress, they are transferred to FHWA and allocated to the agency administering the project. Title 23 federal-aid procedures are followed in the design and construction of the project.

At this time, 58 individual off base roadway projects have been identified and proposed as part of the GRN as discussed in Volume 6, Chapter 2, Section 2.5.1.7. These 58 projects have been evaluated for DAR eligibility and eight have been DAR-certified. Eight additional projects were DAR-eligible. A summary of the funding status of these GRN projects is provided on Table 1.1-1.

The DoD is assisting the GDPW in its development of a capacity improvement project list for the off base roads under their jurisdiction to justify increasing the FHWA annual allocation for Guam.

The DoD would participate in a working group with the GovGuam to coordinate and manage the transportation system. The DoD, together with the GovGuam, would utilize a Pavement Management System2, managed by GDPW, to prioritize and justify DAR funding for strengthening projects that would preserve and maintain the off base roadway infrastructure.

The setting for the project encompasses the primary roadway network for the entire island of Guam, composed of 20 federal-aid roadways and one local road totaling approximately 66 miles (106 kilometers) in length.

1.1.5 Governing Laws, Regulations, and Standards

Governing laws, regulations, and standards include the Council on Environmental Quality's Regulations for Implementing NEPA (40 Code of Federal Regulations [CFR] 1500-1508); FHWA environmental regulations (23 CFR 771); FHWA Technical Advisory T6640.8A (Guidance for Preparing and Processing Environmental and Section 4(f) Documents) (FHWA 1987); FHWA Section 4(f) Regulations (23 CFR 774—Parks, Recreation Areas, Wildlife and Waterfowl Refuges, and Historic Sites (Section 4(f)); and the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) (23 U.S. Code 139).

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[2] Pavement Management System is a term that relates to a system that utilizes the condition coding of roadways coupled with the identification of strategies to determine maintenance or re-construction activities. The system involves identification of optimum strategies at various management levels to maintain pavements at an adequate level of serviceability. These include, but are not limited to, systematic procedures for scheduling maintenance and rehabilitation activities based on optimization of benefits and minimization of costs. A pavement management system is a planning tool that is able to model pavement and surface deterioration due to the effects of traffic and environmental ageing, and contains a series of decision units used to determine how and when to repair the roads surface based on various tests. It can be used to determine long-term maintenance funding requirements and to examine the consequences on network condition if insufficient funding is available. Pavement management systems are now used in all 50 states as well as other countries worldwide in order to efficiently manage the maintenance of paved roadway surfaces (Wikipedia 2010).

Table 1.1-1. Funding Status of GRN Construction Projects

Fiscal Year	*GRN Projects*[1]	*Funding Status*
FY 2010	Intersection improvements at Route 1/8 (GRN #1)	These five high priority projects have been DAR-certified, authorized and appropriated.
	Intersection improvements at Route 1/3 (GRN #2)	
	Replacement of Agana Bridge on Route 1 east of Route 4 (GRN #3)	
	Pavement strengthening along Route 11 from Port to intersection with Route 1 (GRN #4)	
	Intersection improvements at Route 1/11(GRN #5)	
FY 2011	Pavement strengthening and widening (from 2 to 4 lanes) on Route 3 from NCTS Finegayan to Route 28; add median and shoulders. At the Route 3/28 intersection, add an additional southbound left-turn lane and add northbound right-turn lane. (GRN #9)	These three projects have been DAR-certified and are awaiting authorization and appropriation.
	MAP 2 on Route 3 at NCTS Finegayan Commercial Gate (GRN #38)	
	MAP 3 on Route 3 at NCTS Finegayan Main Gate (GRN #39)	
(TBD)	Relocation of Route 15 onto DoD land (GRN #36)	These eight projects have been determined to be DAR-eligible.
	MAP 8 on Route 1 at Andersen South Main Gate (GRN #44)	
	MAP 10 on Route 1 at Andersen South Secondary Gate (GRN #46)	
	Replace Atantano, Laguas, Sasa, and Fonte bridges. Replace box culvert at Asan #1 bridge (GRN #35) [2]	
	MAP 16 on Route 12 at Naval Munitions Site – relocation to Harmon Road (GRN #52)	
	Pavement strengthening and widening on Route 3 from NCTS Finegayan to Route 9 (GRN #10)	
	Pavement strengthening (2 lanes) on Chalan Lujuna from Route 1 to Route 15 (GRN #11)	
	Pavement strengthening and widening on Route 9 from Route 3 to Andersen AFB North Gate (GRN #22)	

Notes:

[1] Refer to Volume 6, Figure 2.5-8 for GRN project locations.

[2] For GRN #35, replacement of box culverts at Agueda and Asan #1 bridges would be funded by Department of Public Works in the future.

Legend: AFB = Air Force Base; DAR = Defense Access Road; DoD = Department of Defense; FY = Fiscal Year; GRN = Guam Road Network; MAP = Military Access Point; NCTS = Naval Computer and Telecommunications Station; TBD = To Be Determined.

1.1.5.1 Least Environmentally Damaging Practicable Alternative

Volume 2, Chapter 4 contains an analysis of the Least Environmentally Damaging Practicable Alternative, which is required under the Section 404(b)(1) guidelines of the CWA. Specifically, Section 404(b)(1) of the CWA stipulates that no discharge of dredged or fill material into waters of the U.S., which include wetlands, shall be permitted if there is a practicable alternative (Least Environmentally Damaging Practicable Alternative) which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant environmental consequences. Furthermore, an alternative is considered practicable if it is available and capable of being implemented after taking into consideration cost, existing technology, and logistics in light of overall project purposes. The Section 404 (b)(1) guidelines are applicable to proposed actions that are analyzed in Volume 6.

1.2 DIRECT AND INDIRECT IMPACTS

The DoD's proposed action to relocate about 8,600 Marines to Guam and the Navy and Army actions covered by this EIS would create ripple impacts affecting Guam. Impacts can be identified as direct impacts or indirect (or induced) impacts. Direct and indirect impacts are defined by the Council on Environmental Quality in the CFR, Title 40 Part 1508. As described in Volume 1, Chapter 4, a direct impact is an effect caused by the proposed action and occurs at the same time and place.

1.2.1 Direct Impacts for Utilities and Roadways

For utilities and roadways, direct impacts generally relate to the demand for utility services and roadways by the military population and facilities. For the military relocation, direct impacts are under the control of the DoD. An indirect impact can be caused by the proposed action at a later time or further away from the proposed action, such as changes in population or land use. For utilities and roadways, indirect impacts generally relate to population growth outside of the base and the demand that this off base population would have on existing utilities and roads. Direct impacts related to utilities and roads are analyzed and discussed in detail in this Volume. Indirect impacts related to utilities and roads are also analyzed and discussed in this Volume, but their analysis is more general and qualitative in nature using readily available information from owners and operators of these systems, and from regulatory agencies.

1.2.2 Indirect Impacts for Utilities and Roadways

For utilities and roadways, indirect impacts generally relate to the increased demand for utility services and roadways by increases in the civilian population and facilities. There are two main contributors to the indirect impacts for utilities and roadways: the construction workforce that would come to Guam and induced civilian population growth from increased economic activity, both related to the proposed military relocation. Anticipated civilian population growth in absence of the military relocation has been considered in the forecast of future demand for utility services and roadways, but is not a major contributor.

In accordance with CEQ regulations (i.e. 40 CFR §1502.22), incomplete or unavailable information exists to enable a comprehensive understanding and assessment of the functionality, capacity, and condition of off-base water and wastewater systems owned and operated by GWA. As such, it is not possible to fully assess or determine the full significance of the indirect and cumulative impacts of the proposed action associated with induced civilian population growth and workforce housing and logistics. Because these off-base systems are owned and operated by GWA and regulated by USEPA and GEPA, DoD has no authority to conduct required surveys and assessments. Therefore, the DoD must rely on the information provided by these entities outlining the current conditions of these systems. Further, efforts to accurately survey, map, and assess the conditions of these systems would involve exorbitant costs and necessitate extensive excavation of neighborhoods and key roadways. Based on the best available information, which is presented in the following sections, DoD has identified, to the extent possible, the indirect and cumulative impacts of the proposed action associated with induced civilian population growth and workforce housing and logistics and their significance. In making these assessments, DoD employed industry and regulatory standards to make its determinations of impacts and significance.

1.2.2.1 Construction Workforce

Construction of facilities for the relocation is expected to bring a temporary population of off-island workers to Guam between the years 2010-2016. Housing would be provided for most of these workers by the construction contractors. The DoD would not provide workforce housing. Navy-issued contracts would require construction contractors to provide housing for their workforce that meet Guam building codes and standards, which would include providing necessary utilities and associated permits.

Various proposals are being developed by potential contractors in anticipation of winning construction contracts. At this time, specific details about the timing and location for construction and/or renovation of housing to accommodate the construction workforce are incomplete, but one of the workforce housing projects has already commenced construction. As of March 2010, there were nine applications submitted to the Guam Department of Land Management, Division of Land Planning for temporary workforce housing facilities, which are in various stages of the approval process. The applications are for facilities that range in size from 30 living units to 18,000 (recently reduced to 14,000) living units in locations in the central and northern portions of Guam. The DoD has no decision-making authority related to these proposed construction workforce housing facilities, including which facilities should be approved and where they should be located. Approval of these facilities is the purview of GovGuam under its land use and zoning authorities. Additionally, the Record of Decision for the Marine Corps relocation would not cite or endorse specific proposals for workforce housing.

Utilities needed for workforce housing, including power, water, wastewater, and solid waste disposal, would be the responsibility of the individual construction contractors who provide the housing units. Coordination with Guam utility providers, including obtaining approvals and permits for connections to power, water, and sewer services, is the responsibility of the construction contractors and is not within DoD’s control.

Environmental and public health impacts that could result from these facilities and their connection to off base Guam utilities are considered indirect impacts under this Final EIS. These indirect impacts are analyzed in the Final EIS using readily available information from GovGuam agencies and from USEPA Region 9. Because detailed information about the size, type, and location of these construction workforce housing units is undetermined at this time, and because it is unknown which facilities would be approved, the impact assessment in this Final EIS for these facilities as they relate to water, power, sewer, and solid waste demands has been based on these assumptions: two-thirds of the construction workforce would be housed in northern Guam and one-third in central Guam. This assumption is most important to the wastewater utility as the wastewater treatment plants serve certain geographic areas, while potable water, power, and solid waste are islandwide systems.

Construction workers that are working on the job site where DoD facilities would be built would be using utilities provided by the DoD at the work site, if available. But for a currently remote worksite, such utilities would be provided by the construction contractors who would likely obtain utility services from Guam civilian utilities.

1.2.2.2 Induced Civilian Population

In addition to construction workers, the relocation is expected to result in an influx of off-island people beginning in the year 2010. This population is referred to as an “induced population” and includes dependants of construction workers, and people who migrate to Guam in response to the economic growth that would be brought about as a result of the DoD relocation. This induced population would live and work off base, and obtain utilities services from existing GovGuam agencies. The DoD would not provide housing or utilities services for this induced population and has no authority to control where this population would live, work, or obtain services from the GovGuam.

Environmental and public health impacts that could result from these facilities and their connection to off base Guam utilities are considered indirect impacts under this Final EIS. These indirect impacts are analyzed in the Final EIS using readily available information from GovGuam agencies and from USEPA Region 9. Because detailed information about where this induced population would live and work is undetermined and would evolve over time, the impact assessment in this Final EIS for these facilities as they relate to water, power, wastewater, and solid waste demands is general and qualitative in nature.

Nonetheless, there has been a continuous dialogue in the last year between the DoD, USEPA Region 9, Guam Environmental Protection Agency, and Guam utility providers (e.g., GWA, GPA, and the Consolidated Commission for Utilities) to cooperatively identify strategies and solutions for on and off base utilities issues related to the relocation. The goal of these discussions is to improve the overall quality reliability of utilities on Guam for the benefit for all of Guam and working together to identify funding sources to implement these solutions. This Volume discusses these cooperative efforts in later chapters, particularly for potable water and wastewater issues.

1.2.2.3 Ability of Guam Utilities to Manage Indirect Impacts

The DoD acknowledges the current problems Guam has with some of their infrastructure, including utilities. These infrastructure issues are most pronounced in the areas of water, wastewater, and social services. The ability of Guam utilities to meet additional demands is questionable. The USEPA Region 9, working with the GovGuam has identified the need for an estimated $1.3 billion (B) in funding to implement necessary water and wastewater infrastructure improvements that must be accomplished in the first five years to accommodate the military relocation.

GovGuam has an $842M outstanding debt balance (164% of FY 2008 General Fund revenues) and pays $76.2M in annual interest costs on that debt (15% of FY 2008 General Fund revenues). GovGuam, over the years, has used long-term debt financing to fund current operations and reduce annual budget deficits. As of 2009, these deficits have accrued to $416M. Furthermore, GovGuam also has substantial unfunded pension liabilities ($193M).

Strictly speaking, GovGuam does have $34.7M remaining under its debt ceiling (a limit to governmental debt arranged in the Organic Act) but, for all intents and purposes, GovGuam would be better served by reducing debt rather than increasing it. The Guam Office of Public Accountability recommends that “Our government should strive to contain its spending and increase its revenues in order to have cash to pay down the deficit.”

Financial indicators published in 2010 state that GovGuam’s ratio of current assets to current liabilities is 0.28 to 1 (when an adequate ratio is 2 to 1) and GovGuam’s ratio of total cash to current liabilities is 0.08 to 1 (when a desirable ratio is 1 to 2). Furthermore, private sector analysis of GovGuam’s fiscal situation concluded that, based on data that show over 120% of GovGuam’s assets are funded with debt or other obligations, GovGuam’s fiscal condition is currently in the worst shape it has been in since, at least, 2003.

In addition to the financial problems of GovGuam, “component units” of GovGuam such as the GPA, GWA, and A.B. Won Pat Airport hold steep debt balances and are in poor fiscal health. As of the end of FY 2008, “component units” of GovGuam held a principle balance on bonds payable of $767 million. If these bond obligations were to be paid off under current schedules it would cost these agencies, including interest, over $1.3B. It is likely that this level of debt can never be repaid. For instance GPA has received two notices of default since March, 2009 with the defaults due, in large part, to lack of payment by other GovGuam component units. (Sources):

- Basic Financial Statements, Additional Information and Independent Auditors' Report (GovGuam 2008:80)
- Guam Economic Development Authority Fiscal Year 2009 (Guam Office of Public Accountability 2010a)
- Guam Economic Development Authority FY 2009 Financial Highlights (Guam Office of Public Accountability 2010b)
- Office of Public Accountability Annual Report Calendar Year 2009 (Guam Office of Public Accountability 2010d)
- Guam Power Authority FY 2009 Financial Highlights (Guam Office of Public Accountability 2010c)

Recent changes on Guam now allow utilities to levy a fee on new developments to assist in providing utility services to those new developments. That would enhance available funds to the Guam utilities, but may not be sufficient or timely.

DoD recognizes the constraints on GovGuam to be able to address these indirect impacts of the proposed military relocation. DoD is seeking financing from the Government of Japan (GoJ) for water and wastewater improvement projects that would support the U.S. Marine Corps move pursuant to the terms of the Realignment Roadmap Agreement between the U.S. Government and the GoJ. The Realignment Roadmap and more specifics on the financing being sought is described in the Executive Summary of Volume 1.

In addition to DoD's efforts to secure funding with GoJ, the Council on Environmental Quality has also facilitated interagency discussions with DoD and appropriate federal agencies to identify the specific projects, the of level of funding, and source of funding for necessary water and wastewater infrastructure improvements that must be accomplished in the first five years of the military relocation effort. Although no validated estimates are yet available, a preliminary estimate has these various projects totaling approximately $1.3B over the five year period. These estimates are based on a conceptual cost analysis conducted by USEPA Region 9, and continue to be refined.

The Economic Adjustment Committee (EAC) is evaluating overall Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD relocation. As part of this evaluation the EAC is specifically examining federal funding options for the remaining portion of the estimated $1.3B water and wastewater improvements that may not be provided by GoJ financing.

In addition, the DoD could utilize force flow reduction and/or adaptive program management of construction to reduce population growth rates and when the peak growth would occur to reduce these indirect impacts. These concepts are presented in Volume 7.

1.3 NON-DECISION POINT ACTIONS

The DoD's proposed action to relocate about 8,600 Marines and their dependents to Guam and the Navy and Army actions covered by this Final EIS would create ripple impacts affecting Guam. Effects on some resource areas could occur but may not be discernable as direct and indirect impacts. This section discusses planned Port Authority of Guam facilities and potential impacts on the A.B. Won Pat International Airport that are related to the proposed action, but are not in the DoD's control.

1.3.1 Port of Guam

The Jose D. Leon Guerrero Commercial Port (also known as the Port of Guam [Port]) is located in the northern portion of Outer Apra Harbor. It is the only port on Guam and more than 90% of all imported goods and materials come through the Port. This makes the Port an essential facility that supports the entire population of Guam. The proposed military relocation on Guam would create an increased demand for imported goods and materials (especially construction supplies, equipment, and materials) that would be shipped to Guam. Also, during the peak years of construction, goods and other supplies would be required to support the estimated off-island construction workers and induced population. Long-term operational impacts include importing supplies, goods, and materials that would support the additional permanent population created by the proposed action.

The Port is administered by the Port Authority of Guam and operates as a semipublic organization.

Since its construction in 1969 the Port has remained largely unchanged. With many areas near capacity or unusable, expanding the Port’s facilities and equipment upgrades would create operational efficiencies and maximize Port capacity. Before the news of the proposed military relocation, Port improvements and expansion were under consideration. However, the proposed military relocation created an additional impetus to implement planning studies and improvements to service the anticipated construction work and additional population.

In August 2007, work began to update the Port’s master plan. The recommendations and updates address future expansion and development based on typical commercial growth, as well as the impending military relocation. Needs assessments for the proposed military relocation on Guam were based on preliminary information about cargo volumes and personnel relocation provided by the Joint Guam Program Office. A final draft Port master plan was completed in April 2008, which updated the master plan and set the road map for upgrading the facilities. The master plan for the Port calls for nearly $200M in capital improvement upgrades to the Port facilities to support the military relocation. The modernization program, which was granted conditional approval from the Guam Legislature in December 2008 would address both Guam’s expected growth without the proposed action and the anticipated increase in cargo volume resulting from the proposed action.

There are three phases to the Port modernization program: IA, IB, and II (Rosenthal 2010), as follows:

- Phase IA: The focus is on productivity and efficiency improvements, such as new equipment, systems, and buildings, and terminal modernization and new yard capacity. Elements include demolition of buildings; installation of utilities; terminal yard paving and upgrade of pavement; installation of high mast lighting; installation of water, sewer, stormwater, and fire protection systems including installation of new stormwater outfalls into Apra Harbor; installation of security systems; and new cargo handling and equipment systems. The project would significantly increase the operating efficiency and capacity of the terminal by an eastward extension of useable terminal area and through modernization of upland port facilities, equipment, utilities, and systems including new gate systems with automated gate technology and modern truck scanning equipment.

  Preliminary design of Phase IA Port expansion was recently completed. The Environmental Assessment for Phase IA is anticipated to be completed in August 2010. The preparation of permit applications is expected to be completed by the end of 2010. Full funding for the proposed work is anticipated in 2011 and construction would be completed in 2013 (Rosenthal 2010).

- Phase IB: The focus is on structural refurbishment of existing docks (F4, F5, and F6), modernization of terminal areas to the west and acquisition of cranes. It includes dredging to increase berth depths at F4, F5, and F6 to -42 feet (-13 meters) mean lower low water and security equipment and process improvements to meet International Ship and Port Facility Security Code requirements. Construction would last approximately two years. The preliminary design, preparation of permit applications, and the NEPA process would start as soon as funding has been identified (Rosenthal 2010).
- Phase II: The focus is on construction of a new berth F7 and additional terminal capacity to the east to meet long-term organic growth. Creation of the new berth F7 would require some land reclamation (i.e., placement of fill in Apra Harbor), removal of existing derelict vessels, and the addition of 900 feet (274 meters) of berthing/wharf space. Dredging would also be included. Execution of this phase is likely 20 or more years into the future and funding has not been identified (Rosenthal 2010).

Funding for the Port's improvements (modernization) and expansion is anticipated to come from various federal agencies, GovGuam, and private sources. The funds for capital improvements would likely be repaid through user fees that would then be passed on to consumers, businesses, and other entities (i.e., DoD). While the DoD is not directing the Port improvements, an amendment to the 2010 Defense Appropriations Bill is proposed in Congress, which calls for the transfer of $50M of DoD FY10 funds to the Department of Transportation to fund Phase I of the port improvements.

The modernization projects are also included in the cumulative impacts discussion of Volume 7, Chapter 4.

1.3.2 A.B. Won Pat International Airport

The A.B. Won Pat International Airport (Airport) is a primary regional airport serving passenger and cargo needs between Guam and the U.S., Asia, Australia, and various islands in the Pacific region. There are numerous capital improvement projects planned under Project Airport Guam. Construction has begun on some projects but they are phased for completion through 2030. Project Airport Guam is included as a cumulative project in Volume 7, Chapter 4.

The increase in population associated with the proposed action would increase the number of passengers and operations at Airport. The increase would be addressed in the airport master planning process. Facility improvements may be required to meet the increased traffic and these improvements may be eligible for federal Airport Improvement Program Funding.

It is anticipated that increased customs and agricultural inspections would be coordinated through both Guam and relevant federal officials, including the U.S. Department of Agriculture. DoD would work with relevant Guam and federal inspection authorities to address required inspection of military cargoes that pass through the Airport. In addition to continuing to implement existing Standard Operating Procedures and DoD requirements covering the inspection and transport of material and personnel from Guam to other locations, the Navy is also funding and coordinating the preparation of a Micronesia Biosecurity Plan. This plan would address all aspects of the potential for the unintended transport of the brown tree snake and all potential non-native species to other Pacific Islands and from other locations to Guam due to both civilian and military activities originating on Guam.

Funding for Airport improvements, including increased customs and agricultural inspection requirements, would be funded from federal agencies, GovGuam, and private sources. The DoD would work with the Airport to identify possible increased sources of federal funds. It is further anticipated that the DoD would work with the airport to investigate the development of possible user charges and fees to cover the costs of increased customs and agricultural inspection associated with shipment of materials for military-relocation related construction projects and increased civilian growth.

The increased inspection needs associated with civilian population growth would be a function of Airport planning, implementation, and coordination with relevant Guam and federal customs and inspection authorities. In any instance, it is not anticipated that the DoD would conduct the required inspections.

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CHAPTER 2.
PROPOSED ACTION AND ALTERNATIVES

The proposed military relocation on Guam associated with the relocation of the U.S. Marine Corps (Marine Corps), the Navy aircraft carrier berthing, and the Army Air and Missile Defense Task Force (AMDTF) would increase the demand for power, potable water, and wastewater utilities. It would also affect the remaining life of existing solid waste facilities and the demand for the new Government of Guam (GovGuam) Layon Landfill in Dandan. The proposed actions would also require roadway improvements. To support the proposed military relocation, utility and roadway alternatives were developed.

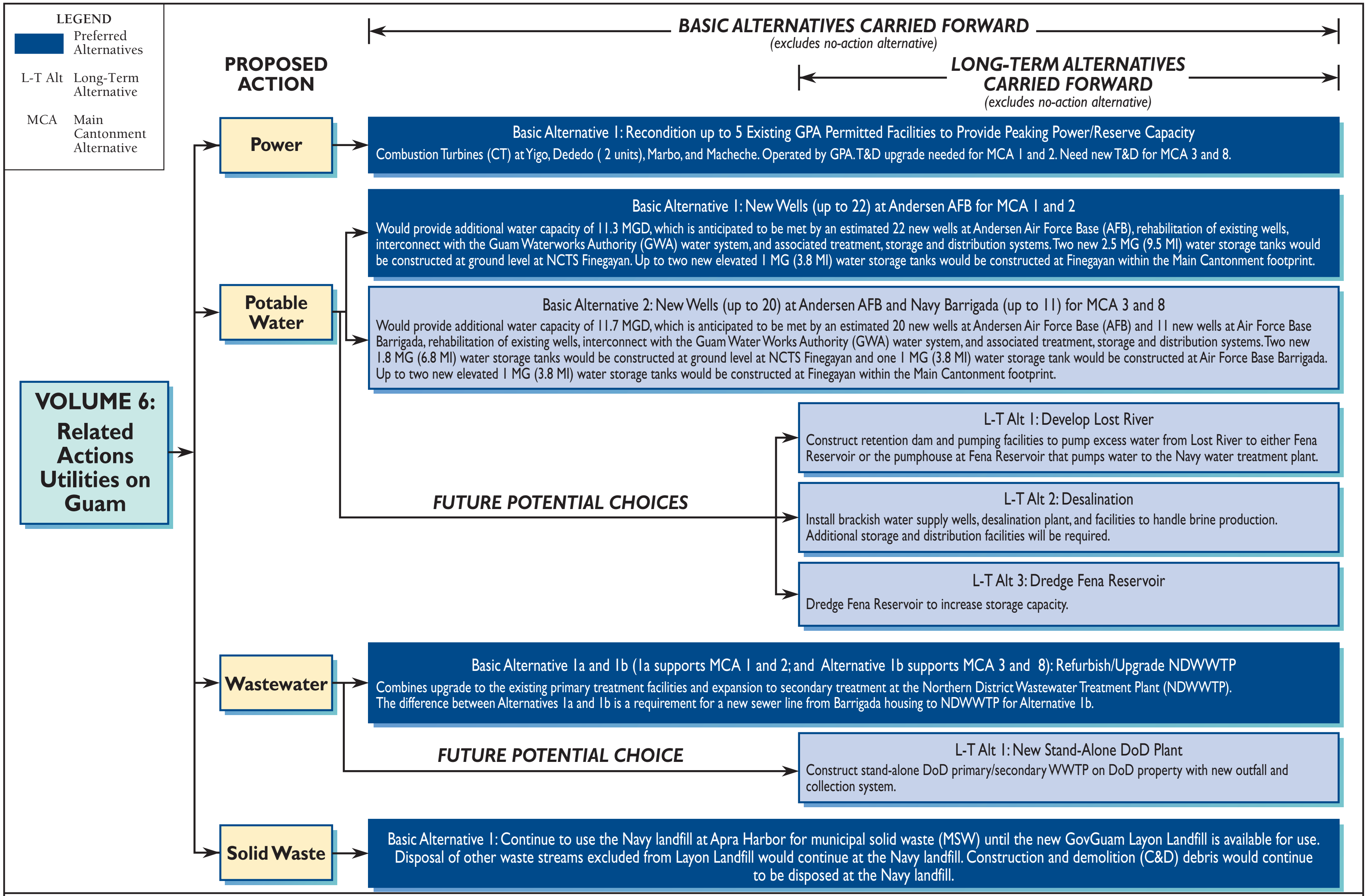
It is anticipated that some solutions would be implemented by Special Purpose Entities (SPEs), which would likely be SPEs formed to finance, operate, manage, upgrade, or develop utility plants and associated infrastructure such as collection or distribution systems. It is anticipated that the SPEs would utilize GoJ financing provided in accordance with the Realignment Roadmap. Alternatively, GoJ financing could be provided to Guam utilities to conduct the upgrades. The precise manner in which these SPEs would operate is not known. The Department of Defense (DoD) will not exercise any authority or control over the SPEs but is committed to facilitate discussions between the Government of Japan, the SPEs, and Guam to focus efforts on addressing utility impacts associated with the realignment, including short-term construction workforce and long-term population growth. The U.S. Government would then likely purchase utilities from the SPE or utility under a Utilities Service Contract. Fees generated through utilities service contracts could be used to repay financing costs. The DoD rate structure would reflect current rates adjusted for inflation. Given that these SPEs have yet to be formed, these business arrangements are not currently defined in detail. Therefore, they are presented as “conceptual” business arrangements.

For utilities, basic and long-term alternatives have been developed.

- ***Basic alternatives*** would meet the demand for utilities to support the military relocation on Guam for both the near-term and long-term and are evaluated in this Final Environmental Impact Statement (EIS) in a project-specific manner. For basic alternatives, no additional National Environmental Policy Act (NEPA) analysis, other than what is included in this EIS, would be conducted.
- ***Long-term alternatives*** would meet the demand for utilities over the long term in the event that the basic alternatives are found to be insufficient in the future. Long-term alternatives are presented conceptually, as much of the detail related to them is unknown and would require substantial study, planning coordination, and budgeting. In the future, if the long-term alternatives are pursued, additional NEPA analysis would be required because the long-term alternatives are currently not ripe for detailed project-specific environmental impact evaluation.

Basic Alternatives

The following basic alternatives for utilities are analyzed in a project-specific manner. They are described in more detail later in this Volume and are graphically presented in Figure 2.0-1.



Power

Basic Alternative 1: Recondition up to 5 Existing GPA Permitted Facilities to Provide Peaking Power/Reserve Capacity

Combustion Turbines (CT) at Yigo, Dededo (2 units), Marbo, and Macheche. Operated by GPA. T&D upgrade needed for MCA 1 and 2. Need new T&D for MCA 3 and 8.

Potable Water

Basic Alternative 1: New Wells (up to 22) at Andersen AFB for MCA 1 and 2

Would provide additional water capacity of 11.3 MGD, which is anticipated to be met by an estimated 22 new wells at Andersen Air Force Base (AFB), rehabilitation of existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 2.5 MG (9.5 Ml) water storage tanks would be constructed at ground level at NCTS Finegayan. Up to two new elevated 1 MG (3.8 Ml) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

Basic Alternative 2: New Wells (up to 20) at Andersen AFB and Navy Barrigada (up to 11) for MCA 3 and 8

Would provide additional water capacity of 11.7 MGD, which is anticipated to be met by an estimated 20 new wells at Andersen Air Force Base (AFB) and 11 new wells at Air Force Base Barrigada, rehabilitation of existing wells, interconnect with the Guam Water Works Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 1.8 MG (6.8 Ml) water storage tanks would be constructed at ground level at NCTS Finegayan and one 1 MG (3.8 Ml) water storage tank would be constructed at Air Force Base Barrigada. Up to two new elevated 1 MG (3.8 Ml) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

FUTURE POTENTIAL CHOICES

L-T Alt 1: Develop Lost River

Construct retention dam and pumping facilities to pump excess water from Lost River to either Fena Reservoir or the pumphouse at Fena Reservoir that pumps water to the Navy water treatment plant.

L-T Alt 2: Desalination

Install brackish water supply wells, desalination plant, and facilities to handle brine production. Additional storage and distribution facilities will be required.

L-T Alt 3: Dredge Fena Reservoir

Dredge Fena Reservoir to increase storage capacity.

Wastewater

Basic Alternative 1a and 1b (1a supports MCA 1 and 2; and Alternative 1b supports MCA 3 and 8): Refurbish/Upgrade NDWWTP

Combines upgrade to the existing primary treatment facilities and expansion to secondary treatment at the Northern District Wastewater Treatment Plant (NDWWTP). The difference between Alternatives 1a and 1b is a requirement for a new sewer line from Barrigada housing to NDWWTP for Alternative 1b.

FUTURE POTENTIAL CHOICE

L-T Alt 1: New Stand-Alone DoD Plant

Construct stand-alone DoD primary/secondary WWTP on DoD property with new outfall and collection system.

Solid Waste

Basic Alternative 1: Continue to use the Navy landfill at Apra Harbor for municipal solid waste (MSW) until the new GovGuam Layon Landfill is available for use. Disposal of other waste streams excluded from Layon Landfill would continue at the Navy landfill. Construction and demolition (C&D) debris would continue to be disposed at the Navy landfill.

Figure 2.0-1
Summary of Proposed Action and Alternatives Carried Forward for Utilities, Guam

Power

- Basic Alternative 1 — supports all alternatives by reconditioning up to five existing Guam Power Authority (GPA) generating facilities and continue to operate within existing permitted capacity and upgrade Transmission and Distribution (T&D) systems.

The other power alternatives presented in the Draft EIS were deemed unnecessary after the reevaluation of current power demand on the GPA system and estimated increases in power demand from the proposed military relocation. This showed that adequate power would be fairly easily provided in time to accommodate the proposed military relocation.

Potable Water

- Basic Alternative 1 — supports Main Cantonment Alternatives 1 and 2 by providing additional water capacity of 11.3 MGd (42.8 MLd), which is anticipated to be met by an estimated 22 new wells at Andersen Air Force Base (AFB), rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 2.5 MG (9.5 ML) water storage tanks would be constructed at ground level at NCTS Finegayan. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.
- Basic Alternative 2 — supports Main Cantonment Alternatives 3 and 8 by providing additional water capacity of 11.7 MGd (44.3 MLd), which is anticipated to be met by an estimated 20 new wells at Andersen Air Force Base (AFB) and 11 new wells at Air Force Base Barrigada, rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 1.8 MG (6.8 ML) water storage tanks would be constructed at ground level at NCTS Finegayan and one 1 MG (3.8 ML) water storage tank would be construction at Air Force Base Barrigada. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

Wastewater

- Basic Alternative 1 (1a supports Main Cantonment Alternatives 1 and 2; and 1b supports Main Cantonment Alternatives 3 and 8) — combines upgrade to the existing primary treatment facilities and expansion to secondary treatment at the Northern District Wastewater Treatment Plant (NDWWTP). The difference between Basic Alternatives 1a & 1b is an additional requirement for a new sewer line from new proposed DoD housing at Barrigada to NDWWTP for Basic Alternative 1b.

Solid Waste

- Basic Alternative 1 — supports all alternatives with the continued use of the Navy landfill at Apra Harbor for municipal solid waste (MSW) until the new GovGuam Layon Landfill at Dandan is available for use. Disposal of other waste streams excluded from Layon Landfill would continue at the Navy landfill. Construction and demolition (C&D) debris would continue to be disposed at the Navy hardfill.

Long-Term Alternatives

As mentioned previously, a programmatic approach is taken in this Final EIS for long-term alternatives. Based on available information, the potential environmental effects associated with the long-term utility projects are analyzed for impacts to the utilities themselves but impacts of the long-term utilities alternatives to other resource areas are not analyzed in this EIS. Additional studies further defining these long-term alternatives are required to properly assess the impacts on the other resource areas. Those studies are beyond the time frame required for this EIS. If such projects were to be pursued, additional NEPA documentation and resource surveys would be completed in the future when project-specific information and funding becomes available for these long-term projects.

The following long-term utilities alternatives are analyzed in a programmatic manner. They are described in more detail later in this Volume.

Potable Water (to augment basic alternative chosen if required):

- Long-Term Alternative 1 — Development of Lost River
- Long-Term Alternative 2 — Desalination of Brackish Water
- Long-Term Alternative 3 — Dredge Sediment from the Navy Reservoir to Increase Storage Capacity

Wastewater (if required):

- Long-Term Alternative 1 — New DoD Only Stand Alone Primary/Secondary Treatment Facility on DoD land at Finegayan including a New Outfall in Support of all Main Cantonment Alternatives.

The utility studies assumed that the construction workforce would reside off base and would be served by Guam public utilities at their places of residence. The dates when utility demand would exceed capacity were estimated to assess the potential effect on Guam public utilities of the combined DoD population increases, construction workforce increases, and civilian population increases with specific discussion of impacts on the NDWWTP, the GWA water system, and the GPA Island-Wide Power System (IWPS).

A socioeconomic analysis performed in support of this EIS projected that in addition to direct increases in DoD-related personnel, the on-base civilian workforce, and the temporary construction workforce, the proposed military relocation would likely affect civilian population growth. The population loadings developed by the socioeconomics team and assumed for analysis in this Final EIS are summarized in Volume 1, Table 2.1-2.

Non-project population increases for the Air Force, Navy, and Coast Guard are considered in the utilities analyses to ensure adequate services and capture the entire impact for the foreseeable future. These "non-project" populations are shown in Table 2.0-1.

All the DoD bases on Guam are now considered one joint region with the Navy as the administrator of base operations and maintenance. However, for the sake of clarity in this EIS, the various utilities systems are still referred to by their original military administrator (e.g., AF Water System, Navy Water System, AF Recycling Center, Navy Landfill).

For roadways, the alternatives listed below were developed in conjunction with each cantonment alternative configuration and are analyzed in a project-specific manner. Each alternative consists of a set of Guam Road Network (GRN) projects, the majority of which are common to all four alternatives. Each project may consist of one or more of six types of roadway improvements (intersection improvements [including Military Access Points (MAP)], bridge replacements, pavement strengthening, roadway widening, roadway relocation, and new road). They are described in more detail later in this Volume and presented in Table 2.5-3. Alternative 2, the preferred Off Base Roadways alternative, supports the preferred Main Cantonment Alternative (also referred to as Alternative 2).

- Alternative 1 — There are 49 GRN projects that would be required for Alternative 1. These are listed in Table 2.5-3, with the exception of GRN #s 38, 39, 41, 47, 48, 49, 49A, 63, and 74. These projects consist of 24 pavement strengthening, 7 roadway widening, 14 intersection improvements (includes 8 MAPs), 2 bridge projects covering a total of eight bridge or culvert replacements, 1 road relocation, and 1 new road.
- Alternative 2 — There are 49 GRN projects that would be required for Alternative 2. These are similar to the GRN projects for Alternative 1 but reflect different locations and configurations for some of the MAP projects.
- Alternative 3 — There are 51 GRN projects that would be required for Alternative 3. These are listed in Table 2.5-3, with the exception of GRN #s 20, 31, 38A, 39A, 41, 41A, and 124. These projects consist of 22 pavement strengthening, 9 roadway widening, 17 intersection improvements (includes 11 MAPs), 2 bridge projects covering a total of eight bridges or culvert replacements, and 1 road relocation.
- Alternative 8 — There are 50 GRN projects that would be required for Alternative 8. They are listed in Table 2.5-3, with the exception of GRN #s 38, 39, 41, 47, 48, 49, 63, and 74. These projects consist of 24 pavement strengthening, 7 roadway widening, 15 intersection improvements (includes 9 MAPs), 2 bridge replacements projects covering a total of eight bridges or culvert replacements, 1 road relocation, and 1 new road.

Table 2.0-1. Projected "Non-Project" Population Considered in the Analysis of Utilities

	Baseline[1] (Non-Project)	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*Total at 2019 (incl. baseline)*
Non-Project*: Air Force[2]												
Active	2,145	80	80	80	80	120	120	120	120	120	120	2,265
Dependents (44% Spouse, 56% Children)	2,950	118	118	118	118	210	210	210	210	210	210	3,160
Transient	0	900	900	1,256	1,256	1,256	1,256	1,256	1,256	1,256	1,780	1,780
Civilian Work Force (on-base)[2]	805	17	17	17	17	25	25	25	25	25	25	830
Subtotal	5,900	1,115	1,115	1,471	1,471	1,611	1,611	1,611	1,611	1,611	2,135	8,035
Navy[3]												
Non-Project: Active	4,350	0	0	0	0	0	80	80	80	80	280	4,630
Non-Project: Dependents (44% Spouse, 56% Children)	5,230	0	0	0	0	0	50	50	50	50	50	5,280
Non-Project: Civilian Work Force (on-base)[3]	1,631	0	0	0	0	0	3	3	3	3	10	1,641
Subtotal	11,211	0	0	0	0	0	133	133	133	133	340	11,551
Non-Project*: United States Coast Guard[4]												
Active	140	0	0	0	50	50	50	50	50	50	50	190
Dependents (44% Spouse, 56% Children)	180	0	0	0	30	30	30	30	30	30	30	210
Transient	0	0	0	0	0	0	0	0	0	0	0	0
Civilian Work Force (on-base)[5]	53	0	0	0	10	10	10	10	10	10	10	63
Subtotal	373	0	0	0	90	90	90	90	90	90	90	463
Grand Total Non-Project:	17,484	1,115	1,115	1,471	1,561	1,701	1,834	1,834	1,834	1,834	2,565	20,049

Notes:

[1] Baseline loadings (from the Guam Integrated Military Development Plan, July 2006) are not included in projected loadings (years 2010-2019). Projected loading numbers for each year are additive for each year from 2010 through 2019. "Total at 2019" column is baseline plus projected loadings.

[2] 15 Sep. 08 Congressional Memo (using specific Air Force #s in the 22 Aug 08 Gregory Perkinson email for civilian workforce, factoring out 25% who are assumed to be dependents, and 25% who are assumed current Guam residents).

[3] 15 Sep. 08 Congressional Memo is basis for Aircraft Carrier (CVN) transient load; 22 Dec 08 email from Thomas McLemore (Numbers) is the basis for other numbers. 25% of the civilian workforce was assumed to be part of the dependent population, and 25% were assumed current Guam residents.

[4] Guam Integrated Military Development Plan, 2006.

[5] Civilian Work Force is 40% of Active Duty and of that 40%, 25% live on base (are assumed part of the dependent population). An additional 25% are assumed current Guam residents.

2.1 POWER

2.1.1 Overview

The proposed actions on Guam would create an increased power demand. Table 2.1-1 lists the anticipated demand for each component of the proposed military relocation, including the AMDTF. The estimated total Marine Corps demand is 21.36 megawatts (MW) and total estimated future DoD demand is 126.29 MW (existing, transient, and future). The total demand is anticipated to occur as early as 2015, when all planned facilities would be in service and operational. Each of the demand values in Table 2.1-1 is based on the Unified Facilities Criteria (UFC) planning criteria, but does not include additional capacity for future growth, which would be used for long-term power generation planning.

Power requirements presented are based on planned facilities to meet the needs of the projected population. Different Main Cantonments would require different T&D upgrades, but the basic facility demands would be the same as presented in Table 2.1-1. Proposed generation facilities are expected to remain the same in both capacity and location.

The DoD estimates a future peak demand of 126.29 MW. This includes 56 MW of current DoD demand at existing DoD facilities on Guam, a total of 9.11 MW from other planned non-project DoD actions, a total of 21.36 MW from the proposed Marine Corps relocation, and a net total of 39.82 MW of transient demand.

Transient power demand would occur when either the proposed berthing of a transient aircraft carrier and escorts or the ships that make up an Expeditionary Strike Group (ESG) would be in port. The demand from the transient aircraft carrier and associated escort ships is estimated at 39.82 MW. The ESG demand is estimated at 16.78 MW. The transient aircraft carrier and its associated escort ships would not be in port at the same time as an ESG; therefore, the power demand for the transient aircraft carrier and an ESG is not combined. The higher demand number related to the transient aircraft carrier was considered in demand projections and is part of the total estimated future demand of 126.29 MW.

Table 2.1-1. Estimated Department of Defense Power Demand for Guam

	Demand (MW)			
Demand Description	*Existing DoD Demand*	*Other Planned DoD Demand Increases*	*Marine Corps Demand Increases*	*Total DoD Future Planned Demand*
Andersen AFB	In Total	7.76	1.12	8.88 + exist
Northwest Field	In Total	0.00	0.00	0.00 + exist
Andersen South	In Total	0.00	0.00	0.00 + exist
NCTS Finegayan (plus utilities)	In Total	0.88	20.00	20.88 + exist
Barrigada	In Total	0.00	0.00	0.00 + exist
Naval Hospital	In Total	0.47	0.00	0.47 + exist
Naval Base Guam	In Total	0.00	0.24	0.24 + exist
Total Demand (excludes transient)	56	9.11	**21.36**	86.47
Naval Base Guam (max. transient demand) [1]				39.82
Total Electrical Demand (MW) [2]				**126.29**

Notes:
[1] Represents maximum demand on any given day for aircraft carrier and associated escort ships (Navy), or Expeditionary Strike Group (ESG) (Marine Corps) (not in port on the same days).
[2] For 19 service locations.
Legend: AFB = Air Force Base; DoD = Department of Defense; MW = megawatts; NCTS = Naval Computer and Telecommunications Station.
Source: NAVFAC Pacific *2010f.*

Current planning for the transient demand includes a dedicated transmission line between the planned transient aircraft carrier berthing at Polaris Point and Piti Substation, located near Cabras Power Plant. Under the proposed action for a transient aircraft carrier wharf, there would be a cumulative total of up to 63 visit days per year, with an anticipated length of 21 days or less per visit. Because of the short length of the transient visits, such visits are categorized as a peaking type load, and planned power for transient ships would be provided by peaking-power facilities instead of a base load power generation facility.

A peaking-power facility is operated for relatively short periods of time and often has a lower installed cost per MW of capacity because of the type of facility and operating requirements. Base load power generation must operate continuously except for periods of maintenance or equipment failure, thus typically has a higher cost per MW of installed capacity to achieve this operational ruggedness. Thus, using peaking power units for short time periods is more economical when factoring in capital costs.

The non-transient DoD demand increase is estimated to be 30.47 MW (126.29 MW – 39.82 MW – 56 MW). Power usage at existing DoD facilities was evaluated to determine their ratio of minimum power demand to maximum power demand so the power demand could be segregated into base and peaking type power demands. Thirty-one days of data from 17 DoD utility meters were reviewed and resulted in an approximate ratio of 90/10. That is, 90% of the peak load is the minimum load in a day and generally represents the base load percentage typically needed to serve DoD demand.

The minimum continuous demand from the existing DoD system is approximately 90% of the peak demand. The 90/10 ratio of base demand to peak demand is applied to the anticipated future DoD demand, which results in a required increased base demand of 27.42 MW, with 3.05 MW plus the transient load of 39.82 MW, which results in an additional peaking demand of 42.87 MW.

Although the above analysis of power requirements does include power required for the transient ships, the basic alternative presented does not include this power demand. It is anticipated that a transient aircraft carrier and its escort ships would rely on shoreside utility infrastructure for water, wastewater, and solid waste after 2015. Electric power would be provided in accordance with customer service agreements between Guam Power Authority (GPA) and the U.S. Navy. Any GPA commitments for additional power to support the aircraft carrier and its escort ships will be determined by future CSA modifications. Any required changes in the shoreside power infrastructure or their operations to meet the requirements for the aircraft carrier and its escort ships may require additional NEPA review.

Two other types of demand would increase power demand on Guam. One is induced civilian growth and the other is construction workers. Power demand from induced civilian growth was considered to be similar to but less than existing per capita power demand because less additional infrastructure per person is expected to be required. In other words, the basic infrastructure is currently present on Guam and any additional power consuming infrastructure required to support the induced civilian growth would be less than existing per capita power demand. Given that consideration, the power demand for induced civilian growth was estimated at two-thirds of the current per capita demand for Guam, which is 1.1 kilowatt (kW). The construction worker load was assessed at a smaller demand because of the expectation that construction workers would be in a high-density living arrangement and have somewhat limited amenities in their housing (e.g., minimal yard lighting, minimal/shared kitchen and entertainment appliances). Thus, the power demand from this population was considered at one-third of current per capita civilian demand.

Power demand from induced civilian population growth caused by the planned military relocation on Guam would then be estimated at 0.74 kW average demand per person. Power demand from construction workers would be estimated at 0.36 kW per person. Table 2.1-2 shows the anticipated demand requirements for DoD, construction workers, general population growth projections, and population growth induced by the proposed military relocation on Guam. This table uses an 80/20 split for baseload and peaking load as that is the approximate split GPA uses in managing their generating facilities.

The majority of the construction activities associated with the proposed Marine Corps relocation is expected to be completed between 2012 and 2015, with other non-project actions completing in 2019. The proposed military relocation on Guam coincides with GPA exceeding its “1 day in 4.5 years” reserve capacity to meet reliability goals. This capacity represents a statistical system capacity that would result in an outage of less than 1 day in 4.5 years. The IWPS reserve analysis is based on the Reliability Manual (GPA 1998). In general, the capacity used by GPA to meet its reserve capacity of “1 day outage in 4.5

years" requires a generation capacity in the installed system of approximately 1.52 times the peak demand level. That is, 1.52 MW of supply capacity is required for every 1.0 MW of demand (a simplification of the actual reliability requirements for the power system). GPA's current system supply capacity is indicated in Table 2.1-2 as 324.21 MW and 363.68 MW after the proposed reconditioning of Combustion Turbines (CTs). This is based on a system generation capacity of 492.8 MW and 552.8 MW, respectively, for the years from 2010 to 2014.

GPA's supply forecast is based on an installed generation capacity of 552.8 MW. A review of 1 year of GPA's actual generation capacity indicates an average daily generation capacity of 492.8 MW, or nearly 15% less than its stated capacity. This appears to be largely related to units that are under repair and/or not needed and, therefore, not included in the generation capacity for the daily report. The daily-capacity report is a document produced by GPA that was evaluated over a 1-year period to determine what GPA's typical unavailable capacity is on a regular basis. In this report, the existing CTs had been under repair and/or not needed. A CT refers to a facility that includes a direct-fired turbine (i.e., one in which fuel is fed directly to the turbine) that is connected to and drives a generator for power production. The CT system includes fuel storage and handling, the turbine generator unit, exhaust handling system, cooling system, and related components.

Table 2.1-2. Power Supply and Demand on Guam (MW)

GPA Power System	*Megawatts (MW)*									
	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Islandwide, including DoD and GPA baseline projected growth										
Existing Guam	272	278	285	290	294	297	300	303	306	309
Guam Induced Civilian Increase (induced growth caused by military increase)	4.93	12.25	19.99	23.44	29.24	22.08	11.23	7.75	7.75	7.88
Construction Worker Increase	1.18	2.99	5.19	6.51	6.7	4.43	1.38	0	0	0
DoD Increase	1.83	2.18	5.04	11.35	17.99	27.55	29.53	29.53	29.53	30.5
Total Demand	279.94	295.42	315.22	331.3	347.93	351.06	342.14	340.28	343.28	347.38
Total Baseload Demand (80%)	223.95	236.34	252.18	265.04	278.34	280.85	273.71	272.22	274.62	277.90
Total Peaking Demand (20%)	55.99	59.08	63.04	66.26	69.59	70.21	68.43	68.06	68.66	69.48
Base Load Supply	352	352	352	352	352	352	352	372	372	372
Other Load Supply (medium load, peaking and reliability reserve)	140.8	140.8	200.8	200.8	200.8	200.8	200.8	200.8	200.8	200.8
Total Supply	492.8	492.8	552.8	552.8	552.8	552.8	552.8	572.8	572.8	572.8
Baseload Supply – Baseload Demand	128.05	115.66	99.82	86.96	73.66	71.15	78.29	99.78	97.38	94.10
Total Supply/1.52 reliability factor	324.21	324.21	363.68	363.68	363.68	363.68	363.68	376.84	376.84	376.84
Total Supply/1.52 – Total Demand	44.27	28.79	48.46	32.38	15.75	12.62	21.54	36.56	33.56	29.46

Legend: DoD = Department of Defense; GPA = Guam Power Authority; MW = megawatts.
Source: NAVFAC Pacific 2010f. GPA 2008 for existing Guam growth projections.

Planning indicates that new power generation capacity would not be required to meet the planned demand increase. However, additional renewable generation is planned by GPA and would be available by approximately 2017. This new power capacity would be approximately 20 MW based on the Integrated Resource Plan (GPA 2008). It is planned to have the reconditioned CTs used as peaking/standby capacity as future generation capacity is added.

2.1.2 Screening Process

The following power generation alternatives were evaluated in the Guam Power Generation Study Report for Proposed USMC [United States Marine Corps] Relocation (Naval Facilities Engineering Command [NAVFAC] Pacific 2010f). These alternatives were evaluated for their ability to provide a long-term solution to meet anticipated increased energy demands.

The following alternative energy sources for producing base load power were considered:

- Ocean Thermal Energy Conversion (OTEC)
- Wind power
- Solar energy conversion
- Biofuel power
- Waste-to-Energy (WTE)
- Fuel cells
- Wave energy conversion
- Geothermal

In addition, the following conventional generation fuel options were considered:

- Heavy (No. 6) fuel oil
- Liquefied Natural Gas
- Diesel No. 2
- Coal

These alternatives were evaluated based on a qualitative approach to identify the most viable alternatives, using the following criteria for base load and peak power generation:

- *Quality:* Stable frequency and voltage (affected by the balance of the IWPS)
- *Quantity:* Sufficiency to handle peak demand and unscheduled surge, coordinated with GPA generation
- *Fuel Source Availability:* Availability of fuel resources to supply generation plants with sufficient reserve storage for extended delivery schedule
- *Cost Effectiveness:* Analysis of cost-versus-benefit analysis
- *Reliability:* Infrequent outages and reliability in excess of 85% (includes planned outages for operation and maintenance)
- *Ability to Support Base Load:* Ability of the source or system to reliably generate power to meet base load demand
- *Suitability of Site:* Reasonable availability of suitable site to construct plant

A summary of these alternatives and evaluation to the criteria is included in Table 2.1-3.

2.1.3 Alternatives Dismissed

The long-term alternatives that were evaluated but dismissed and the rationale for their dismissal are summarized below.

Table 2.1-3. Summary of Alternatives Evaluated for Power Systems

Power System Alternative	*Evaluation Considerations*	*Recommendation*
Ocean Thermal Energy Conversion	• Suitable for base load power • Not a reliable mature technology at utility scale installations • Very high cost of generation capacity (potentially 20 times) when compared to steam or combustion turbine technologies	Eliminated (possible future consideration with technology improvement)
Wind Power Generation	• Marginal wind quality on Guam • Limited data (a study done at Andersen AFB concluded that wind quality was rated as a 2, or approximately 12 mph, on a scale of 1 of 5 with 5 being the best) • Few installed applications with similar typhoon exposure; therefore, not a mature application for the technology in a typhoon area • Not suitable for base load power (wind is not consistent)	Eliminated (possible future consideration with technology improvement)
Solar Energy Conversion	• Not suitable for base load power (energy available only during daylight) • Relatively high cost for energy when compared to conventional technology • Large land area required (possibly not available) to meet demand requirements; therefore, not viable	Eliminated
Biofuel Power Generation	• No source of bioenergy (crops, vegetable oil source) on Guam • Fuel cost is higher than diesel fuel or heavy fuel oil currently used and conversion technology is similar to current generation (no technology advantage)	Eliminated
Waste-to-Energy Generation	• No available site on Guam • Possibly suitable for base load generation • Insufficient quantity of waste to supply generation large enough to support planned loads	Eliminated
Fuel Cell Power Generation	• No current facility larger than 200-500 kW (would not support planned loads) • No site available suitable to support a fuel cell based facility	Eliminated
Wave-Energy Generation	• Insufficient wave energy/intensity to provide viable facility • Occurrence of typhoons limits ability to provide a suitable installation; therefore, not viable • Not commercially available in sufficient size to support planned demand	Eliminated
Geothermal	• Insufficient geothermal activity on Guam based on available data • Generally reliable with consistent energy source • No suitable site on Guam identified	Eliminated (possible future consideration with additional study

Power System Alternative	*Evaluation Considerations*	*Recommendation*
Conventional Generation (Fuel Options)		
Heavy (No. 6) Fuel Oil	• High sulfur content results in excessive air emissions • Most used fuel for existing base load generation • Substantial fuel storage capacity on Guam to support generation needs	Retained
Liquefied Natural Gas	• Fuel not currently available on Guam in quantities to support generation • Supplier identified that would provide turnkey natural gas supply on Guam; therefore, could be a viable option because the desire is to go for cleaner fuels • Fuel can be transported in liquid form (smaller volume) and gasified at the generation site • Lower emissions than diesel or heavy fuel oil	Retained
Coal	• Fuel not currently available on Guam • Stable fuel cost and historically lower than oil to produce energy • High carbon dioxide emissions • Mercury emissions	Eliminated
Diesel No. 2	• Higher fuel cost than heavy fuel oil or coal • Lower sulfur emissions than heavy fuel oil • Available sources on Guam	Retained
Interconnection Options		
Construct a New PE-Owned/Operated Base load Power Plant on DoD-Provided Land with the Ability to Sell Excess Power to GPA	• Unlikely that GPA would purchase power during low DoD use periods (GPA does not currently have a shortage of power) • Additional cost of backup capacity from GPA could increase energy costs another 10% to 20% • The PE would not be able to increase the size of the facility to serve loads outside of Finegayan (and thus reduce the per-MW capital cost)	Eliminated
Construct a New PE-Owned/Operated Base Load Power Plant for Load on North Finegayan with No Connection to the GPA	• A separate system would require the power producer to provide the necessary system backup and spinning reserve capacity to meet system demands and reliability requirements • The system would require privately owned transmission lines to deliver power to remote load locations for loads associated with the Marine Corps relocation, and would require the associated rights-of-way for these transmission line routes • The facility design requirements would include additional standby generation units to address reliability criteria required by the DoD facilities	Eliminated

Power System Alternative	*Evaluation Considerations*	*Recommendation*
Construct a New Power Plant at Cabras/Piti—Combination of Repowering Existing Generation Units and New Power Plant and Distribution System, with Base Load Generation Fueled by Coal and Peaking Generation Fueled by Diesel No. 2	• Coal was dismissed as a viable fuel alternative because of the investment in infrastructure, air quality concerns, and inability of coal to benefit the current generating units on Guam • Land is available near the existing generation facilities in Cabras/Piti that is suitable for development of additional generation capacity • The current nonattainment area near Cabras/Piti would require an agreement with GEPA before any progress could be made to site a facility or increase generation capacity in the Cabras area • Fuel storage/availability is convenient because of proximity to the harbor and existing storage (in the case of diesel and No. 6 fuel oil)	Eliminated
Construct a New Power Plant at Cabras/Piti and Related Distribution System Improvements, and Repower Existing Generation Units, with Base Load Generation Fueled by No. 6 Oil or LNG, and Peaking Generation Fueled by Diesel No. 2 or LNG.	• Use of low-sulfur fuel oil or LNG offers the potential to operate within air quality limits for the area • Land is available near existing generation facilities and T&D systems for interconnection with the IWPS • Close proximity to the harbor allows limited overland transportation of fuel or minimal new pipelines to deliver fuel	Eliminated
Construct a New Power Plant at Potts Junction and Associated Distribution System Improvements to Deliver the Power, and Repower Existing Generation Units, with Base Load Generation Fueled by No. 6 Oil or LNG, and Peaking Generation Fueled by Diesel No. 2 or LNG	• The site area would be less impacted by existing air pollution concerns than the Piti/Cabras location • The area is owned by DoD • Either fuel would need to be trucked in or a new fuel line would need to be built for delivery • A new electrical substation adjacent to the new power plant would be required instead of potential upgrades to an existing substation	Eliminated
Place All Generation Planning, Sizing, and Implementation Responsibility with GPA, Possibly by Using Current Generation Capacity (Including Long-Term Higher Use of Combustion Turbine Site Fueled with Diesel) to Meet Power Needs beyond 2015 and Delay New Generation	• GPA would have final decision regarding use of new generation or longer term operation of existing assets. Existing diesel combustion turbines would have higher energy costs because of higher fuel costs. • Current system performance managed by consolidated commission on utilities would be maintained. • Higher energy costs of combustion turbine operation would be passed on to DoD based on input from GPA. • Current projected demand and generation improvements by GPA would meet electrical needs as discussed in the April 2010 Study.	Retained

Legend: AFB = Air Force Base; DoD = Department of Defense; GEPA = Guam Environmental Protection Agency; GPA = Guam Power Authority; IWPS = Island-Wide Power System; kW = kilowatt; LNG = Liquefied Natural Gas; mph = miles per hour; MW = megawatt; SPE = Special Purpose Entity; T&D = Transmission and Distribution.
Source: NAVFAC Pacific 2010f.

2.1.3.1 Construct a New SPE-Owned/Operated Base Load Power Plant on DoD-Provided Land with the Ability to Sell Excess Power to GPA

This alternative anticipates that a PE would construct a new power-generating facility (on DoD-provided land) to meet the anticipated load requirements for the Marine Corps relocation to Guam. The facility would be configured primarily to provide energy to support DoD loads and would include the ability to sell excess power to GPA. The facility would rely on GPA for backup power requirements.

This alternative was dismissed because of the following primary issues:

- It is unlikely that GPA would purchase power during low DoD use periods. (GPA does not currently have a shortage of power generation that would require such a purchase and needs to maximize use of current assets to cover the cost of the facilities.)
- The additional cost of backup capacity from the GPA could increase energy costs by another 10% to 20%.
- The PE would not be able to increase the size of the facility to serve loads outside of Finegayan (and thus reduce the per-MW capital cost). The customer base would be limited to Finegayan and the amount of power that the GPA would agree to purchase. (Although the system would be sized to meet peak requirements, it would operate at that level for only a small percentage of the time and thus would not maximize output and minimize cost.)

2.1.3.2 Construct a New SPE-Owned/Operated Base Load Power Plant for Load on North Finegayan with No Connection to the GPA

This alternative would establish a separate grid system for planned loads. One of the main issues associated with this approach is backup power and system reliability. In general, a power facility with a firm capacity of 60 MW (e.g., three 20-MW units) would require installation of two additional 20-MW units so that one unit could be removed from service, a second unit could fail, and the 60-MW firm capacity rating could still be met. This would enable the system to provide sufficient capacity for stand-alone power with standby capacity, allowing for maintenance of duty units and continued operation should a duty unit fail unexpectedly. The system's reliability would also be affected by the distribution system design. Most distribution systems provide multiple paths to provide power to a location. The number of paths would depend on the voltage level and type of equipment located at the point in question.

Either of these two issues (generation and distribution) would have a tremendous effect on the installed cost for this alternative. The installed generation capacity could be up to double the estimated demand to meet reliability requirements. Moreover, to maintain an equivalent level of redundancy with the existing GPA transmission system, the distribution system would need to be designed with alternate feeders to be used should the primary feeder fail.

Several other major considerations make this alternative undesirable:

- A separate system would require the power producer to provide the necessary system backup and spinning reserve capacity to meet system demands and reliability requirements.
- The system would require privately owned lines to deliver power to the Finegayan load locations associated with the Marine Corps relocation, and would require the associated rights-of-way for these routes if not on DoD land.
- The facility design requirements would include additional standby generation units to address reliability criteria required by the DoD facilities.

These issues would result in a cost basis that cannot provide a competitive power cost to the new customers associated with the Marine Corps relocation. This option was therefore eliminated from further consideration.

2.1.3.3 Construct a New Power Plant at Cabras/Piti—Combination of Reconditioning Existing Generation Units (20-40 MW) and New Power Plant and Distribution System, with Base Load Generation Fueled by Coal and Peaking Generation Fueled by Diesel No. 2

Coal is a cheaper fuel option than oil, but carries with it some other burdens. Coal use would require a large investment in material handling infrastructure to transport, unload, transfer, and store coal near the new power plant. These activities would require a substantial amount of space. Because this location is currently considered a nonattainment area with regard to air pollution, implementation of this alternative would likely require state-of-the-art combustion such as a fluidized bed that refers to the combustion chamber/process for a boiler system, in combination with exhaust cleanup technologies such as electrostatic precipitators and wet scrubbers. Even with these features, exhaust from the existing oil-fired generators would likely need to be cleaned up to prevent degradation in the region's air quality.

In considering potential new fuel sources, coal offers a viable new and more economical source for only the new power plant. Diesel generators cannot be converted to coal use except through coal liquefaction or gasification, which are both more expensive than oil.

Coal was dismissed as a viable fuel alternative because of the cost of the infrastructure, air quality concerns, and the inability of coal to benefit the current generating units on Guam.

2.1.3.4 Wind Power

Wind turbines for electrical generation are commercially available in sizes from 25 kW to 3,000 kW. Based on review of the available wind studies for Guam, the best areas for wind development for the military are Andersen Air Force Base (AFB) in northern Guam, the ridgeline at the Naval Munitions Site, and the Orote Peninsula at Naval Base Guam in central Guam. Long-term historical wind data are not available for Andersen AFB. Data are available for the Guam Airport: however, winds there average 11 miles per hour (mph) (18 kilometers per hour [kph]) at 164 feet [ft] [50 meters (m) above ground]). Based on a wind-speed scale of Class 1 to Class 5 (with 5 being the best), these speeds achieve only a Class 2 rating. A minimum wind-speed rating of Class 3 (average wind speed of approximately 15 mph [24 kph.]) is generally considered necessary to prove cost effective based on current capital costs.

Because a unit of power varies proportionally with the cube of the wind speed, a 12-mph (19-kph) wind-speed site would have only one-half the potential wind power output of a 15-mph (24-kph) wind-speed site. However, because electrical costs on Guam are much higher than those in the U.S., 12-mph (19-kph) wind speeds may be adequate to make this wind development viable. This fact was also weighed against the much higher construction costs for Guam, compared with average costs in the U.S.

Consideration was also given to typhoon wind requirements. Facility design for Guam requires the ability to withstand 180-mph (290-kph) winds. Although some wind-power towers have been developed in Japan for typhoon conditions, few have withstood typhoon winds to provide a basis for a proven tower design.

Wind energy provides the benefit of being a renewable and sustainable energy source that is nonpolluting. However, visual aesthetics and the large land area required for siting the wind turbines are major considerations. In addition, this energy source is intermittent depending on the actual wind speeds present at the site, and cannot be used as a reliable means of power generation to serve as a continuous-duty or even backup source of power. For these reasons, wind power generation was eliminated from further consideration for base load power generation. However, wind energy could be used to supplement the base load power generation.

2.1.3.5 Photovoltaic Energy (Solar)

The majority of photovoltaic panels for electrical generation are commercially available in crystalline, polycrystalline, and amorphous silicon panels. A residential system is typically 2 kW and commercial applications are typically 50 kW or larger. Inverters are used to convert the direct-current power output from the panels into alternating-current power. Most of these systems are installed on houses or buildings, and supply the power at 120 or 220 volts.

Based on the available solar insulation data for Guam made available by National Renewable Energy Laboratory, a majority of the U.S. military lands on Guam are in areas with an average of 5.08 kilowatt hours per square meter (m^2) per day (or the amount of solar energy that strikes a square meter of the earth's surface in a single day). However, large land or large rooftop areas are required for panel installation. As a rule of thumb, 1 kW of power output requires 100 square feet (ft^2) (9 m^2) of roof area. A 5-MW system would thus require 500,000 ft^2 (152,400 m^2) of area; a 50-MW system, 5,000,000 ft^2 (465,000 m^2). In addition, this energy source is available only during sunlight hours, and is intermittent depending on the weather.

Consideration was given to the wind design requirements associated with typhoon regions. Facility design for Guam requires the ability to withstand 180-mph (290-kph) winds. Photovoltaic systems can be installed with mechanisms that rotate panels and minimize exposure to wind but damage from wind driven objects would be likely during a typhoon.

Consequently, photovoltaic energy cannot be used as a reliable means of continuous-duty or even backup power generation; therefore, solar energy generation was eliminated from further consideration for base load power generation. However, photovoltaic energy could be used to supplement the base load power generation.

Although photovoltaic power generation would not be used for baseline power needs, it may be used for incremental usage. Solar hot water heaters and photovoltaics are being considered for individual buildings including housing and office buildings.

2.1.3.6 Biofuel (Biodiesel) Power

Biofuels, ethanol, and hydrogen can be burned in power-generating turbines or engines principally designed to use fossil fuels. CTs can operate on ethanol or biodiesel, gas engines can operate on ethanol, and diesel engines can operate on biodiesel fuels. Examples include a simple or combined Brayton cycle CT (originally developed for aircraft jet engine technology); reciprocating gas or diesel engine technology can also be employed.

Air emissions from biofuel power plants would be lower than from power plants burning conventional fossil fuels. Improvements in air emission control technology such as low-nitrogen-oxide control burners would further reduce emissions of nitrogen oxides. Further reduction in air emissions is possible with the use of water or steam injection, or with the use of selective catalytic reduction technology. However, these additional emission controls add substantial capital and operational maintenance costs.

Currently, no agricultural business on Guam is developing crops for the biofuel market, and no producers of biofuel are present on Guam. At present, 20% of the land on Guam is used for agriculture, and another 15% is used for pastureland. Although some potential exists for further development, the implementation of biofuel power on a sustainable basis is not realistic at this time. In addition, there are no current biofuel importers on Guam. Thus, biofuels would need to be imported to Guam if they are to be used in the immediate future; therefore, biofuel power generation was eliminated from further consideration.

2.1.3.7 Fuel Cell Power

Fuel cells operate on the chemical reaction between hydrogen and oxygen that produces electricity, and water as a byproduct. Although a few DoD lands using fuel cell power are in operation, the technology is still in commercial development. Although they are also nonpolluting, fuel cells rely on hydrogen as their fuel source. The potential of fuel cell technology to provide reliable power is limited because of the high cost and lack of applications for systems other than small (less than 500-kW) system capacity.

Hydrogen is not commercially available as a fuel source, and extracting hydrogen from water and/or the reducing gas or other fuels into hydrogen requires additional equipment and is energy intensive. Natural gas is often used as a fuel stock for the fuel cells. However, because Guam lacks natural gas resources, the natural gas would need to be imported if it is to be used.

Because this technology is not yet commercially available, and because sustainable sources for the production of hydrogen fuel have not yet been developed and the quantity that could be produced would be limited, the use of fuel cell generators is not recommended at this time; therefore, fuel cell power generation was eliminated from further consideration.

2.1.3.8 Wave-Energy Generation

Wave-energy generators extract the energy carried in ocean waves that flow across the coastline, principally through mechanical action. Wave-energy generators are not commercially available; however, a wave-energy demonstration project sponsored by DoD is being constructed offshore from Marine Corps Base Hawaii. Although wave-energy generators are nonpolluting and renewable, the amount of power extracted from these units would be intermittent and dependent on the strength of the ocean waves. These units cannot be used to provide a reliable means of power for continuous-duty, peak shaving, or emergency power generation; therefore, wave-energy generation was eliminated from further consideration.

2.1.3.9 Waste-to-Energy Conversion

Conventional WTE power plants are steam power plants that sort and burn solid wastes. Because the wastes are normally burned to generate steam (which drives a turbine generator), air emissions are a primary issue. The typical needs for combustion air-emission controls and scrubbing of the waste-exhaust air stream add to the complexity and operating costs for this type of system.

Alternative technologies to conventional WTE steam power plants include gasification, smelting, and plasma-arc technologies. However, none of these competing technologies are yet available in the commercial market.

This alternative was dismissed because under Guam Public Law 25-175, it is unlawful for any person to construct or operate a municipal solid waste incinerator or WTE facility on Guam, as defined by the rules and regulations of the U.S. Environmental Protection Agency (USEPA) or U.S. laws. However, this alternative would still be considered as a supplemental energy source if the law prohibiting operation of a WTE facility were to change to support this technology.

2.1.3.10 Long-Term Renewable-Energy Concepts

Implementation of the renewable-energy concepts discussed below would require additional studies. However, these sources of renewable energy have the potential to provide supplemental power for long-term solutions, given Guam's available resources and available technology. Because these energy concepts may be considered viable as the technology matures, they are being carried as notional options for renewable alternative-energy sources for long-term power solutions.

Ocean Thermal Energy Conversion

OTEC is a method for generating electricity that uses the temperature difference between deep and shallow waters to run a heat engine. As with any heat engine, the greatest efficiency and power is produced with the largest temperature difference. This temperature difference generally increases with decreasing latitude (i.e., near the equator, in the tropics). OTEC systems utilize this temperature gradient between warm surface-ocean waters and cold deep-ocean waters to drive an ammonia-closed cycle, an open cycle, or a combined-cycle power plant. Although none of these systems are in commercial production, the technology has been proven several times. In 1979, a 50-kW demonstration plant was operated at the National Energy Laboratory of Hawaii Authority. This plant generated 50 kW of gross power and a net power of 10 kW, with about 40 kW required for pumping. Although this plant is not currently operating, the Navy is examining a barge-mounted OTEC facility for its Diego Garcia base. A 1-MW net power output production plant is being built at the National Energy Laboratory of Hawaii Authority.

Guam is an ideal location for OTEC because its western coastline fringes on cold deep-ocean water from the Mariana Trench. In fact, a difference of 40 degrees Fahrenheit (22.2 degrees Celsius) can be found between sea level and 3,281 ft (1,000 m) below sea level at a location less than 0.6 mile (1 kilometer) from Guam's shore. This cold ocean water, in conjunction with Guam's warm coastal surface waters, can provide a renewable and sustainable energy source that is nonpolluting. Cold water pumped from the deep ocean can also be used for aquaculture, as a direct cooling source for central chilled-water air conditioning systems, and as a source of freshwater that is generated as a byproduct in open OTEC cycles. Because the supply of deep cold water and warm surface water is available daily throughout the year, OTEC systems could provide a reliable source of power for either continuous-duty or even backup or supplemental power generation.

Geothermal Power Generation

Geothermal power is energy generated from heat stored in the earth, or the collection of absorbed heat derived from underground. Guam is situated several miles east of the southern projection of a historically active line of volcanoes that compose the Mariana volcanic arc. The area is still subject to volcanic activity, with the nearest known active volcanism being an underwater eruption that occurred 100 mi (161 kilometers) north, just south of Saipan. Because the Mariana island chain is at the edge of the subduction zone between the Philippine and Pacific Plates, Guam is subject to frequent earthquakes and tectonic plate movements that make Guam a likely candidate for subterranean volcanic activity and possible geothermal development.

However, there are no known detailed studies or assessment of the geothermal potential for Guam other than a report from the Colorado School of Mines, published in 1975, that provided an overview of the potential for geothermal energy in the Pacific region (Colorado School of Mines 1975). Additional geological studies and drilling are needed to quantify and determine the potential for geothermal development on Guam.

2.1.4 Power Basic Alternative 1 (Preferred)

Power basic alternative 1 was chosen as it utilizes existing GPA generating resources, can be implemented in a timely fashion, and provides adequate power for the proposed relocation and preferred cantonment alternative. Upgrades to T&D facilities would use existing corridors. Not requiring new generating facilities or new T&D corridors renders this a desirable approach, which has been agreed to by GPA. See below for additional details.

It is projected that new power requirements would be the same for all four Main Cantonment alternatives, and only the cantonment locations and thus T&D requirements of the planned DoD facilities would be different. Main Cantonment Alternatives 1, 2, 3, and 8 would require different T&D upgrades to support substantially different load locations. The locations of the currently proposed power sources are shown in Figure 2.1-2.

This alternative would recondition up to five existing permitted GPA CTs to restore the IWPS system to its original design capacity and support required reserve capacity for reliability. These CTs are designated as reserve/peaking units for the power system. Units to be reconditioned would include the CTs at Yigo, Dededo Units No. 1 and No. 2, Marbo, and Macheche. Projected generation requirements to meet demand indicate the ability to serve DoD facilities while maintaining CT operation as dominantly reserve capacity. GPA evaluated an operating scenario that results in CT operation at a maximum of 500 hours per unit per year on average, or 2500 hours per year total for 5 CTs. The 500 hours per unit per year maximum on average was established as a conservative value based on projected generator unit operational data prepared by GPA. This document evaluates generator unit operation by year for years 2010 to 2021 and accounts for all projected demand growth on Guam using 2009 actual data as the baseline (for more details, see Volume 9, Appendix K). A summary of operating hours for the five CTs is presented in Figure 2.1-1.

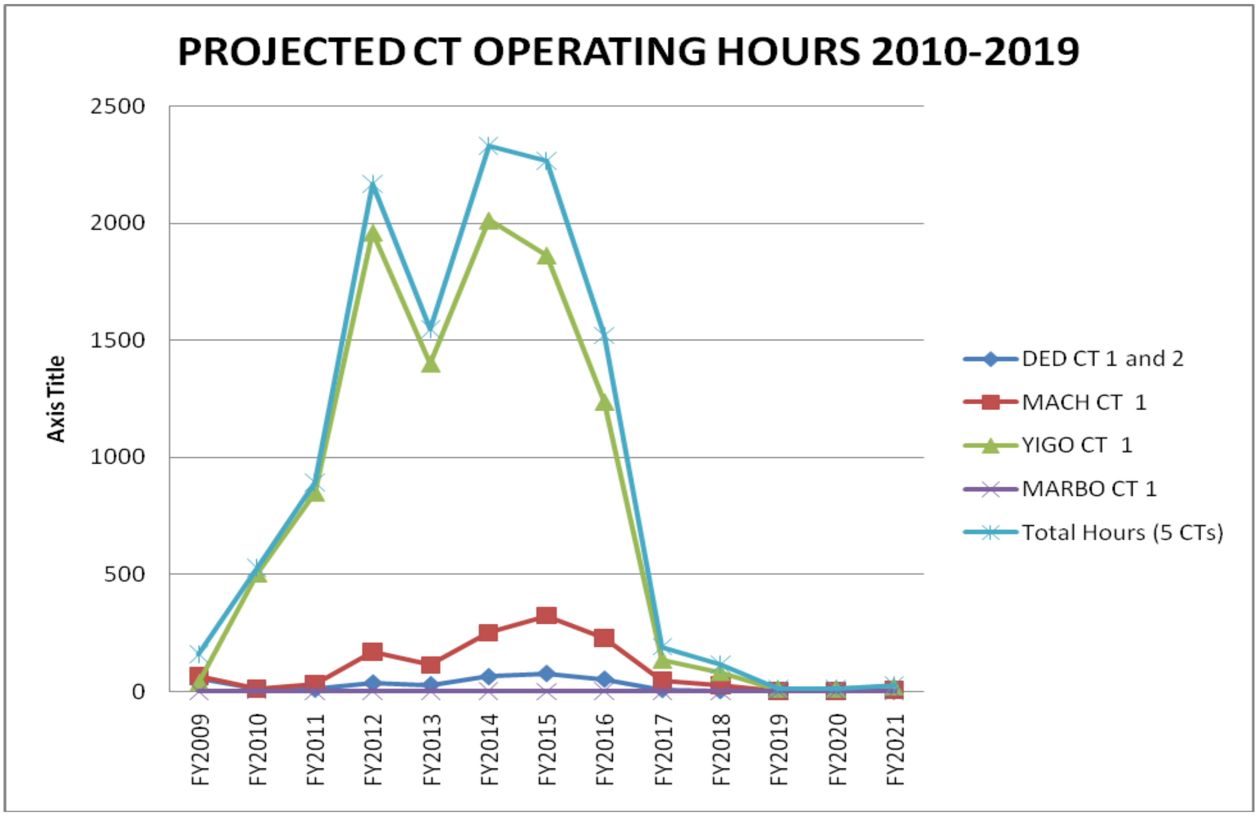


Figure 2.1-1. Projected CT Operating Hours 2010-2019

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Figure 2.1-2
Proposed Power Alternative Locations

This alternative supports Main Cantonment Alternatives 1 and 2. For Main Cantonment Alternatives 3 and 8, the reconditioned CTs selected would remain the same but require additional upgrades to the T&D system to support these Main Cantonment locations as described in Table 2.1-4.

The evaluation of power generation considered islandwide power capacity and requirements. The DoD load calculations include DoD facilities only, but the effects of construction workers and induced civilian growth were considered when evaluating overall IWPS demands as shown in Table 2.1-2 and also in Chapter 3 of this Volume. This increased demand on the IWPS has been estimated by year in order to evaluate the yearly ability of the IWPS to meet the increased demand. The location of workforce housing is currently in flux, with about 9 applications for housing locations and facilities currently submitted to Guam authorities and one facility already starting construction. Necessary localized power T&D upgrades to support workforce housing would be coordinated between the contractor and GPA.

Present requirements for T&D upgrades associated with the military relocation on Guam for the Main Cantonment Alternatives 1 and 2, in addition to elements required for the Main Cantonment Alternatives 3 and 8, are listed in Table 2.1-4. The anticipated transmission facilities are expected to support the Marine Corps relocation and other proposed DoD actions, including non-project actions. The proposed T&D modifications include the following major components identified as part of Cantonment Alternatives 1 and 2:

- North Finegayan Marine Corps facilities
- South Finegayan Marine Corps facilities
- ESG facilities at Naval Base Guam
- Aircraft carrier located at Polaris Point

The Marine Corps relocation results in impacts to the IWPS. The demand increases require a series of T&D upgrades to support T&D of the increased power. Those T&D upgrades are summarized in Table 2.1-4 and include capacity for all anticipated demands.

Each of the listed upgrades was identified while coordinating with GPA during preparation of the Power Generation Study Report (NAVFAC Pacific 2010f) as well as additional meetings. These upgrades were identified as necessary to meet system requirements for voltage and capacity while maintaining two sources of power to each area. The transmission line projects described would upgrade T&D for Guam circuits that impact Yigo, Andersen, Finegayan, Pott’s Junction, Orote, Piti, and Naval Computer and Telecommunications Station (NCTS). These upgrades would be sized to support all Marine Corps projected loads for Finegayan, Andersen AFB, and Main Navy Base to avoid upgrading the same lines twice within a short period of time. The lines follow existing utility distribution rights of way and the new 34.5 kilovolts Harmon/Finegayan/Andersen line would require underground trenching.

The capacitor banks would be installed at existing facility locations (substations, switchgear, or similar locations) and connected to the circuits to improve system voltage regulation. The existing and proposed upgrades to the GPA T&D system for Guam are shown in Figure 2.1-3.

Reconditioning existing CT generation facilities would not require new generating units. This reconditioning would ensure reliability for service as peaking and reserve capacity.

Table 2.1-4. Proposed T&D Upgrades

Item	*Project Description*	*System Overhead/Underground*	*Voltage*
1	Upgrade Piti X20 to Orote X35 line	Overhead	34.5kV
2	Upgrade Harmon X87 to Andersen X73 line	Overhead	34.5kV
3	Upgrade Yigo X160 line to Andersen X70	Overhead	34.5kv
4 and 4A	New Harmon-Finegayan-Andersen Line (via Routes 3 and 9; or Item 4A via Alternate Route 1)	Overhead	115kV
5	New Harmon-Finegayan-Andersen line	Underground	34.5kV
6	New Piti to Orote line	Overhead	115kV
7	New Harmon-Andersen via Route 1 (alternative to item 4 above)	Overhead	115kV
8	New 2-6 MVAR Capacitor Bank at Orote 13.8kV	NA	13.8kv
9	New 2-6 MVAR Capacitor Bank at Andersen 13.8kV	NA	13.8kV
10	New 2-6 MVAR Capacitor Bank at NCTS	NA	13.8kV
11	New Andersen Substation (Anticipated 112 MVA) Power Transformer	NA	115kV
12	New Orote Substation With 112 MVA Power Transformer	NA	115kV
13	New 2-3 MVAR Capacitor Bank at North Ramp 13.8kV	NA	13.8kv
14	Harmon Substation Reconstruction	NA	115kV/34.5kV
15	Piti Substation Reconstruction	NA	115kV/34.5kV
16	New 2-3 MVAR Polaris Point Capacitor Bank	NA	13.8kV
1	AF Barrigada (Eagle Field) Substation located at Air Force Barrigada	NA	34.5kV
2	Line from Barrigada to Air Force Barrigada (Eagle Field)	Overhead	34.5kV
3	Line from Air Force Barrigada (Eagle Field) to Pulantat (essentially re-routing Barrigada to Pulantat 34.5 kV line to go through Eagle Field Substation first)	Overhead	34.5kV
4	Apra to Talofofo Line	Overhead	34.5kV
5	12 MVAR capacitor bank at Air Force Barrigada (Eagle Field) for voltage support.	NA	13.8kV
6	6 MVAR capacitor bank at Navy Barrigada for voltage support	NA	13.8kV

Legend: kV = kilovolt; MVA = mega volt ampere; MVAR = mega volt ampere reactive; NA = not applicable; NCTS = Naval Computer and Telecommunications Station.

2.1.5 Energy Efficiency and Renewable Energy Initiatives

Energy efficiency and renewable energy power generation are both aspects that would allow the DoD to meet the goals set by Executive Orders and Energy Policy Act of 2005 (EPA Act 2005) to reduce energy consumption and increase use of alternative energy sources. Part of the design basis for planned facilities in Guam would be to meet Leadership in Energy and Environmental Design (LEED) silver design goals. This approach would reduce energy consumption in planned facilities. Additional energy goals require sourcing power from renewable resources. The reduction in energy consumption is expected to be more than 10% based on the information presented below.

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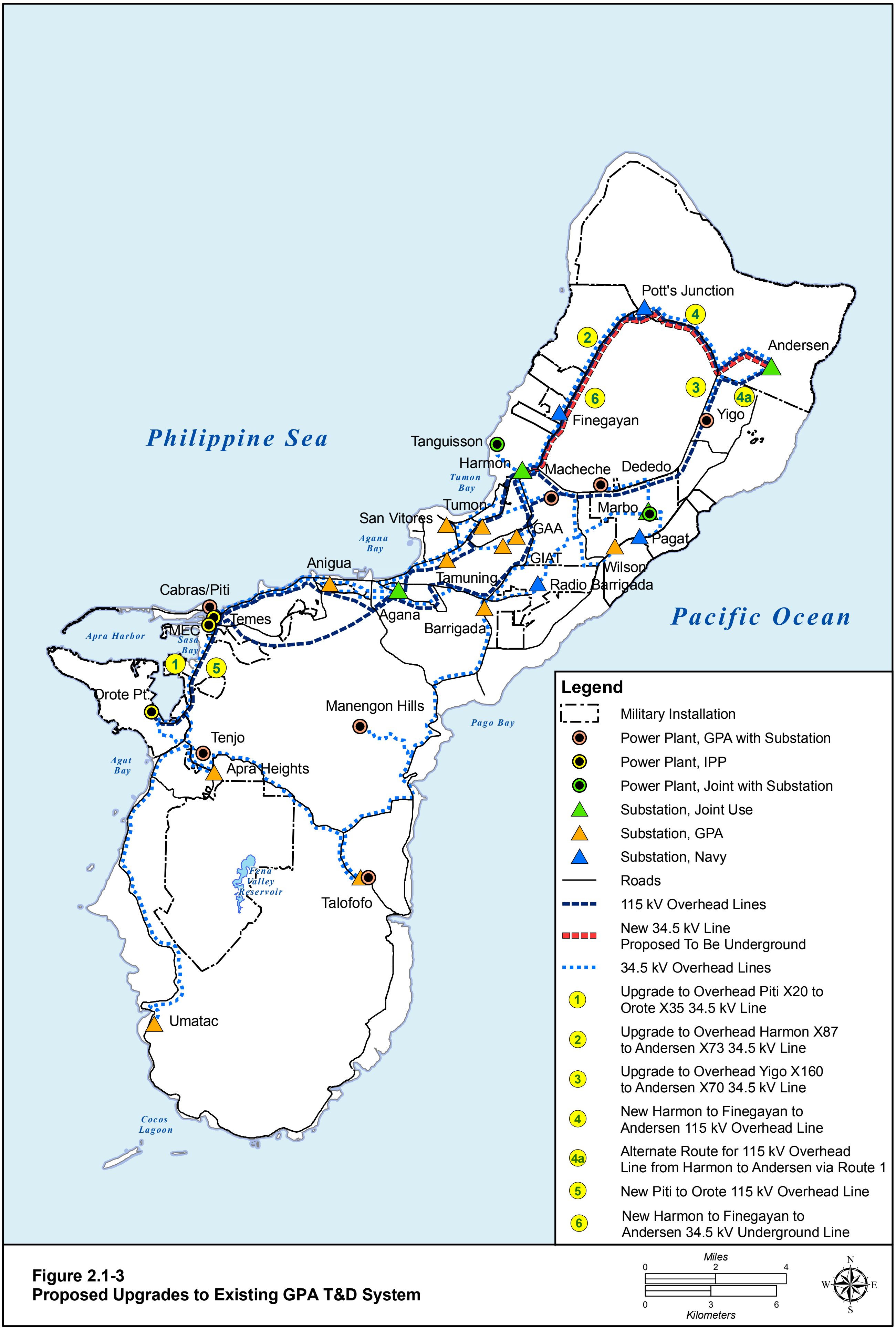

Figure 2.1-3
Proposed Upgrades to Existing GPA T&D System

A comprehensive energy management plan is being developed for Guam to support the on base development related to the military relocation. The plan has interest from several federal executive departments and would focus on the following: reducing the energy consumption of DoD infrastructure, a “Nega Watt” approach, and the development of renewable energy sources for Guam. Nega Watt and renewable energy efforts would be coordinated closely with GPA. The strategy is comprised of the following basic elements with a listing of some of the measures being taken with respect to existing and proposed facilities:

a. Conservation and demand reduction:

Existing Infrastructure	Relocation Infrastructure
Facility Energy Audits	Smart Metering on all buildings
Energy Conservation Programs	Demand reduced through sustainability
Energy Conservation Investment Program	User training and education
	Smart base technology

b. Sustainable Design/Development Strategies

Existing Infrastructure	Relocation Infrastructure
LEED projects being implemented	All Facilities LEED Silver
Sustainable Program Officer	
Sustainable Systems Integration Modeling	

c. Sustainable Infrastructure

Existing Infrastructure	Relocation Infrastructure
Foot Print Reduction	Low Impact Development
Adaptive Reuse of Facilities	Integrated Site Design
Brown Field Development	Passive Solar Orientation
	Carbon Sequestration
	Reuse of Construction and Demolition Debris
	Transportation Demand Management

d. Renewable Energy

Existing Infrastructure	Relocation Infrastructure
Solar Hot Water System Conversions	Solar Hot Water Systems
Integrated Solar Photovoltaic Systems	Photovoltaic Compatible Facilities
	Renewable Energy Studies

UFC incorporate energy conservation standards and policy from various Executive Orders and public laws to provide guidance and goals for new and renovated DoD facilities. These conservation measures would result in a reduction in the increased demand for utilities. Many of these conservation standards and policy were initiated in compliance with the EPA Act 2005. The following provisions would be incorporated into the planning, design and construction of DoD facilities:

- New Bachelor Enlisted Quarters (BEQ) and Bachelor Officer Quarters would be designed and constructed in accordance with the EPA Act 2005.
- New buildings (excluding residential areas) would be designed to comply with American Society of Heating, Refrigerating and Air Conditioning Engineers Standard 90.1. Based on UFC guidance, the building design would also strive to achieve an energy consumption level that is 30% below American Society of Heating, Refrigerating and Air Conditioning Engineers Standard 90.1.
- New residential buildings would be designed to comply with the International Code Council International Energy Conservation Code. Based on UFC guidance, the building design would

also try to achieve an energy consumption level that is 30% below International Energy Conservation Code standards.

- All new purchases of energy consuming products would be either Energy Star-qualified or Federal Energy Management Program-recommended.
- Relevant energy conservation measures to be considered include:
- Optimizing building orientation to reduce cooling loads or energy loads to cool the buildings
- Building insulation optimization
- Sealing building envelope for air tightness
- “cool roof”
- Using motion detectors to reduce lighting and to setback cooling in unoccupied buildings
- Natural Lighting
- Energy compliance analysis and life cycle cost analysis:
- Systems modeling is being used to analyze usage of energy conservation measures and provide comparative life cycle costs. This process comprehensively examines energy, water, transportation, ecological resources, green building, social/cultural and economic factors. Within the parameters of energy, this modeling evaluates: building insulation; windows; infiltration; lighting; heating, ventilation, and air conditioning systems; delivery efficiency; water use; conventional water heating; solar thermal water heating; and building integrated Photovoltaics. This modeling approach follows a three step process:
- First it considers measures to make the building work more efficiently. This includes orientation, solar shading/high performance facades, and building envelope/air tightness considerations.
- Secondly, use of various levels of system efficiencies is considered, analyzing energy usage, capital, and life cycle costs.
- Thirdly, it considers what potential renewable systems could be utilized for the specific location and facilities.
- To date, this analysis has been performed on two types of buildings: BEQ and duplex housing. The modeling analysis has thus far resulted in the following estimates of energy savings:
- BEQ – 31% savings for \$1.88/ft^2
- Duplex House – 32% savings for \$4.93/ft^2

The DoD is committed to meet the required 30% energy savings and has identified approaches to reach this goal. The areas that would allow meeting that goal for the BEQ are listed in Table 2.1-5.

The modeling has validated that it is possible to meet the 30% energy reduction at a minimal cost resulting in a lower energy footprint for the new facilities. The DoD is committed to meeting the 30% reduction and would be looking to leverage additional savings where deemed appropriate and affordable on a facility by facility basis. Since the energy compliance behavior of the occupants, proper maintenance of systems, and other life cycle aspects would play a major role in the ability to sustain the full savings, the power demand requirements used for planning purposes provided to GPA were conservatively reduced by 10% instead of the 30% energy savings goal. This conservative approach would cover unknown contingencies and provide GPA with reasonable planning data to address the new demand requirements in a cost effective manner.

Table 2.1-5. Approaches Associated With Achieving 30% Reduction in Facilities Demand

Package Summary	*Baseline*	*Efficiency Approach*
BEQ Energy Modeling Summary		
Windows	Code Minimum	High Efficiency
Infiltration	0.5 ACH	0.25 ACH
Lighting	100% Incandescent Fixtures	50% Incandescent/ 50% Compact Fluorescent
HVAC	Standard Efficiency Packaged Terminal AC	High Efficiency Packaged Terminal AC
DHW Use Reduction	USEPA 1992 Baseline	40% DHW Reduction
Environmental Benefit and Cost Indicators		
% Energy Use Improvement	NA	31.20%
% CO_2 Emissions Improvement	NA	31.20%
Additional Capital Cost ($\$/ft^2$)	NA	$\$1.88/ft^2$
Simple Payback Years	NA	~2

Note: Baseline Defined as ASHRAE 90.1.

Legend: AC= air conditioning; ACH = air flow change rate; BEQ = Bachelor Enlisted Quarters; CO2 = carbon dioxide; DHW = domestic hot water; ft2 = square feet; HVAC= heating, ventilation, and air conditioning; NA = not applicable; USEPA = United States Environmental Protection Agency.

NAVFAC Marianas with the DoD is working to implement alternative energy projects in Guam to lower the use of conventional generation. A contract was awarded with Johnson Controls to replace HVAC equipment, install a grid connected solar photovoltaic system to produce as much as 3% of the energy consumed on base (Naval Base) and similar energy efficiency improvement measures with the anticipated reduction of energy consumption by 6.4MWh per year. Additional work has been done to lay the foundation of a wind energy project planned for the Navy Ordinance Annex area to produce up to 4MW of wind energy. Preliminary data gathering has been done for the area and work is proceeding to implement a wind energy project. While these initiatives are not part of the proposed action, they provide examples of energy reduction projects and alternative energy sources that are being implemented on Guam and reduce power demands on the IWPS.

2.2 POTABLE WATER

2.2.1 Overview

The proposed actions on Guam would be located at Andersen AFB, NCTS Finegayan, South Finegayan, Andersen South, Barrigada, and Naval Base Guam. These areas are currently served by the DoD potable water systems of Andersen AFB and Navy.

2.2.2 Anticipated Demand

Population loadings used to calculate the projected future demand included active duty Marine Corps, Army, and Navy personnel and their dependents, transient personnel associated with the aircraft carrier group and the ESG (non-concurrent transient demand), and demands associated with on-base civilian support workers. These are considered direct actions associated with the proposed military relocation. Table 2.2-1 lists the DoD populations for the military relocation. The EIS considered four main cantonment alternatives. Assessment of the water utilities grouped the main cantonment alternatives by military housing locations for the Marine Corps Base. Main Cantonment Alternatives 1 and 2 have military housing at Finegayan only. Main Cantonment Alternatives 3 and 8 have military housing at Finegayan, Navy Barrigada, and Air Force Barrigada. More information on the main cantonment alternatives is provided in Volume 2.

Table 2.2-1. Department of Defense Population Increases

Population Type	*Baseline*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Project-Related Cantonment Alternatives 1 and 2											
Active duty	33	535	1,220	1,220	1,220	8,602	9,182	9,182	9,182	9,182	9,182
Dependents	52	537	1,231	1,231	1,231	9,000	9,950	9,950	9,950	9,950	9,950
Transient	0	0	400	400	400	2,000	2,000	2,000	2,000	2,000	2,000
Civilian Work Force	12	102	244	244	244	1,720	1,836	1,836	1,836	1,836	1,836
Finegayan Total	**97**	**1,174**	**3,095**	**3,095**	**3,095**	**21,323**	**22,968**	**22,968**	**22,968**	**22,968**	**22,968**
Project-Related Cantonment Alternatives 3 and 8											
Active duty	33	395	884	884	884	6,239	6,659	6,659	6,659	6,659	6,659
Dependents	52	179	410	410	410	3,000	3,317	3,317	3,317	3,317	3,317
Commuters from Barrigada	0	140	335	335	335	2,364	2,523	2,523	2,523	2,523	2,523
Transient	0	0	400	400	400	400	2,000	2,000	2,000	2,000	2,000
Civilian Work Force	12	92	220	220	220	1,548	1,653	1,653	1,653	1,653	1,653
Finegayan Total	**97**	**806**	**1,850**	**2,250**	**2,250**	**13,551**	**16,152**	**16,152**	**16,152**	**16,152**	**16,152**
Active duty	0	140	335	335	335	2,364	2,523	2,523	2,523	2,523	2,523
Dependents	0	358	821	821	821	6,000	6,633	6,633	6,633	6,633	6,633
Transient	0	0	0	0	0	0	0	0	0	0	0
Civilian Work Force	0	10	24	24	24	172	184	184	184	184	184
Barrigada Total	**0**	**508**	**1,180**	**1,180**	**1,180**	**8,535**	**9,340**	**9,340**	**9,340**	**9,340**	**9,340**
Nonproject-Related Cantonment Alternatives 1, 2, and 3 and 8											
Active duty	2,145	80	80	80	80	120	120	120	120	120	120
Dependents	2,950	118	118	118	118	210	210	210	210	210	210
Transient	0	900	900	1,256	1,256	1,256	1,256	1,256	1,256	1,256	1,780
Civilian Work Force	805	17	17	17	17	25	25	25	25	25	25
Andersen AFB Total	**5,900**	**1,115**	**1,115**	**1,471**	**1,471**	**1,611**	**1,611**	**1,611**	**1,611**	**1,611**	**2,135**
Active duty	4,490	0	0	0	50	50	130	130	130	130	330
Dependents	5,410	0	0	0	30	30	80	80	80	80	80
Transient	0	0	0	0	0	0	7,222	7,222	7,222	7,222	7,222
Civilian Work Force	1,684	0	0	0	10	10	13	13	13	13	20
Navy Bases Total	**11,584**	**0**	**0**	**0**	**90**	**90**	**7,445**	**7,445**	**7,445**	**7,445**	**7,652**

Notes: 1. 7,222 transients at Apra Harbor are housed on ships. Water utilities are provided dockside for the ships. 2. Civilian workforce does not include construction workers. The civilian workforce lives off base.

Legend: AFB = Air Force Base.

The future induced civilian population and construction workers are not included in the DoD populations. The induced population, construction workers, civilian workers, and their dependents are expected to be housed off base and are considered indirect or induced actions associated with the proposed military relocation. The demand calculation for GWA is provided in Section 2.2.2.2 and includes the induced population and construction workers and dependent water demands anticipated off base. The estimated indirect future water demand on the GWA system from the off-base induced population and the construction workers is presented in Section 2.2.2.2. The estimated indirect impacts to the GWA water system from the civilian population growth is examined and discussed in Volume 6, Chapter 3.

2.2.2.1 On-Base Water Demand

On-Base Water Demand with Current DoD Criteria Demand Calculation

The demand calculations presented in Water, Wastewater, and Solid Waste Management Impact Assessment for GJMMP, Guam (Helber Hastert & Fee, Planners, Inc. 2006) are the basis for the calculation of anticipated on-base water demand below, with modifications as necessary.

The water capacity for the water system to support the new Marine Corp Base was calculated using the UFC 3-230-19N guidance, UFC Design: Water Supply Systems (DoD 2005). System capacity calculations include total requirements for domestic, industrial, fire protection, and unaccounted for water (UFW) demands for the military relocation population in year 2019. The UFC guidance provides a means of estimating water demands considering primarily water uses, peak demands, and climatic effects. The quantity estimate is the basis for sizing components of the facility using factors prescribed in the UFC guidance. The guidance document was developed from an evaluation of facilities, and best design practices and standards of the military, national professional societies, associations, and institutes. Because the design would incorporate sustainability and water conservation practices, water consumption is expected to be less than estimated by UFC guidance. An estimate of water usage incorporating sustainability and water conservation practices is provided later in this section.

Estimates for potable water demand for the direct DoD on-base population were made based on DoD UFC guidance (DoD 2005). Per capita (person) requirements for domestic potable water uses including drinking water, household uses, and household lawn irrigation for permanent and temporary installations (DoD 2005) are as follows, with the per capita requirements for the tropics selected for Guam:

- Unaccompanied Personnel Housing, 155 gallons per capita per day (gpcd)
- Family Housing, 180 gpcd
- Transients and On-Base Workers Living Off Base (per shift), 45 gpcd

The average domestic demand in gallons per day (gpd) is calculated by Equation 1:

Equation 1

$$\text{Average daily domestic demand in gpd} = \text{gpcd} \times \text{design population} \times \text{growth factor}$$

The following growth factors are used in Equation 1:

- Large systems (5,000 population or greater), 1.25.
- Small systems (populations less than 5,000), 1.50.

Total average demand is the sum of average demands for unaccompanied personnel housing, family housing, and workers. Other controlling demands are calculated by Equation 2:

Equation 2

Maximum Daily Domestic Demand = average daily domestic demand in gpd x K

Where

K is 2.25 for populations $< 5{,}000$ and 2 for populations $> 5{,}000$.

Visiting ships docked at Apra Harbor would be connected to the Navy islandwide water system for potable water. Potable water requirements for visiting ships are included in the domestic demand based on transient populations as described in Volume l4 of the EIS for aircraft carriers and UFC 4-150-02 (DoD 2003) for other visiting ships. Visiting ship-related water demand of 0.44 MGd (1.66 MLd) is included in the Navy demands.

It is assumed that the water demands for the services would be addressed by the DoD water systems as follows:

- Marine Corps—Finegayan Base Complex water system and Navy islandwide system
- Air Force—Andersen AFB water system
- Navy—Navy islandwide water system
- Army—Finegayan Base Complex water system
- U.S. Coast Guard—Navy islandwide water system
- Special Operations Force—Finegayan Base Complex water system, Navy islandwide water system, and Andersen AFB water system

Two basic scenarios for housing the Marine Corps are examined: (1) entirely within the Finegayan Base Complex (Main Cantonment Alternatives 1 and 2), or (2) split between the Finegayan Base Complex, Navy Barrigada, and/or Air Force Barrigada (Main Cantonment Alternatives 3 and 8). Main Cantonment Alternative 2 was taken as representative for both Alternatives 1 and 2, and Alternative 3 was taken as representative for both Alternatives 3 and 8.

Industrial water uses include air conditioning, irrigation, swimming pools, shops, laundries, dining, processing, flushing, and boiler makeup water. Demands for air conditioning were assigned according to the values in UFC 3-230-19N (DoD 2005). Additionally, UFC 3-230-19N (DoD 2005) requires the use of water demand data from other activities with uses similar to those anticipated. The industrial demands for the facilities not covered by UFC 3-230-19N (DoD 2005) were assigned a demand based on the measured demands for similar facilities within the existing Navy bases. The future estimated average daily industrial use is 1.2 MGd (4.5 MLd) at the Finegayan Base Complex. This demand includes 225 gallons per minute (851 liters per minute) for use in on-base power generation. The industrial demands for Main Cantonment Alternatives 3 and 8 are similar to the industrial demands estimated for Main Cantonment Alternatives 1 and 2. There is a water demand on the Navy bases of 0.05 MGd (0.19 MLd) for ship washdowns. The water demand related to construction is not included in the DoD water demand estimates. The construction-related demand is relatively low (0.05 MGd [0.19 MLd]) and for this analysis is assumed to be supplied by the contractor through the GWA water system. The DoD could provide the construction-related demand through the DoD water system depending upon location of available sources and water availability from GWA. Industrial demands are summarized in Table 2.2-2.

Table 2.2-2. Future DoD Industrial Demands

Industrial Demands (MGd)	*Marine Corps Finegayan Base*	*Andersen AFB*	*Navy Bases*
Existing	0.1	0.76	3.8
Marine Corps Relocation	0.8	0.07	0.02
Additional from Projects In Progress	0	0.17	0.73
Washdown 25,000 gallons over 5 days	0	0	0.05
225 gpm for Power Generation	0.32	0	0
Total Industrial	1.2	1	4.6

Legend: AFB = Air Force Base; gpm = gallons per minute; MGd = million gallons per day.

UFW is water that is not metered, and includes water loss due to leakage in the distribution system, tank overflows, water connections that are not documented or billed, theft, and inaccurate metering. UFW is derived by subtracting the amount of water measured by meters, from the water that is produced from the treatment plants and wells and net changes in water storage tank inventories. Most water utilities, policymakers, and associations such as the American Water Works Association consider a 10% to 15% UFW loss to be acceptable. However, the utility reports for the DoD facilities indicate Navy and Air Force systems currently have higher loss rates. Estimates of the existing UFW rates from base personnel were used in the demand calculations. The DoD UFW rates are shown in Table 2.2-3. The existing UFW rate for the Navy is 25%. The existing UFW rate at Andersen AFB is 50%.

Table 2.2-3. DoD Unaccounted for Water

Facility	*Existing UFW*
Existing Navy [a]	25%
Existing Andersen AFB [b]	50%
Future Additional Navy	15%
Future Additional Andersen AFB	50%
Future Marine Corp Base	5%

Legend: AFB = Air Force Base; [a] Personal Communication (Barker 2010), [b] Personal Communication (McKnight 2010).

A UFW of 15% is assumed for additional demands at the Navy islandwide system because the growth is confined to Apra Harbor and water would not be transmitted across island putting this estimate at the high end of the acceptable UFW range. The UFW of 50% is kept for additional demands at Andersen AFB because the proposed action does not include replacement of existing T&D water lines. However, the actual UFW for Andersen AFB in the future is likely to be lower because plans are in discussion to replace portions of the aging water mains including the line from Andersen South Annex to the main base. A UFW of 5% is assumed for Marine Corps relocation areas at the proposed new Marine Corps Finegayan base and Barrigada because the water systems would be brand new, there would be more meters installed to monitor water use, and conservation and sustainability concepts would be integrated into the design of facilities which include measures to prevent water loss. The future UFW demands for the Marine Corps relocation are shown in Table 2.2-4.

The anticipated DoD water demands are summarized in Table 2.2-5.

Table 2.2-4. Future DoD UFW

	Marine Corps Finegayan Base (MGd)	*Andersen AFB (MGd)*	*Navy Bases (MGd)*
Average UFW Demand	0.3	1.1	3.2
Maximum UFW Demand	0.5	1.6	3.7

Legend: AFB = Air Force Base; MGd = million gallons per day; UFW = Unaccounted for Water; Marine Corps = United States Marine Corps.

Table 2.2-5. Projected Future DoD Water Demands

	Baseline	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Average Daily Demand (MGd)											
Cantonment Alternatives 1 and 2											
Finegayan	0.13	0.32	1.00	1.40	1.79	4.73	5.02	5.02	5.02	5.02	5.95
Andersen AFB	2.14	2.29	2.41	2.56	2.68	2.71	2.71	2.71	2.71	2.71	3.19
Navy	8.10	8.10	8.41	8.71	9.03	9.03	9.57	9.57	9.57	9.57	10.14
Total	10.37	10.71	11.81	12.67	13.50	16.48	17.30	17.30	17.30	17.30	19.28
Cantonment Alternatives 3 and 8											
Finegayan and Barrigada	0.13	0.33	1.03	1.42	1.82	4.90	5.20	5.20	5.20	5.20	6.18
Andersen AFB	2.14	2.29	2.41	2.56	2.68	2.71	2.71	2.71	2.71	2.71	3.19
Navy	8.10	8.10	8.41	8.71	9.03	9.03	9.57	9.57	9.57	9.57	10.14
Total	10.37	10.72	11.84	12.69	13.53	16.65	17.48	17.48	17.48	17.48	19.51
Maximum Daily Demand (MGd)											
Cantonment Alternatives 1 and 2											
Finegayan	0.16	0.59	1.63	2.02	2.42	8.17	8.75	8.75	8.75	8.75	10.61
Andersen AFB	3.14	3.44	3.55	3.75	3.86	3.94	3.94	3.94	3.94	3.94	4.88
Navy	9.82	9.82	10.13	10.43	10.77	10.77	11.84	11.84	11.84	11.84	12.98
Total	13.12	13.85	15.31	16.20	17.05	22.87	24.52	24.52	24.52	24.52	28.48
Cantonment Alternatives 3 and 8											
Finegayan and Barrigada	0.16	0.61	1.68	2.08	2.47	8.52	9.11	9.11	9.11	9.11	11.07
Andersen AFB	3.14	3.44	3.55	3.75	3.86	3.94	3.94	3.94	3.94	3.94	4.88
Navy	9.82	9.82	10.13	10.43	10.77	10.77	11.84	11.84	11.84	11.84	12.98
Total	13.12	13.87	15.36	16.26	17.11	23.22	24.89	24.89	24.89	24.89	28.94

Legend: AFB = Air Force Base; MGd = million gallons per day.

Demand Adjusted to Reflect Federal Mandates to Reduce Consumption

The on-base potable water demand assumptions presented in Section 2.2.2.1 are based on UFC (UFC-3-230-19N DoD, 2005) and provides a conservative estimate to plan the potable water source demand for a standalone system to serve the long-term needs of a generic military base located anywhere in the world. Construction on military bases is standardized and dictated by UFC documents that provide planning, design, construction, sustainment, restoration, and modernization criteria. They are applicable to Military Departments, Defense Agencies, and DoD Field Activities. They were relied upon in the development of project designs and would be incorporated into construction documents and permits, and operations and maintenance activities. The documents address issues such as design standards for water systems based primarily on installation population. There is little flexibility in minimal design standards, but there is flexibility in site planning. Congressional appropriations require the incorporation of all relevant UFCs in design.

Unfortunately, UFC-3-230-19N addresses the criteria to be used to define the source of water, but does not account for the fact that several federal mandates (Executive Order [EO] 13423, Energy Policy Act of

2005, Energy Independence and Security Act of 2007, EO 13514) have been issued since the last release of UFC-3-230-19N. These federal mandates require the use of water conservation technology to achieve significant reductions in water usage. EO l3514 (5 October 2009) requires federal agencies to reduce their water consumption 26% by 2020 as compared to the federal agency's water consumption in 2007. As a result of mandated reductions in usage, the capacity of a UFC-compliant water source would exceed projected demand. To address this situation in advance of an update of UFC-3-230-19N and to factor in a more realistic scenario based on Guam, the analysis presented herein incorporates sustainability and water conservation into the water demand calculation. This approach has been endorsed by the Navy Criteria team that is responsible for updating the UFCs and is considered consistent with the spirit and intent of the UFCs. It is essential to start with UFC-3-230-19N and apply sound engineering judgment to adjust requirements to preclude the construction of a more costly system that would constrain a limited water resource and ultimately be underutilized, potentially resulting in long term operating issues for the Marines if other water demands are not addressed with the system.

The reduction in on-base water demand for the proposed new Marine Corps base is expected to be in the order of 22% or more for the average daily demand and 40% or more for the maximum daily demand if conservation measures, sustainability principles, and Guam site-specific conditions are applied. The reduced demand presented below provides a realistic estimate of the expected demand for planning purposes.

Sustainability Principles

The following directives and guidance documents address water conservation:

- EO 12902, Energy Efficiency and Water Conservation at Federal Facilities
- EO 13423, Strengthening Federal Environmental, Energy, and Transportation Management
- Energy Policy Act of 2005
- Energy Independence and Security Act of 2007
- 10 U.S. Code 2866, Water Conservation at Military Installations
- 10 U.S. Code 2915, New Construction: Use of Renewable Forms of Energy and Energy Efficient Products
- Military Handbook 1165, Water Conservation, Mil-HDBK-1165 (1996)
- Navy Water Conservation Guide For Shore Activities
- EO 13514, Federal Leadership in Environmental, Energy, and Economic Performance (5 October 2009)
- Greenhouse Gas Targets Announcement for DoD (29 January 2010)
- Energy Awareness Message from Secretary of the Navy Ray Mabus (30 October 2009)
- LEED for New Construction and Major Renovation 2009

The existing Navy and Air Force bases are subject to water conservation goals, such as those in EO 13423. Implementation of this order requires a reduction in water usage of 16% by 2015 on existing bases. This percent reduction is included in the modified potable water demand estimates presented herein. The water conserved at the existing bases would then be available for future uses as "excess" water supply. For more information on sustainability policies and guidance, refer to Volume 8, Chapter 6.

The DoD is in the process of developing and approving water conservation measures for the Marine Corps base through equipment selection and management practices. Water consumption at the Marine Corps base would differ from consumption at the existing bases because, as part of the proposed action, the design and construction of the new base at Finegayan would implement low-flow equipment and other improvements to the extent practical. Reduction strategies being considered are indoor reduction, indoor reuse, and outdoor capture. Examples include the following potential water conserving measures:

- Low-flow faucets
- Ultra-low-consumption toilets/urinals with electric flush sensors
- Low-flow showerheads
- Lower flow commercial-type “Energy Star” washing machines in housing units
- Energy- and water-saving dishwashers (Energy Star)
- Use of washwater recycling in industrial washing and rinsing of aircrafts and vehicles
- Water efficient cooling systems
- Rainwater collection and reuse
- Air conditioning condensate recycling
- Water conservation education

For more information on the sustainability measures, see Volume 8. A summary of the Sustainability Program Summary Report is provided in Section 2.2.5.8. The text of the Sustainability Program Summary Report is provided in Volume 9, Appendix F.

Water management practices would be implemented at the Marine Corps base to better control water consumption and prevent water loss. The amount of water used to water lawns and landscapes would be minimized or eliminated through sustainable landscape design and use of native vegetation. Meters would be installed at all facilities and at key locations within the water distribution system significantly improving the ability to quickly identify leaks and take corrective action. Water management operation procedures would be reviewed periodically and revised as needed. Base residents would be educated with regard to living responsibly on a sustainable base in order to create a sustainable culture through responsible actions by residents. Education programs on proper use of water would include: watering lawns sparingly or not at all, installing low-flow fixtures, water reuse, full load clothes washing, etc. Metering would provide water users with full awareness of their water usage. For housing residents, meters would support billing of water usage directly to the residents. Water conservation would be a key program and receive command level attention and monitoring.

Site-Specific Water Conservation Measures

Because the proposed Marine Corps base would be located on Guam, some of the assumptions behind the development of the UFC guidance are not relevant. Notably, the water needed for lawn irrigation would be minimal because of Guam’s climate, particularly during the rainy season. As described above, the facility design would be expected to utilize water conserving equipment and design elements that would likely produce at least a 22% water savings compared to UFC requirements. This water savings is mandated by EO 13514. No irrigation would be utilized for housing and minimally used elsewhere on the base. Landscaping throughout the base would use local plants that can survive with little watering. A common components manual to guide the development of the new Marine Corps base at Finegayan would address which local plants could be utilized in landscaping. Improved leak detection, extensive metering, and management systems would be expected to reduce the amount of UFW to a rate of 5% based on engineering judgment. It is noted that the UFC-3-230-19N does not address the issue of UFW. The controlling demand factor used to estimate the maximum daily demand and to size water system components would be lower for Guam because there are limited climatic changes on Guam as compared to the mainland and other locations. Actual water demand at the base is expected to differ from the UFC-based water demand estimate due to the incorporation of water conservation measures.

The potential savings from water conservation measures for Main Cantonment Alternatives 1 and 2 at Andersen AFB and Navy bases are shown below in Table 2.2-6. The potential water conservation reductions are similar for Main Cantonment Alternatives 3 and 8.

Incorporating these assumptions, the average daily water demand for the proposed Marine Corps base is estimated at 22% less and maximum daily water demand at 40% less than that based on the UFC. Impacts of these estimated water demand reductions is discussed in Volume 6, Chapter 3.

Table 2.2-6.Water Demand Comparisons Using Conservation/Sustainability Measures for Main Cantonment Alternatives 1 and 2

	Water Demand (in MGd)			
Water Demand Criteria(Existing and Proposed)	*Marine Corps Finegayan*	*Andersen AFB*	*Navy*	*Total*
Average Daily Demand using UFC Guidance	6.0	3.2	10.1	19.3
Average Daily Demand using Sustainability Principles	4.7	2.5	8.7	15.8
Potential Percent Reductions for Average Daily Demand	22%	22%	14%	18%
Maximum Daily Demand using UFC Guidance	10.6	4.9	13.0	28.5
Maximum Daily Demand using Sustainability Principles	6.3	3.0	9.8	19.1
Potential Percent Reductions for Maximum Daily Demand	40%	39%	25%	33%

Legend: AFB = Air Force Base; MGd = million gallons per day; UFC = Unified Facilities Criteria.

2.2.2.2 Off-Base Water Demand (Including Indirect Off-Base Induced Population and Construction Workforce)

Off base water demand including indirect impacts of the military relocation would be placed on the GWA water system. The indirect population growth consists of the baseline growth (the expected growth in the Guam population without military relocation) in the existing population plus indirect impacts of the proposed military relocation (the induced civilian population growth and construction workers). Most construction workers are expected to reside in work camps. The islandwide off-base population is estimated to peak in the year 2014 at 249,642 as shown in Table 2.2-7.

Table 2.2-7. Off-Base Indirect Population Estimates

			Off-Island Construction Workers			*Off-Island Civilian DoD Workers*			
Year	*Current*	*Baseline Growth*	*On-Campus Worker*	*Off-Campus Worker*	*Off-Campus Dependent*	*Workers*	*Depen-dents*	*Off-Island Induced*	*Total*
2010	180,692	0	2,300	940	1,160	119	97	5,393	190,700
2011	NA	2,389	5,840	2,360	2,585	261	232	13,723	208,082
2012	NA	4,743	10,320	3,900	3,797	261	232	22,957	226,902
2013	NA	7,062	12,970	4,860	3,968	261	232	27,450	237,495
2014	NA	9,350	13,280	5,090	4,725	1,745	1,634	33,126	249,642
2015	NA	11,610	8,660	3,480	2,832	1,861	1,745	25,233	236,113
2016	NA	13,849	2,690	1,090	1,052	1,861	1,745	12,374	215,353
2017	NA	16,065	0	0	0	1,861	1,745	8,718	209,081
2018	NA	18,250	0	0	0	1,861	1,745	8,718	211,266
2019	NA	20,403	0	0	0	1,861	1,745	8,895	213,596

Legend: NA = not applicable.

The off-base water demand is estimated using existing water supply information from GWA. The current GWA water production rate of 42 MGd (159 MLd) was used as the current baseline. The current production rate covers all water demands from the general public including domestic, industrial, tourist related and UFW loss.

Of the 42 MGd (159 MLd), 18 MGd (68 MLd), is billed. The remaining 24 MGd (91 MLd), is UFW. According to GWA, the loss from leaks is 10% and the remainder is from unmetered or undermetered connections. USEPA has commented that the 10% UFW from leaks is unreasonably low. They are concerned that UFW fraction attributed to leaks is unacceptably low because the leak detection study focused on water lines greater than 6-inches (in) in diameter. Not all water lines greater than 6-in in diameter were surveyed. Most water lines with a diameter less than 6-in in diameter were not surveyed. Leakage from the smaller water lines could be significant. Many of the smaller water lines are made of heavily corroded galvanized iron with a history of leaks. Additionally, the leak detection study documentation did not describe the quality control measured instituted for the study. USEPA recommends using a range of 25% to 40% as the best estimate for UFW due to, recognizing that the true number could be higher or lower.

The midpoint of the UFW range between GWA's reported UFW due to leakage (10%) and the high end of USEPA's recommended range (40%) is used in this estimate of GWA's water demand. The selected UFW due to leakage for the GWA water system is 25%. Most water utilities, policymakers, and associations, such as the American Water Works Association deem a 10% to 15% UFW loss as acceptable. A UFW of 25% is outside of the acceptable range of UFW loss and is the same as the UFW for the current Navy Island Wide water system. In Chapter 3, the GWA supply is compared to the estimated water demands assuming 10%, 25%, and 40%.

The estimated increases to the population served by GWA is consistent with Table ES-2 of the Final EIS. The table is provided below with the civilian populations identified within red boxes. The civilian military workers are additional civilian staff supporting Finegayan base who work on base, but are housed off base with their dependents. Off-Island Construction Workers would work temporarily on Guam to construct the base and related facilities. Most construction workers would be housed within a hotel like work camp. A portion of the construction workers, probably having management or supervisor roles, are assumed to live outside of the work camp with their dependents. Off-Island Workers for Indirect/Induced Jobs are assumed to live within the general Guam population, supporting the additional military, civilian military workers and construction workers in employment such as teaching and commercial businesses. Information on how the population estimates were developed is presented in Volume 9, Appendix F of the Final EIS. The population estimates used in the water demand calculations are from the unconstrained scenario which assumes no constraints would be imposed by Guam to lessen the indirect economic growth potential resulting from the action.

Future water demand for GWA is estimated as the current production rate (42 MGd [159 MLd]) plus water demand resulting from the population increases. Table 2.2-8 provides the domestic water demand calculation for the population increase in 2014. The populations were multiplied by the gpcd rates shown in Table 2.2-8. The consumption rate for Construction Workers On-Campus is 70 gpcd, which is the hotel domestic water allowance from Table 2-1 of UFC 3-230-03A 16 January 2004 for Water Supply (DoD 2004). For all other off-base populations the consumption rate is 125 gpcd from the 2007 Water Resources Management Plan. The domestic water demand in 2014 for the additional populations is 7.89 MGd (29.9 MLd).

Table 2.2-8. Increases in Off-Base Domestic Daily Water Demand for 2014

	Off-Base Population Increase Year 2014	*Rate (gpcd)*	*2014 Increase in Daily Domestic Water Demand (MGd) [A x B]*
Column	**A**	**B**	**C**
Baseline Growth	9,350	125	**1.17**
Construction Workers On-Campus	13,280	70	0.93
Construction Worker + Dependents Off-Campus	9,815	125	1.23
Construction Workers & Dependents			**2.16**
Civilian Workers Project	1,720	125	0.22
Non-Project Civilians	25	125	0.003
Civilian Workers Dependents Project	1,634	125	0.20
DoD Civilian Workforce & Dependents			**0.42**
Induced	33,126	125	**4.14**
Total			**7.89**

Legend: DoD = Department of Defense; gpcd = gallons per capita per day; MGd = million gallons per day.

Table 2.2-9 presents the calculation of the overall water demand for GWA in 2014. UFW from leaks is assumed at a rate of 25% (1.97 MGd [7.5 MLd]). Water required for construction of 0.05 MGd (0.19 MLd) is added. The estimated total demand for GWA in 2014 of 51.92 MGd (196.5 MLd) is the sum of the current production, domestic demand, additional UFW from leaks and water from construction.

Table 2.2-9. 2014 Estimated Off-Base Water Demands

	2014 Increase in Daily Domestic Water Demand (MGd)	*2014 Increase in UFW (MGd) [A x 25%]*	*2014 Total Increase in Water Demands (MGd) [A+B]*	*Demand in 2014 (MGd)*
Column	**A**	**B**	**C**	
Baseline	-	-	-	42
Baseline Growth	1.17	0.29	1.46	1.5
Construction Workers & Dependents	2.16	0.54	2.70	2.7
DoD Civilian Workforce & Dependents	0.42	0.11	0.53	0.5
Induced	4.14	1.04	5.18	5.2
Water for Construction	0.05	0.0125	0.06	0.06
Total	**7.94**	**1.99**	**9.93**	**51.96**

Legend: DoD = Department of Defense; MGd = million gallons per day; UFW = unaccounted for water.

The off-base water demand estimate is provided in Table 2.2-10 for the 2010 through 2019. Off-base water demand peaks in 2014 at 51.9 MGd (196 MLd). A separate estimate is provided for the population located in northern and central Guam, where the water demand is met primarily through GWA groundwater resources.

Table 2.2-10. Estimated Off-base Water Demands by Year

			Off-Island Construction Workers			*Off-Island Civilian DoD Workers*					
Units: MGd Year	*Current*	*Baseline Growth*	*On-Campus Worker*	*Off-Campus Worker*	*Off-Campus Dependents*	*Workers*	*Dependents*	*Off-Island Induced*	*Total*	*North and Central*	*South*
2010	42.0	0.0	0.2	0.1	0.2	0.0	0.0	0.8	43.4	35.3	8.1
2011	NA	0.4	0.5	0.4	0.4	0.0	0.0	2.1	45.9	37.4	8.5
2012	NA	0.7	0.9	0.6	0.6	0.0	0.0	3.6	48.5	39.7	8.8
2013	NA	1.1	1.1	0.8	0.6	0.0	0.0	4.3	50.0	41.0	9.0
2014	NA	1.5	1.2	0.8	0.7	0.3	0.3	5.2	51.9	42.6	9.2
2015	NA	1.8	0.8	0.5	0.4	0.3	0.3	3.9	50.1	41.0	9.1
2016	NA	2.2	0.2	0.2	0.2	0.3	0.3	1.9	47.2	38.5	8.8
2017	NA	2.5	0.0	0.0	0.0	0.3	0.3	1.4	46.4	37.7	8.7
2018	NA	2.9	0.0	0.0	0.0	0.3	0.3	1.4	46.8	38.0	8.8
2019	NA	3.2	0.0	0.0	0.0	0.3	0.3	1.4	47.1	38.3	8.8

Legend: MGd = million gallons per day.

The baseline average water demand per person is estimated in Table 2.2-11 for the GWA water system. The baseline population is increased to account for the tourist population which was estimated at 23,000 in a comment from Guam Environmental Protection Agency (GEPA) on the Draft EIS. The industrial demand estimate provided in the 2007 WRMP was subtracted from the total water demand to estimate the average daily domestic water demand including the UFW. The gallons per person per day is 126 gpcd after accounting for 25% UFW.

Table 2.2-11. GWA Baseline Gallons per Person per Day Estimate

	Population
GWA Baseline Population	180,692
Tourists	23000
Population + Tourists	**203,692**
	Demand
Total Demand (MGd)	42
Industrial Demand (MGd)	-10
Domestic Demand (MGd)	32
Gallons per Capita per Day (gpcd)	157
Adjusted for UFW (gpcd)	**126**

Legend: gpcd = gallons per capita per day; GWA = Guam Waterworks Authority; MGd = million gallons per day; UFW = Unaccounted for Water.

A similar comparison is provided below. Water demand was estimated using 70 gpcd for construction workers housed on the work camp; and 125 gpcd was used for the remaining population. The average gallons per person is lower during 2010 through 2016 when the construction workers housed on campus are present. After 2016, the average gallons per person is 125 gpcd. The water demand per person used in this analysis is consistent with the baseline average demand per person of 126 gpcd. As shown in Table 2.2-12, the percent increase in population is not the same as the percent increase in water demand, but these differences are due to the use of to the lower water demand for the construction workers housed on campus; the presence of a tourist population that is not included in the baseline population estimate and the use of water for industrial purposes.

Table 2.2-12. Comparison between GWA Population and Water Demand Increases

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
GWA Population	190,700	208,082	226,902	237,495	249,642	236,113	215,353	209,081	211,266	213,596
Population Increases Over Baseline	10,008	27,390	46,210	56,803	68,950	55,421	34,661	28,389	30,574	32,904
Population Percent Increase	6%	15%	26%	31%	38%	31%	19%	16%	17%	18%
Total Projected Demand (UFW: 25%)	43	46	49	50	52	50	47	46	47	47
Demand Increases Over Baseline	1.4	3.9	6.5	8.0	9.9	8.1	5.2	4.4	4.8	5.1
Water Demand Percent Increase	3%	9%	16%	19%	23%	19%	12%	11%	11%	12%
Gallons per Capita per Day (gpcd)	140	142	141	141	143	146	151	156	156	156
Adjusted for UFW (gpcd)	**112**	**113**	**113**	**112**	**114**	**116**	**121**	**125**	**125**	**125**

Legend: gpcd = gallons per capita per day; GWA = Guam Waterworks Authority; UFW = Unaccounted-for Water.

2.2.3 Water Supply Sources

Water supply sources considered to meet on-base and off-base water demands are described below. These include groundwater as the primary supply source, and surface water. Development of groundwater resources would require coordination between DoD, GWA, and the GEPA. This coordination is a necessary part of the well permitting and the construction process, and for proper management of the Northern Guam Lens Aquifer (NGLA), a designated sole source aquifer. The NGLA, located directly underneath northern Guam, is a sole-source aquifer and is the primary source of available drinking water on Guam. A sole-source aquifer is an underground water supply designated by USEPA as the “sole or principal” source of drinking water for an area because it supplies at least 50% of the drinking water consumed in the area overlying the aquifer. The DoD recognizes that the best future sources of water within the NGLA are under DoD land; therefore, coordination between DoD, GWA, and GEPA regarding the use and management of the NGLA is paramount to sustain this critical resource.

2.2.3.1 DoD Water Supply Sources

The current DoD water resources are summarized in Table 2.2-13. The existing DoD water supply is sufficient to meet current on-base DoD demands at Naval Station Guam and Andersen AFB. Additional supply to meet future Marine Corps, Army, and Navy demands would be required for the military relocation.

Table 2.2-13. Current On-Base DoD Potable Water Supply

Resource		*Capacity (gpm)*	*Capacity (MGd)*
Navy Surface Water Resources		**7,614**	**10.97**
Navy Southern Guam	Almagosa Spring	928	
Navy Southern Guam	Bona Spring	426	
Navy Southern Guam	Fena Reservoir	6,260	
Navy Groundwater Resources		**1,534**	**2.21**
Navy Hospital	NRMC #1	234	
Finegayan	NCTS #6	125	
Finegayan	NCTS #7	235	
Finegayan	NCTS #9	200	
Finegayan	NCTS #10	180	
Finegayan	NCTS #11	180	
Finegayan	NCTS #12	180	
Finegayan	NCTS B1	200	
Air Force Groundwater Resources		**3,285**	**4.73**
Andersen South Annex	Marbo Well No. 1	170	
Andersen South Annex	Marbo Well No. 3	210	
Andersen South Annex	Marbo Well No. 5	180	
Andersen South Annex	Marbo Well No. 6	480	
Andersen South Annex	Marbo Well No. 7	255	
Andersen South Annex	Marbo Well No. 8	490	
Andersen South Annex	Marbo Well No. 9	400	
Main Base	Well 3A	300	
Main Base	Well 5	200	
Main Base	Well 6	200	
Main Base	Well 7	200	
Main Base	Well 8	200	

Legend: gpm = gallons per minute; MGd = million gallons per day; NCTS = Naval Computer Telecommunications Station; NRMC = Navy Regional Medical Center.

2.2.3.2 Non-DoD Water Supply Sources

Non-DoD water supply sources consist of groundwater and surface water supplies throughout Guam. The GWA water supply sources are presented in Table 2.2-14. Potable water is mainly supplied to the northern system by 119 deep wells. Collectively, these wells have a current daily average production rate of approximately 38 MGd (144 MLd). Due to high chlorides, GEPA is proposing that GWA reduce production of wells in the Agana subbasin. It is expected that a reduction of 2 MGd (7.6 MLd) would be undertaken. GWA has advised DoD that it intends to drill additional wells with a capacity of up to 7 MGd (26.5 MLd). Additional water supply capacity is not included in the future water supply estimate for GWA because it is not certain that funding will be available for the improvements. It is assumed that GWA would reduce leakage from their distribution system in northern Guam to support baseline growth by 3.2 MGd (12.1 MLd) by 2019. This assumption is made because the baseline growth would occur with or without the proposed DoD relocation and water supply for this population would be the responsibility of GWA, not the DoD. Water supply from GWA surface water resources currently totals 2.4 MGd (9.1 MLd). Modification to the Ugum Water Treatment Plant (WTP) has the potential to increase water supply in southern Guam by 1.8 MGd (6.8 MLd).

In addition to the deep wells, the northern system also receives up to 4.0 MGd (15 MLd) from the Navy WTP in southern Guam, which is supplied by surface water from Fena Reservoir, according to the current agreement between DoD and GWA.

The total future GWA water supply of 45.6 MGd (173 MGd) including the water transferred from Fena Reservoir is adequate to meet normal expected civilian growth without the proposed indirect impacts of the military relocation. Between the existing non-DoD water supply sources and GWA's rehabilitation and expansion plans, there would be sufficient water supply to meet the anticipated normal civilian growth without the proposed military relocation.

Table 2.2-14. Guam Waterworks Authority Water Supplies

	Current Production (MGd)	*Current Capacity (MGd)*	*Future Expansions (MGd)*	*Future Capacity (MGd)*
North and Central				
Deep Wells	38	39.4	0	39.4
Planned Lower Production of Agana Wells with Elevated Chloride	0	0	-2	-2.0
Well Expansion to Meet Baseline Growth in 2019	0	0	0	0
South				
Ugum Water Treatment Plant	2.2	2.2	1.8	4.0
Santa Rita Spring	0.2	0.2	0	0.2
Total GWA Supplies	**40.4**	**41.8**	**-0.2**	**41.6**
Navy to GWA Transfer to Central	4	4	0.0	4.0
Total with Existing Navy Transfer	**44.4**	**45.8**	**-0.2**	**45.6**

Legend: GWA = Guam Waterworks Authority; MGd = million gallons per day.

2.2.3.3 Development of Alternatives to Increase DoD Water Supply Sources

The future DoD water supply requirements are shown in Table 2.2-15. Using UFC guidance, the supply is based on the maximum daily demand. For water systems based on groundwater supply wells, UFC guidance requires that the supply equivalent to the capacity of the largest well in the system be added. For DoD an additional 11.3 MGd (42.8 MLd) of additional water supply would be required to meet future on-base DoD demands projected for the military relocation for Main Cantonment Alternatives 1 and 2 utilizing UFC requirements (Marines). The water transferred to GWA from the Navy water system is not included in the maximum daily demand shown in Table 2.2-15.

Table 2.2-15. Projected Future DoD Water Supply Requirements

	Maximum Daily Demand	*Largest Well*	*Required Supply*	*Current Supply*	*Additional Supply Needed*
Marines	10.61	0.65	11.26	0.00	**11.26**
Andersen AFB	4.88	0.71	5.59	4.73	**0.86**
Navy	12.98	NR	12.98	13.18	**-0.20**
Total	28.48		29.83	17.91	**11.92**

Notes: Units: MGd
Legend: AFB = Air Force Base; MGd = million gallons per day; NR = not required.

Several alternatives for increasing DoD water supply sources are carried forward for analysis in this EIS, which are discussed in detail in Section 2.2.4 below. These alternatives were developed based on an assessment of nine primary water system improvement options. These water system improvement options were evaluated in the Guam Water Utility Study Report for Proposed U.S. Marine Corps Relocation (NAVFAC Pacific 2010h) and are listed below.

- *Option 1:* Optimize groundwater resource development within DoD land and add additional supply wells
- *Option 2:* Rehabilitate, replace, or treat well water from existing wells that are not currently in production due to contamination, structural, and/or mechanical problems
- *Option 3:* Coordinate with GWA to establish the quantity of potable water that GWA would be agreeable to selling to DoD, and purchase water from GWA
- *Option 4:* Dredge sediment from the Navy Reservoir to increase storage capacity
- *Option 5:* Expand storage capacity of the Navy Reservoir by raising the dam crest
- *Option 6:* Reclaim potable water through effluent reuse
- *Option 7:* Indirectly reclaim potable water through groundwater recharge
- *Option 8:* Perform desalination
- *Option 9:* Develop a new surface water source (e.g., the "Lost River").

Each of the nine options identified above was evaluated with regard to several factors: feasibility, technical complexity, reliability, regulatory acceptance, environmental impacts, overall cost, time to implement, and the quantity of water that would potentially be obtained. This screening process is included in the Guam Water Utility Study Report for Proposed USMC Relocation (NAVFAC Pacific 2010h). Options 5, 6, and 7 were dismissed from further consideration. Combinations of the remaining options were used to build the alternatives that are carried forward for analysis in this Final EIS, as discussed in Section 2.2.4.

For potable water, no distinction is made between interim and long-term alternatives for the first two basic alternatives. These alternatives would be pursued in a phased implementation approach, which reduces costs and the time needed to implement. Should there be a need for additional water supply sources, three long-term alternatives have been identified and carried forward on a programmatic basis.

2.2.3.4 Water Supply Options Considered to Build Alternatives

The following is a brief discussion of the water supply options that were retained for further consideration and are used to build the alternatives carried forward for analysis in this EIS.

Option 1: Optimize Groundwater Resource Development within DoD Land and Add Additional Supply Wells

This option includes the development of groundwater wells drawing water from the NGLA in the Navy water system and the Andersen AFB water system. Because they and the GWA water system in northern Guam draw water from the same sole source aquifer with a limited sustainable yield, the development of this option to include new production wells must consider the effects of wells pumping in adjacent areas and proposed additional well production from GWA. The effects include potential saltwater intrusion problems, excessive drawdown in the aquifer, and other related water quality problems. This option includes continued use of the existing Navy wells at Finegayan that produce up to 2.2 MGd (8.3 MLd) for the Navy islandwide water system. The Marine Corps water system would be connected with both the Air Force and Navy islandwide systems to allow the flexibility needed to meet water demands on the DoD bases in northern Guam if housing were to be shifted away from the Finegayan Base and in emergencies.

The development and implementation of this option would be managed by DoD, avoiding uncertainties in timely implementation through direct management. Coordination with GWA is important in the development of new production wells in the DoD areas to avoid negative effects caused by overpumping of the aquifer.

The freshwater lens aquifer is segregated into six distinct and hydrologically separate subbasins on the northern portion of the island. The primary subbasin used for groundwater extraction by the Navy, Finegayan Subbasin, is near its maximum sustainable yield. The subbasin being utilized by Andersen AFB still appears to have sustainable yield available before reaching capacity. Based on review of the sustainable yield and current pumping capacity for existing wells, the water supply obtained from within DoD lands can meet the projected Marine Corps demand.

<u>Option 2: Rehabilitate, Replace, or Treat Well Water from Existing Wells that Are Not Currently in Production Due to Contamination, Structural, and/or Mechanical Problems</u>

This option includes the development of nonoperational and under-performing existing groundwater wells drawing water from the NGLA in the Navy water system and the Andersen AFB water system. Because DoD and the GWA water systems in northern Guam draw water from the same aquifer with a limited sustainable yield, the development of this option to include rehabilitation or replacement of existing production wells also considers the effects of wells pumping in adjacent areas. These impacts would include potential saltwater intrusion problems, excessive drawdown in the aquifer, and other related water quality problems. Successful rehabilitation or replacement of the inactive wells would not provide sufficient water supply to meet the projected future DoD water demand for the Marine Corps Base. The DoD would support efforts to rehabilitate these wells to support off-base water demands related to the Marine Corps relocation depending on need and regulatory approval.

This option has the potential to add to the reliability of a DoD water supply. Coordination with GWA is important in rehabilitation of production wells in the DoD areas to avoid negative effects caused by over pumping.

<u>Option 3: Coordinate with GWA to Establish the Quantity of Potable Water that GWA Would Be Agreeable to Sell to DoD, and Purchase Water from GWA</u>

This option includes obtaining water from GWA by either purchasing water or exchanging water through metered interconnections between the GWA and DoD water systems. There are several existing connections between the GWA and Navy water systems, although given the information currently available, none of these connections would be sufficient to meet a substantial portion of the demand in the northern region without well development, water facilities improvements, and other construction. The implementation of this option would include establishing or upgrading metered connections between the GWA and DoD water systems.

Because the Northern Public Water System operated by GWA is an elaborate water supply system in northern Guam with 119 wells that draw water from the NGLA, this option could supplement DoD's groundwater supply. This option could potentially result in energy cost savings by reducing the cross-island pumping of large quantities of water through the existing parallel water mains running from the north to the south. However, little or no water is available for purchase from GWA in the north that is not already required for GWA customers in that region. The Navy currently transfers up to 4 MGd (15 MLd) of water to GWA for use in central Guam. In the future, the water purchase option may become available if the GWA system is improved to reduce the loss rate, and if expansion of the GWA northern well systems is implemented (GWA 2007).

<u>Option 4: Dredge Sediment from the Navy Reservoir to Increase Storage Capacity</u>

The Navy Reservoir (also known as Fena Reservoir), located in southern Guam, is a primary source of potable water for the island and was created through the impoundment of the Fena River Valley by a dam

(Navy Reservoir Dam). The Navy Reservoir Dam, constructed by the Navy and completed in 1951, is a zoned earth and rockfill embankment with a maximum height of 85 ft (26 m) above original grade. The entire watershed impounded by the dam covers an area of 5.88 square miles (15.23 square kilometers) of moderately to steeply sloped lands, and soil within the watershed is predominantly clay of volcanic origin. The slopes and soil type both contribute to rapid runoff rates and substantial erosion, particularly in areas where the native vegetation has been removed. Eroded soil is ultimately transported to the reservoir itself by the runoff, and resulting sedimentation contributes to ongoing reduction of reservoir capacity.

The increased water supply from implementation of this option would serve DoD demands in southern Guam. It is assumed that the water supply would increase by approximately 2.5 MGd (9.5 MLd) if the reservoir were dredged to the original design elevations. If water were supplied from the NGLA near the Finegayan Base Complex, water supply from implementation of this option would not support the Marines relocation, but would provide additional supply in the south that could be transported to northern Guam if necessary.

Potential benefits of the proposed dredging are several. First, the proposed work is relatively simple and would not present a great demand for skilled labor that may be difficult to procure from the limited labor pool on Guam. Secondly, the dredging would not result in the creation of new capital structures that must be operated and maintained indefinitely. Dredging would maintain the existing hydrology of the reservoir system and would not require inundation of additional land. Finally, this option would not require changes to the existing water distribution network, in that the existing discharge and bypass points would be maintained in place.

Potential obstacles and drawbacks exist as well. In particular, the potential difficulty in mobilizing a dredge to the project site because of its remote location and the large mobilization distances for dredges would cause actual project costs to be uncertain. In addition, there are substantial logistical difficulties in managing dredged material on Guam. The lack of sufficient land area may complicate implementation.

Although dredging is a viable option, it cannot be sustained as a stand-alone alternative for Marine Corps relocation. Water supplied by this option to the Marine Corps Base would require transportation to northern Guam. The option is retained as part of ongoing maintenance for the Navy Reservoir as a long term alternative, which supplies water to DoD facilities in southern Guam.

Option 8: Desalination

Desalination is a process that removes dissolved minerals from seawater, brackish water, or treated wastewater. The water supply provided by implementation of desalination would support the Marine Corps relocation.

Several technologies have been developed for desalination, including reverse osmosis, electrodialysis reversal, and distillation. In reverse osmosis, feedwater is pumped at high pressure through permeable membranes, separating salts from the water. In electrodialysis reversal, ions are transferred through the membranes by means of direct current voltage and are removed from the feedwater as the current drives the ions through the membranes. In the distillation process, feedwater is heated and then evaporated to separate out dissolved minerals.

It is assumed that the brackish water would have a total dissolved solids (TDS) level ranging from about 3,000 mg/L to 4,000 mg/L. Within this TDS range, reverse osmosis is the preferred technology. Brackish water generally requires less energy to desalinate than seawater because of its lower concentration of dissolved solids. Therefore, the desalination of brackish water is generally less expensive than desalination of seawater. Energy costs represent about one-third to one-half of the cost of desalination, and as a result, desalination costs are relatively sensitive to the cost of energy.

For this option, the lowest salinity water available outside of the NGLA would be considered. Brackish-water wells would be located within 1,000 ft (305 m) of the shoreline to avoid effects on the NGLA and existing wells. Sufficient brackish water would be collected from a series of wells to generate 12 MGd (45 MLd) of potable water. The desalination plant would be located near the Finegayan Base Complex on Andersen AFB to be close to the location of the source and the demand. The plant would include units for pretreatment (filtration and disinfection), desalination, and post-treatment (corrosion control and remineralization), resulting in a product of drinking water quality with TDS less than 500 mg/L. If desalination of brackish water were to be implemented, untreated brackish water may be used to meet fire demands, requiring a separate set of nonpotable waterlines and storage.

Desalination plants produce liquid wastes that may contain some or all of the following constituents: high salt concentrations, chemicals used during defouling of plant equipment, and pretreatment residues. Liquid wastes may be discharged directly into the ocean, combined with other discharges (e.g., power plant cooling water or sewage treatment plant effluent) before ocean discharge, discharged into a sewer for treatment in a sewage treatment plant, or dried and disposed in a landfill.

Desalination is a viable option that results in very pure water, excellent pathogen removal, and flexible operations. The costs for this option are likely to be high relative to the water supplied by freshwater wells. The high power demand for desalination would need to be considered in the utility planning for electricity. The cost for desalination would also be sensitive to the TDS level in the brackish water supply. The quantity of brine requiring disposal would be substantial if used as the primary water supply. If water demands eventually exceed the capacity of the freshwater aquifer in the north, desalination could potentially provide a source of potable water for DoD. Therefore, this option is retained as a long-term alternative.

Option 9: Develop a New Surface Water Source (e.g., the “Lost River”)

Development of a new surface water source on Guam would require identifying a new water source; conceptualizing and designing the water source area, the treatment process, and T&D infrastructure; and constructing the complete system to supplement the existing water systems. Such a system preferably would have to be sited within DoD lands, and finding an alternate surface water source with substantial capacity would likely be a major and costly initiative.

A possible new surface water source is the Lost River. The increased water supply from implementation of the Lost River would serve DoD demands in southern Guam. If water were supplied from the NGLA near the Finegayan Base Complex, water supply from implementation of this option would not support the Marine Corps relocation. This option is carried forward as a long-term alternative to supplement water supply to DoD in southern Guam. However, based on comments received from GWA during the public comment period of the Draft EIS, this option could potentially result in loss of a potential surface water source to GWA, so DoD coordination and resolution with GWA would be required if it is considered in the future.

2.2.3.5 Options Eliminated from Further Analysis

Following is a brief discussion of the options that were eliminated from further consideration, and are not used to build the alternatives carried forward in this EIS taken from NAVFAC (NAVFAC Pacific 2010h).

Option 5: Expand Naval Reservoir Storage Capacity by Raising Dam Crest

This option would involve raising the dam crest of the Navy Reservoir to increase capacity. Based on a review of topographic maps depicting the immediate vicinity of the Navy Reservoir, the topography is such that raising the elevation of the dam crest by 20 ft (6 m) would increase total reservoir capacity by 3,940 acre-feet (4.86 million cubic meters), or 1.28 billion gallons. Assuming that the watershed would generate sufficient runoff to ensure the reliability of this supply, the safe yield of the reservoir would increase by 35%, from 11.4 MGd to 15.4 MGd (43.1 MLd to 58.3 MLd).

This option would have the advantage of improving DoD’s water supply by increasing its storage capacity in the Navy Reservoir. However, the disadvantages and uncertainties are substantial and include the following:

- Technical complexity of design and implementation
- Potential adverse environmental impacts (wetlands, endangered species)
- Uncertainties with respect to relative advantages compared to other viable options
- Studies (hydraulic, geotechnical, seismic) required
- Potential difficulties during construction limiting use of the reservoir
- Uncertainties regarding construction and operations and maintenance costs

Because of uncertainties regarding its viability, this option was eliminated from further evaluation.

Option 6: Reclaim Potable Water through Effluent Reuse

This option would include construction of a new tertiary WWTP near the Marine Corps base on DoD land at Finegayan. The plant would provide primary treatment, secondary biological treatment, and advanced tertiary treatment. It would treat the DoD wastewater from existing sources and proposed future expansions in the northern Guam region to drinking water standards.

This treatment application is categorized as direct potable reuse of reclaimed water. Normal treatment practice consists of primary settlement, submersible membrane bioreactor, disinfection, reverse osmosis, and advanced oxidation. The treated, potable water would be returned to the main water supply for reuse.

Although much research has been conducted on the direct potable reuse of reclaimed water, this is not a practice that is in widespread use. Only a few direct potable-reuse applications have been reported worldwide. Even without factoring in its extremely high capital investment cost and sophisticated process operation, it might be difficult to gain regulatory acceptance of this approach. Because of the negative connotations and public perceptions surrounding the use of reclaimed water as a potable water source, it is expected that community acceptance of this approach would also be difficult to achieve. Currently, there are no direct potable-reuse applications in the U.S. All reclaimed water that is treated by WWTPs has been used as potable water in an indirect way, with a natural buffer (e.g., either a stretch of river or a groundwater aquifer) between the reclaimed water introduction and its distribution to the potable-water treatment plant.

This option would require permission from either USEPA or GWA. Because no regulations exist for the reclaimed-water potable-reuse application, treatment requirements and performance monitoring standards for this option would need to be established, adding time and cost to its implementation. Therefore, this option was dismissed.

Option 7: Indirectly Reclaim Potable Water through Groundwater Recharge

This option would include construction of a new tertiary treatment plant on DoD land. The plant would treat the DoD wastewater from existing sources and future proposed military relocation to northern Guam. Treated effluent would be injected into the underground aquifer (i.e., the freshwater lens) for groundwater recharge or to limit salt water intrusion.

Due to the NGLA being a sole source aquifer as discussed above, additional precautions must be taken in managing recharge with reclaimed water. At the selected effluent injection point, the recommended 9- to 12-month detention time in the aquifer before removal could not be met because of the high hydraulic conductivity in the aquifer. Under these conditions, a very high degree of treatment (normally beyond USEPA primary drinking water standards) would have to be achieved.

In practice, even if tertiary treatment of effluent were applied for this kind of indirect potable reuse of reclaimed water, it is expected that this option would not be readily accepted by regulatory agencies. Underground injection control regulations established by GEPA categorize recharge wells discharging effluent from sewage treatment plants as Class V wells. GEPA does not specify the treatment standards and criteria for underground injection of this type of effluent to recharge the aquifer. The process of establishing treatment requirements and performance monitoring standards for this option would increase the cost and time to implement the project. Also public acceptance of recharging the NGLA with WWTP effluent would likely be controversial. Therefore, this option was dismissed.

2.2.4 Alternatives Developed Forward for Potable Water

Using the options carried forward that are outlined in Section 2.2.3, two basic alternatives were developed to meet the water demand resulting from the Marine Corps relocation. If the supply provided by the chosen alternative needs future augmentation, three additional long-term alternatives have also been carried forward. Basic Alternative 1 supports Main Cantonment Alternatives 1 and 2 (use of Finegayan) and basic Alternative 2 supports Main Cantonment Alternatives 3 and 8 (use of Finegayan and Barrigada). These alternatives are summarized below. A summary of the components for the alternatives is provided in Table 2.2-16.

Either basic alternative would fully meet the DoD water demand for the Marine Corps relocation.

Table 2.2-16. Summary of Potable Water Alternatives

	Components				
Alternative	*Water Supply*	*Water Treatment*	*Water Storage*	*Distribution System*	*Comments*
Basic Alternative 1	• The capacity of 11.3 MGd anticipated to be met by an estimated 22 new wells on Andersen AFB • Use of five recently installed wells at Andersen AFB • Continued use of existing Navy wells on Finegayan • Rehabilitation of Navy wells	• Disinfection and fluorination prior to transmission to the base	• Construction of new storage tanks on Finegayan • Abandonment of existing Navy storage tanks on Finegayan	• Waterlines: transport of water to storage tanks, and distribution of water throughout Finegayan • Improvements and interconnect with Andersen AFB water system and Navy islandwide system • Connection to GWA water system	• Supports Main Cantonment alternatives 1 and 2 • Preferred alternative • Revised UFC reduces demand
Basic Alternative 2	• The capacity of 11.7 MGd anticipated to be met by an estimated 31 wells. • 20 water supply wells located on Andersen AFB • 11 water supply wells located on Navy Barrigada	• Disinfection and fluorination prior to transmission to the base	• Construction of new storage tanks on Finegayan • Construction of new storage tank at Air Force Barrigada • Use of existing Barrigada tank • Abandonment of existing Navy storage tanks on Finegayan	• Waterlines: transport of water to storage tanks • Improvements and interconnect with Andersen AFB water system and Navy islandwide system	• Supports Main Cantonment alternatives 3 and 8 • Revised UFC reduces demand
Long-Term Alternative 1	• Rehabilitation of the Lost River cofferdam • Potential to provide additional water supply to DoD in southern Guam during the dry season				• Supplemental supply if basic alternative inadequate
Long-Term Alternative 2	• Applicable to both potable water alternatives • Production of up to 12 MGd of potable water by desalination, which would require 18 MGd of brackish water • This alternative provides supplemental water in the event freshwater resources are inadequate to meet DoD demand.				• Supplemental supply if basic alternative inadequate
Long-Term Alternative 3	• Dredging of the Navy Reservoir to original design elevation to increase storage capacity • Part of long-term water system maintenance				• Supplemental supply if basic alternative inadequate

Legend: AFB = Air Force Base; DoD = Department of Defense; GWA = Guam Waterworks Authority; MGd = million gallons per day; UFC = Unified Facilities Criteria.

If either basic alternative is selected and water conservation measures and sustainability principles are not implemented (i.e., what is assumed by the current DoD UFC demand calculations), then on-base water demand at Finegayan would exceed the available water supply in 2013. The year when the anticipated water demand would exceed the current on-base DoD water supply is called the "breakpoint year." Development of new wells and transmission lines would need to begin in 2011 to ensure their additional supply of water in 2012 to avoid the breakpoint in 2013. This coincides with the expected completion of the initial wells being developed to support Marine Corps needs. Installation of the proposed water system would begin prior to the breakpoint year. Although the maximum daily demand would not be met by the existing supply on Finegayan in 2013, with the installation of a subset of the DoD-planned wells there would be sufficient capacity to meet the estimated average daily demand, though not the required maximum daily demand of the water system (assuming water conservation and sustainability measures are applied). It is assumed that up to 10 wells at Andersen AFB would be required by 2014 to meet the DoD maximum daily demand. Construction workers' water demand would be met by the contractor, through the GWA water systems. Impacts to the GWA water system from this demand are addressed in Chapter 3 of this Volume. If a water shortfall would be predicted, then DoD could implement force flow reductions and/or adaptive program management of construction principals would be implemented such as reducing the pace of construction activity. More information on adaptive program management is provided in Volume 7.

Permits would be required from Guam agencies for either alternative. A full list of permit requirements is provided in Chapter 3 of Volume 8.

Three long-term alternatives were developed to supplement Basic Alternatives 1 and 2. These include rehabilitation of the Lost River, desalination, and dredging the Navy Reservoir. Additional information is needed to fully define the long-term alternatives.

2.2.4.1 Basic Alternative 1 (Preferred)

Basic Alternative 1 supports cantonment alternative 1 and preferred cantonment alternative 2 and provides adequate water supplies with minimal new facilities and costs. Basic Alternative 2 supports cantonment alternatives 3 and 8, which are not preferred. Thus, Basic alternative 1 was selected as the preferred water alternative. See below for additional details.

Basic Alternative 1 would provide additional water capacity of 11.3 MGd (42.8 MLd), which is anticipated to be met by an estimated 22 new wells at Andersen Air Force Base (AFB), rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 2.5 MG (9.5 ML) water storage tanks would be constructed at ground level at NCTS Finegayan. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

Basic Alternative 1 would require water supply, water treatment, water storage, and water distribution components to meet the demand of the military relocation as summarized in Table 2.2-17 and presented in Figure 2.2-1. Development of these water system components would result in a future water supply as summarized in Figure 2.2-1 and Table 2.2-18.

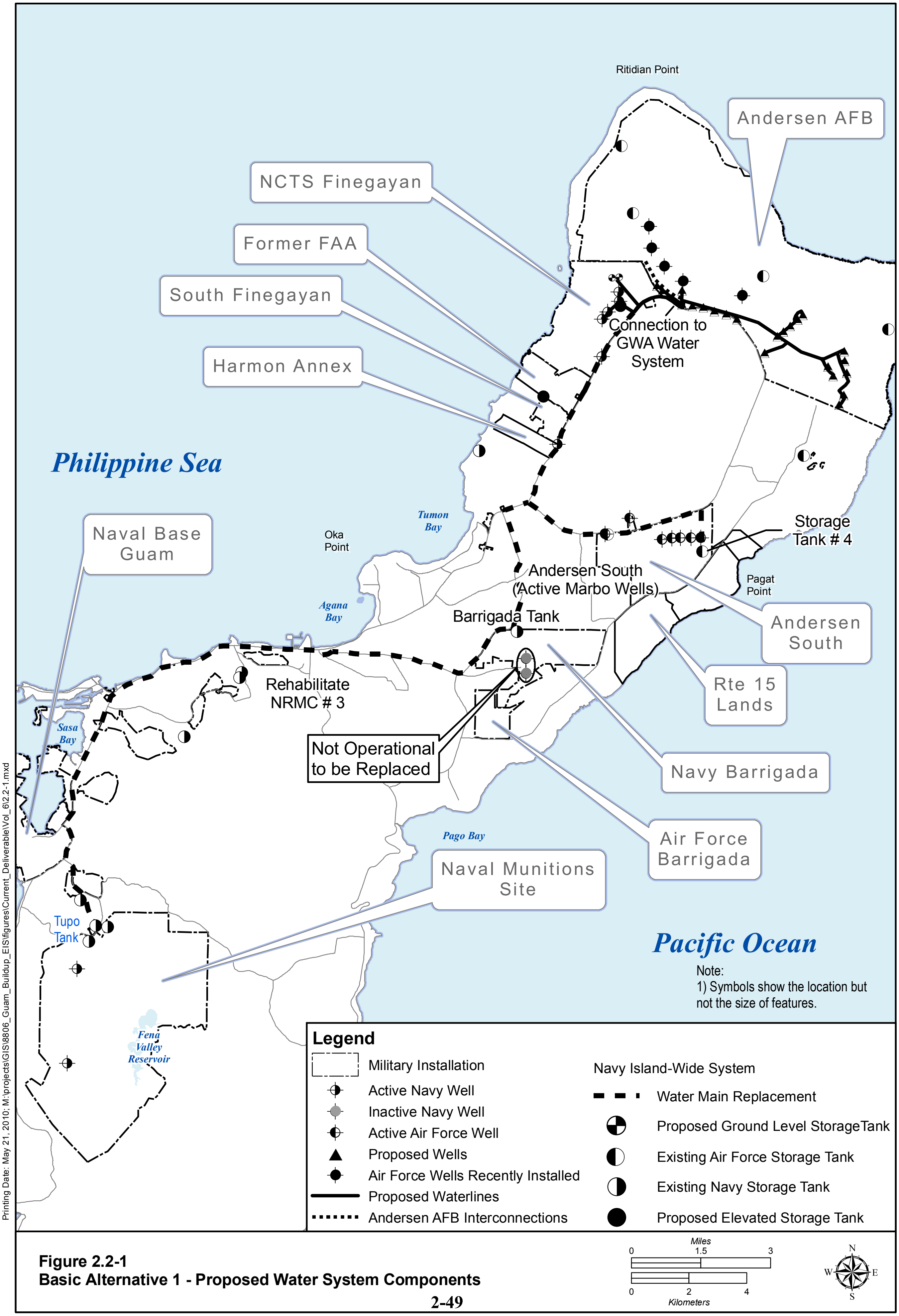

Figure 2.2-1
Basic Alternative 1 - Proposed Water System Components

Table 2.2-17. Basic Alternative 1—Proposed Water System Components

Component	*Description*
Water Supply	• Development of well capacity of 11.3 MGd anticipated to be met by an estimated 22 new wells (including one contingency well) on Andersen AFB • Use of five recently installed wells at Andersen AFB • Continued use of existing Navy wells on Finegayan • Rehabilitation of Navy wells
Water Treatment	• Disinfection and fluorination at the well heads prior to transmission to the base
Water Storage	• Construction of new storage tanks on Finegayan • Abandonment of existing Navy storage tanks on Finegayan
Distribution System	• Waterlines to transport the water from supply wells to storage tanks • Waterlines to distribute water throughout Finegayan • An interconnect with the Navy's islandwide water system • For purposes of the EIS, provide improvements to the Navy's islandwide water system (i.e., size pipes appropriately, replace corroded pipes, transport water to the south as well as north) • Replace water mains connecting existing Navy wells to the water system • Connection to the AF water system • Connection to the GWA water system

Legend: AFB = Air Force Base; EIS = Environmental Impact Statement; GWA = Guam Waterworks Authority.
Source: NAVFAC Pacific 2010h.

Table 2.2-18. Basic Alternative 1—Proposed DoD Water Supply and Demand

	Water Supply (in MGd)			
Water Supply Sources(Existing and Proposed)	*Marine Corps Finegayan*	*Andersen AFB*	*Navy*	*Total*
Main Cantonment Alternative 1 & 2				
Current Surface Water Supply			10.97	10.97
Current Groundwater Supply		4.73	2.21	6.94
Development of new water supply wells	11.28			11.28
Rehabilitation of existing Navy wells			1.23	1.23
Planned Supply Cantonment Alternative 1 & 2	11.28	4.73	14.41	30.42
GWA Transfer From Fena Reservoir	0.00	0.00	4.00	4.00
Maximum Daily Demand using UFC Guidance	10.61	4.88	12.98	28.48
Maximum Daily Demand using UFC Guidance+ GWA Transfer	10.61	4.88	16.98	32.48
Maximum Daily Demand using Sustainability Principles	6.33	2.99	9.75	19.08
Maximum Daily Demand using Sustainability Principles +GWA Transfer	6.33	2.99	13.75	23.08

Legend: AFB = Air Force Base; GWA = Guam Waterworks Authority; MGd = million gallons per day; UFC = Unified Facilities Criteria.
Source: NAVFAC Pacific 2010h.

This alternative would result in excess water of 0.7 MGd (2.5 MLd) at Marine Corps Finegayan, a deficit of 2.6 MGd (9.8 MLd) for the Navy's islandwide system and a deficit of 0.2 MGd (0.8 MLd) at Andersen AFB for Main Cantonment Alternatives 1 and 2. The water demand estimates are based on the conservative assumptions presented in the UFC water supply guidance (DoD 2001, 2005, 2006). There is adequate water supply on all DoD bases to meet average daily demand. Assuming the modified demand shown in Table 2.2-14, the capacity of the Navy and Andersen AFB water supply would be sufficient.

DoD Water Supply

Basic Alternative 1 would develop water supplies in northern Guam (water supply wells) and rehabilitation of a Navy well on Finegayan, and central Guam (rehabilitation of the Navy wells at the Navy Regional Medical Center and Navy Barrigada), would include the capability to distribute water from north to south, and interconnections with the Andersen AFB and GWA water systems. The proposed locations for new water supply wells to be constructed under Basic Alternative 1 are based on information regarding the sustainable and available yield of aquifer subbasins and other siting constraints as discussed below.

Potential Locations for New Proposed DoD Wells

There are numerous constraints imposed through DoD and GEPA guidance relating to well siting. This guidance is intended to minimize contamination of the water supply and interference between adjacent wells. All proposed DoD wells would be located on DoD land. DoD would consult with GEPA on applicability of this guidance and where wells would be located.

Potential water supply well locations were initially sited with consideration of the following land ownership and constraints:

- Limiting well production within subbasins so that the sustainable yield would not be exceeded
- Preferentially locating wells in parabasal zones (as opposed to basal zones) to achieve higher yield with lower chloride levels, thereby reducing the number of wells and associated costs
- Maintaining a 1,000-ft (305-m) distance from the shoreline to avoid saltwater intrusion
- Maintaining an approximately 800- to 1,000-ft (244- to 305-m) distance from other supply wells

The parabasal zones—areas where the freshwater lens bottom is in contact with basement rock, where the basement surface rises above the freshwater-saltwater interface—are roughly drawn in Figure 2.2-2. It is assumed that the parabasal zone extends seaward to a point where the top of the impermeable volcanic basement underlies the limestone aquifer at depth of approximately 131 ft (40 m) below mean sea level (msl). A transitional parabasal/basal zone is assumed to exist in the area where the top of the impermeable volcanic basement underlies the limestone aquifer at depths between 131 and 196 ft (40 and 60 m) below msl. These assumptions are based on existing GWA well locations described as parabasal or transitional that appear to meet these characteristics, according to available volcanic basement contour maps.

The proposed well locations are clustered in the region of the parabasal zones because the wells are expected to have a higher capacity than wells in the basal zone and are less likely to have saltwater intrusion. Some considerations for the proposed locations include:

- According to volcanic-bedrock contour mapping, a substantial portion of the available potential high-yield parabasal zone exists on or near the military reservation boundary.
- If the parabasal zone were to yield less than the proposed well production, some of the wells may need to be relocated to the basal zone on DoD land, farther from the DoD boundary, and additional wells may need to be installed. This alternative layout is not presented in this document because of the uncertainty about land use by Andersen AFB closer to the active facilities. Approximately twice the number of wells would be required if wells were to be located in the basal zone rather than the parabasal zone.
- One of the proposed well locations falls within the inhabited building distance explosive safety quantity-distance arc on Andersen AFB. Because of the spatial limitations, some proposed well locations are near or within residential zones. The Air Force would review and approve facility locations at Andersen AFB. Facility design would incorporate Andersen

AFB requirements. For instance, wells located near the runways would be frangible or flush mounted.

- Wells are located more than 300 ft from the nearest unsewered areas outside of DoD land.
- Wells are located more than 300 ft from the nearest GWA wastewater pumping station.

Figure 2.2-2 presents the l well location or placement constraints. Figure 2.2-5 shows the locations of sinkholes and caves. This figure is from the technical report prepared by WERI, Karst Features of Guam, Mariana Islands (WERI 2004). DoD would continue to seek additional information sources for sinkholes and caves as current sources may not be complete and any new information would be used in future design work. Additional constraints are listed in Table 2.2-19.

Potential Contaminant Impacts on Sources of Drinking Water

- Potential sources of contamination exist on or near Andersen AFB. These include, but are not limited to, the installation restoration sites, a utility corridor including a sewer line, and storm water injection wells.
- DoD would comply with all necessary stormwater requirements. Because the primary military relocation area would not be at Andersen AFB, impacts on stormwater resulting from the military relocation on the proposed wells would be minimal. The Main Cantonment area is within the Finegayan subbasin. Design of the Marine Corps Base would implement Low Impact Development (LID) to manage stormwater in a manner which is similar to the predevelopment hydrology at the site. Design techniques are selected which infiltrate, filter, store, evaporate, and detain runoff close to its source. Small landscape features, known as Integrated Management Practices, are located at the lot level to manage stormwater. Areas selected for Integrated Management Practices include open space, rooftops, streetscapes, parking lots, sidewalks, and medians. The benefits of implementing LID include groundwater recharge and less environmental impact. More information on the LIDs study is provided in Section 2.4.1. This scope of this study does not cover all areas where water system structures are planned.
- Dry wells would not be installed on the Marine Corps Base. Dry wells can provide a direct conduit to the NGLA.
- Sinkholes would be avoided in design and construction; a licensed geologist would conduct a pre-construction survey to identify sinkholes; impacts of sinkholes found during this survey would be determined and projects would be designed in consideration of these sinkholes.
- The proposed wells would be located away from Installation Restoration sites where warranted, based on the nature of the IR site. All well locations would be tested for water quality before installation. If elevated contaminant levels were detected, the wells would be relocated or the design would be revised to include the appropriate treatment processes. A chlorinated-solvent plume containing trichloroethylene (TCE) and perchloroethylene (PCE) concentrations greater than the USEPA drinking water maximum contaminant levels (MCLs) is identified in groundwater on Andersen AFB. Monitoring wells with elevated levels of chlorinated solvents are shown in Figure 2.2-2. This plume is downgradient from the wells and is not expected to affect the proposed well locations.

Table 2.2-19. Well Location Constraints

Location Constraint	*Comments/Approach to Well Placement*
DoD Land	Wells are located on DoD land.
Sustainable Yield	The combined capacity of the existing and planned wells is less than the 1992 sustainable yield estimate.
Parabasal/Basal Zones	Wells are clustered in the parabasal zone to maximize production of the aquifer. Lower chloride levels and higher production are anticipated for parabasal zone wells. Wells are located more than 1,000 ft from the shoreline to avoid saltwater intrusion.
Proximity to Existing and Proposed Air Force and GWA wells	Maintain an approximately 800- to 1,000-ft distance from other supply wells. Monitor for saltwater intrusion. Coordinate with GWA.
Current and Future Land Usage: • Impact on Air Force Mission and Quality of Life • Future Construction in Residential Area • Future Paving of the Utility Corridor	All facility locations would be reviewed by and require the approval of the Air Force.
Explosive Safety Quantity Distance (ESQD)	Wells are located outside all ESQD arcs, except one well that falls inside the inhabited building distance (IBD) arc near the boundary.
Potential Contaminant Sources: • Fuel Pipeline in the Utility Corridor • Fuel Storage • Dry Cleaners • 79 Installation Restoration Program Sites including Active and Inactive Landfills • Areas of past hazardous substance activities • Landfills and target ranges on the Marine Corps Finegayan Base • Underground Injection Control Wells in the Andersen AFB Main Base Area • Unsewered properties • Wastewater pumping stations	Maintain an approximately 800- to 1,000-ft distance from contaminant sources where possible. Water quality would be evaluated during the pilot hole testing and periodically during well use.
Chlorinated VOC Plumes in the Andersen AFB Main Base Area	Monitoring wells with elevated levels of chlorinated VOCs are downgradient from the proposed well locations. Water quality would be evaluated during the pilot hole testing.
UXO/MEC	Precautions would be taken during construction for UXO/MEC.
Sewer Main along Route 9	If wells are proposed along Route 9, DoD would conduct a study to evaluate the integrity of the sewer main.
Runway Approach	DoD/Air Force requirements for design would be observed. Well heads would be flush with the ground or frangible.
Sinkholes and caves	Wells would be located away from known sinkholes and caves.
• Cultural Resources • Sensitive Habitat	Location specific studies are being conducted by DoD. Facility locations would be adjusted as required.

Legend: DoD = Department of Defense; ESQD = explosive safety quantity-distance; ft =feet; GWA = Guam Waterworks Authority; UXO/MEC = unexploded ordnance/ munitions and explosives of concern; VOC = volatile organic compound.

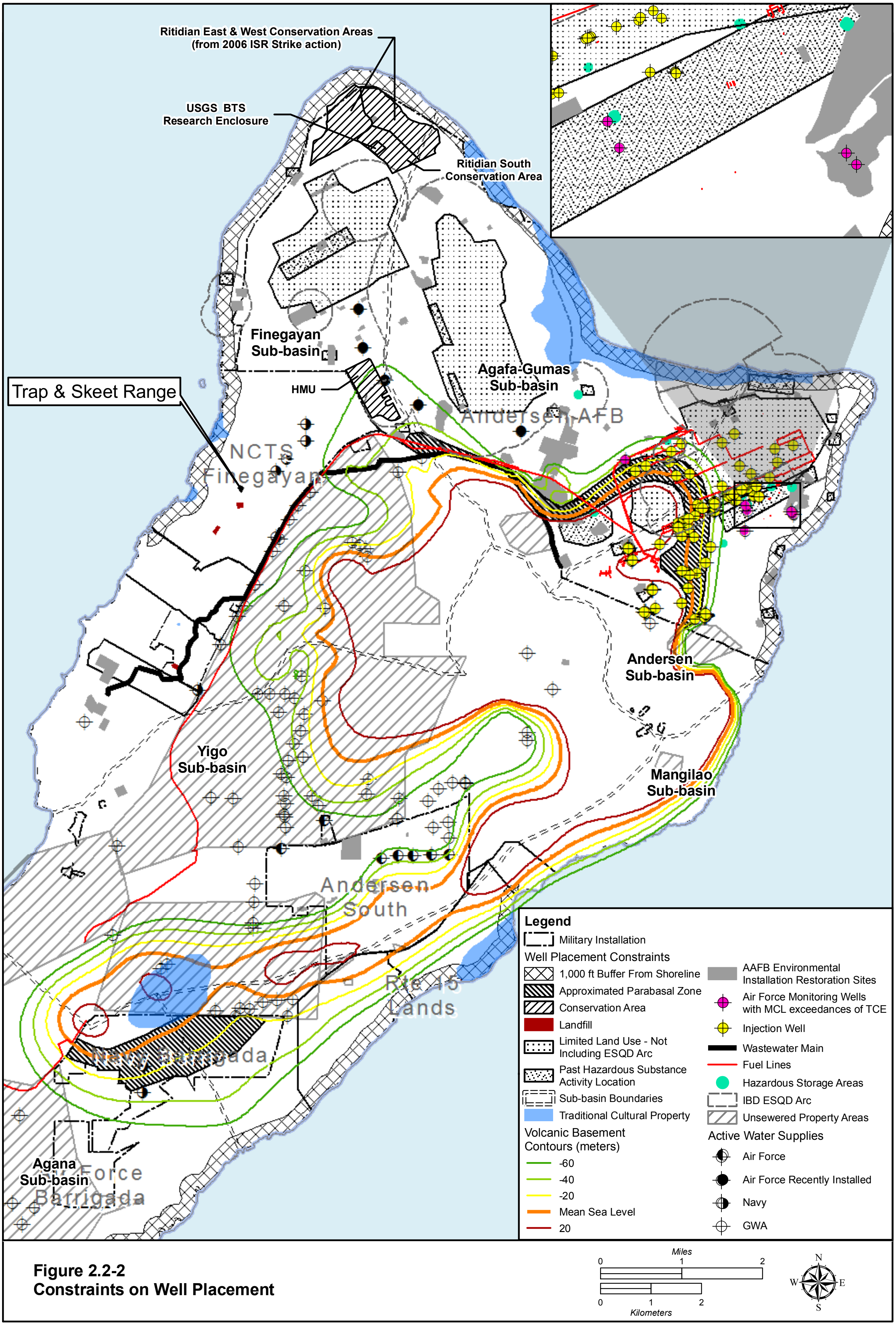

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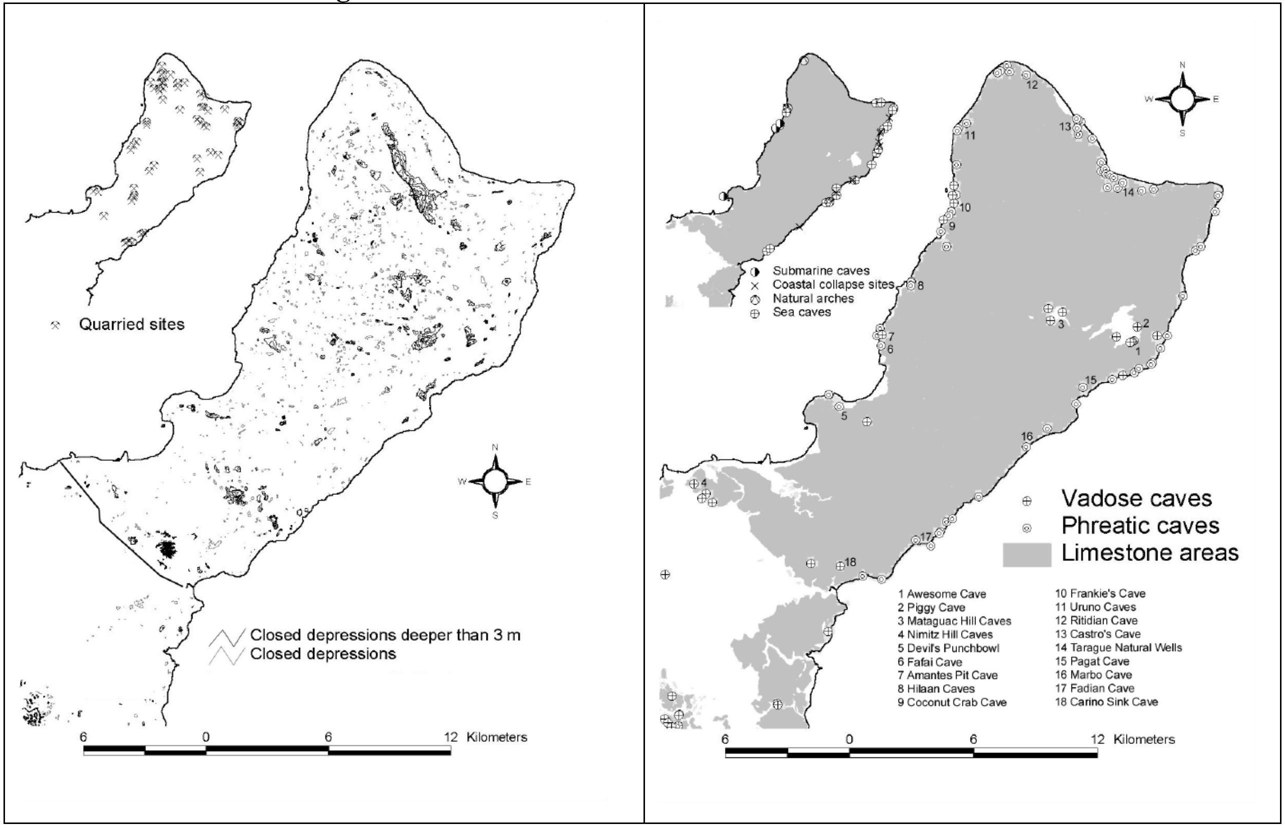
Figure 2.2-2
Constraints on Well Placement

Figure 2.2-3. Sinkholes and Caves in Northern Guam



- Unexploded ordnance (UXO) and munitions and explosives of concern may be found at Andersen AFB. In accordance with Naval Ordnance Safety and Security Activity Instruction 8020.15B, Explosives Safety Submission (ESS) documentation must be prepared that details how explosive safety standards are applied to munitions responses. The ESS also addresses how a project would comply with applicable environmental requirements related to the management of munitions and explosives of concern and material potentially presenting an explosive hazard. At munitions response sites, no site operations may begin unless Naval Ordnance Safety and Security Activity and the DoD Explosive Safety Board have reviewed and approved the ESS. An ESS is prepared for on-site construction support where the likelihood of encountering UXO is determined to be moderate or high and where ground-disturbing or other intrusive activities, including dredging may occur in areas known or suspected to contain UXO. The ESS outlines specific measures to be taken to ensure the safety of workers and the public.
- Studies of cultural resources and sensitive habitat are ongoing. Well locations may be modified as a result of these studies.
- As part of the well permitting process, GEPA would conduct a review of each well location and review site-specific data. Additionally, all federal projects proposed over the NGLA are subject to an aquifer protection review. Projects are reviewed for potential direct or indirect impacts on groundwater. Submittal of detailed site plans, plumbing plans, engineering studies, and calculations may be required. Most recent cultural and natural resources studies being conducted by DoD would also be reviewed.

Groundwater Quality

Historical water quality data from GWA wells are in Table 2.2-20. The Air Force regularly monitors the water quality at South Andersen Annex in the Yigo subbasin. A summary of data collected from the Tumon Maui and Marbo wells is provided in Table 2.2-20 through Table 2.2-24. No data is available for the Agafa-Gumas subbasin. Monitoring well data related to site investigations is available for the Andersen subbasin. Data characterizing biological contamination in the groundwater is not available for this study. Some issues with the water quality from the DoD wells are:

- Groundwater from the Northern Guam Lens is typically hard, containing calcium and magnesium carbonate.
- Tumon Maui and Marbo #2 are not in service due to volatile organic contamination.
- Routine bacteriological testing at wells in the Finegayan area and Naval Hospital area has identified the presence of total coliform and E. coli.
- Chloride levels rose to unacceptable levels (i.e., greater than 250 mg/L) in some wells.
- TCE was detected in monitoring wells above MCLs located on the eastern side of Andersen AFB.

Table 2.2-20. Historical Water Quality

Constituent	*MCL*	*Wells*				*H-1*	*M1-1*
		A Series	*A-9*	*D Series*	*Y Series*		
pH	6.5-8.5	7.0	7.0	7.2	7.3	7.3	7.1
Residue on evap.	n/a	360	600	370	275	450	350
Total Hardness	n/a	292	360	226	242	265	380
Calcium (Ca)	n/a	113	130	78	85	88	98
Ca as $CaCO_3$	n/a	283	325	195	213	220	245
Magnesium (Mg)	n/a	2	10	6	7	10	8
Mg as $CaCO_3$	n/a	8	41	25	29	41	33
Chloride	250	16	140	50	17	95	30
NO_3	n/a	9	9	9.5	9.3	9	4
SO_4	250	2.5	13	8.0	2.0	20	4.5
Iron	0.3	0.01	0.01	0.02	0.02	0.02	0.03

Note: Units are mg/L, except pH

Legend: Ca = Calcium; $CaCO_3$ = Calcium Carbonate; MCL = maximum contaminant level; Mg = Magnesium; n/a = not available; NO_3 = Nitrate; pH= hydrogen ion concentration; SO_4 = Sulfate.

Source: Mink 1976

Table 2.2-21. Harmon and Tumon Sampling Points Downgradient of Andersen South Annex Operating Unit

Analyte	*Units*	*MCL*	*Samples Taken 1978-2007*		
			Min.	*Max.*	*Meeting or Exceeding USEPA Threshold, Result (month/year)*
VOCs					
PCE	µg/L	5	0.2 (est.)	22.4	5 (9/89), 9 (8/90), 8.3 (4/91), 6.1 (6/91), 7.6 (3/94), 14.6 (12/94), 11.6 (3/95), 11.6 (4/95), 12.9 (5/95), 13.1 (5/95), 13.4 (9/95), 9.4 (9/95), 11 (12/96), 11.2 (2/97), 18.2 (2/97), 19.9 (2/97), 19.5 (2/97), 22.4 (2/97), 5.2 (6/01), 5.4 (8/01), 5.0 (8/01)
TCE	µg/L	5	0.2	5.2	5.4 (6/01)
Water Quality Parameters					
Alkalinity, Bicarbonate	mg/L	n/a	154	160	
Chloride	mg/L	250	0.19	9200	

Legend: µg/L= microgram per liter; n/a = not available; PCE = Tetrachloroethene; VOC = volatile organic compounds.

Table 2.2-22. Tumon Maui Well Groundwater Field Quality Parameters 2003-2007

Parameter	*Units*	*MCL*	*Min.*	*Max.*
Ph	pH	6.5-8.5	6.7	7.46
Specific Conductivity	µmhos/cm	1600	0.756	980
Temperature	ºC	n/a	27.01	28.96
Turbidity	NTU	TT	0	9.5
Dissolved Oxygen	mg/L	n/a	3.46	16.23
Redox	mV	n/a	86	508
Chloride	mg/L	250	75.3	119

Legend: mV = millivolt; n/a = not available; NTU = nephelometric turbidity unit; ºC = degree Celsius; TT = 95% of samples measured every 4 hours < 0.3 NTU; µmhos/cmmicromhos per centimeter.

Table 2.2-23. Production Well MW-2 Groundwater Analytical Results, Andersen South Annex

Analyte	*Units*	*MCL*	*Samples Taken 1996-2006* *Min.*	*Max.*	*Meeting or Exceeding USEPA Threshold, Result (month/year)*
VOCs					
PCE	µg/L	5	>0.1	0.2	—
TCE	µg/L	5	0.4	5.8	5 (10/96), 5.4 (10/00), 5.8 (10/01), 5.7 (5/02), 6 (10/02)
Water Quality Parameters					
Alkalinity, Bicarbonate	mg/L	n/a	210	216	—
Chloride	mg/L	250	13.8	67.2	—

Legend: n/a = not available

Table 2.2-24. MW-2 Groundwater Field Quality Parameters, 1996-2006

Parameter	*Units*	*MCL*	*Min.*	*Max.*
pH	pH	6.5-8.5	6.44	8.31
Specific Conductivity	µmhos/cm	1600	398	686
Temperature	ºC	n/a	26.61	30.11
Turbidity	NTU	TT	0	271
Dissolved Oxygen	mg/L	n/a	0.32	9.41
Redox	mV	n/a	-175	3932
Chloride	mg/L	250	6.28	74.7

Legend: NA = not available; NTU = nephelometric turbidity unit.

Installation Restoration Program

There are 79 sites for Andersen AFB and annexes (Figure 2.2-4) with Installation Restoration preprogram (IRP) activities that are currently implemented or proposed to be implemented. There are two sites where groundwater impacts are currently a concern. Site 20, Waste Pile 7, in Andersen South Annex has impacts to groundwater exceeding MCLs for TCE and PCE. A 2000 Interim Remedial Measure covered contaminated soil, long-term management of soil and groundwater contamination. No new wells are proposed in Andersen South Annex. Site 1, Landfill 1, is an active sanitary landfill on the main base that is operated under a Resource Conservation and Recovery Act Subtitle D permit. The inactive portion of the landfill was capped in 1998 with a geotextile membrane and soil cap cover. The inactive portion of the landfill was closed in 2001 with a Resource Conservation and Recovery Act Subtitle D cap in 2001. Groundwater samples from 16 monitoring wells are collected semi-annually to monitor potential impacts of contaminants in the landfill to groundwater. No further actions are planned for the inactive portion of the landfill. Groundwater monitoring would continue as part of the long-term management plan for a period of 30 years. At Site 26, Firefighter Training Area 2, the Air Force opted to install and operate a vapor extraction/bioventing system to address contamination released from an abandoned underground storage tank used to store waste fuel, although the contamination did not represent an unacceptable risk to human health and the environment due to concern that the chemicals could potentially impact groundwater.

There are 24 sites where no further actions are required according to a signed Record of Decision (ROD) or are proposed pending signature of a ROD. Three sites were transferred to Military Munitions Response Program because only ordnance and explosives (OE) was identified. Land use controls are recommended for six sites to prevent exposure to contaminated soil. Contaminated soil removal is recommended at 19 sites. Remedial actions or Interim Remedial Measures have been conducted at 23 sites.

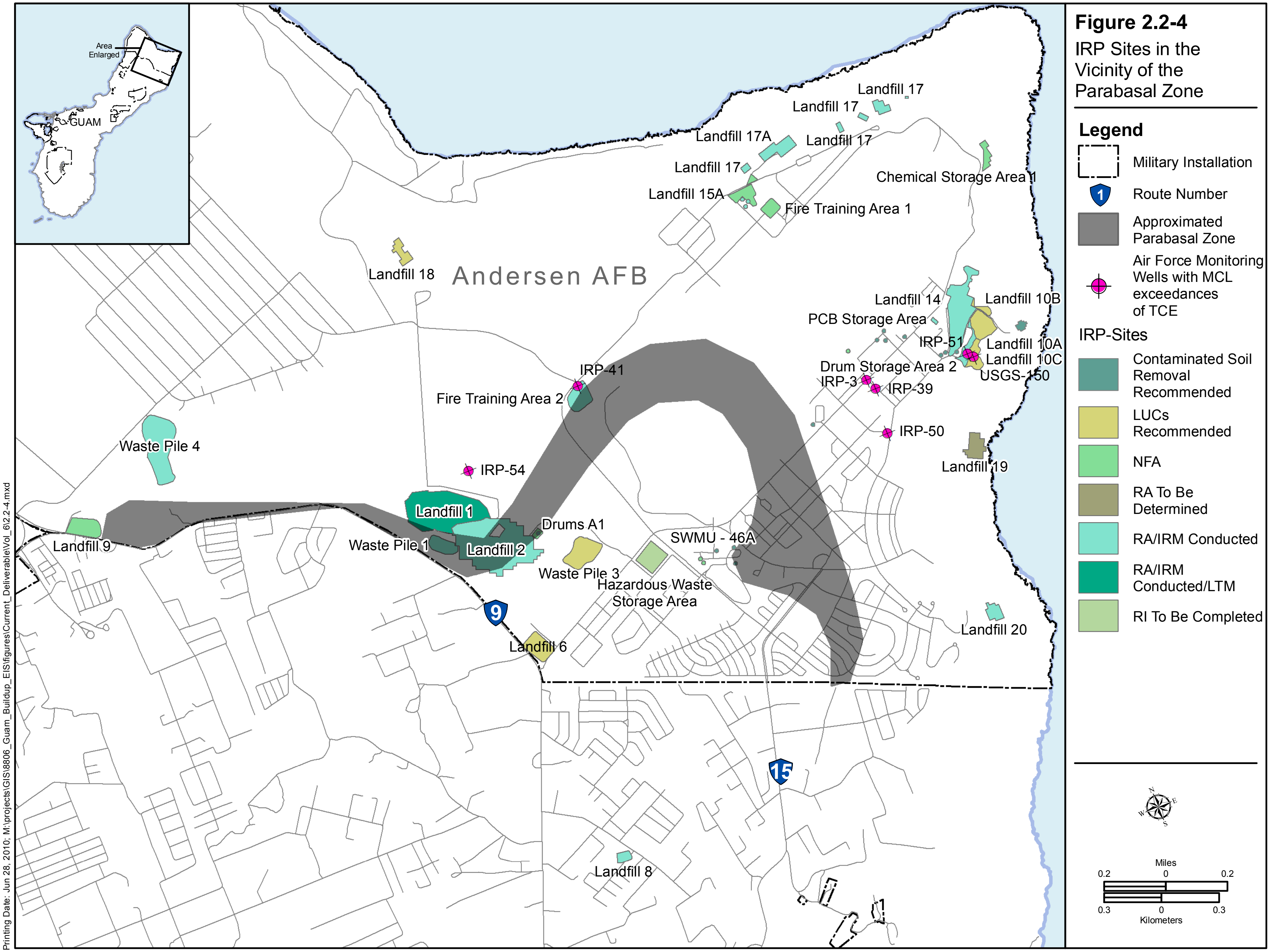


Figure 2.2-4

IRP Sites in the Vicinity of the Parabasal Zone

Remedial Investigations are being conducted at three sites on the main base. Site 27, Hazardous Waste Storage Area 1, reportedly used as an outside storage of petroleum, oils, lubricants and solvents from the 1950s to the 1970s. No compounds of concern were identified during an investigation in 1998. Site 54, Building 18006, is an area where wastes from aircraft operations were disposed according to historical documents. Previous investigations detected TCE in subsurface soils. Site 79, Air to Ground Gunnery Range, was reportedly used as a gunnery range and a sanitary dump. Dichlorodiphenyltrichloroethane, copper and lead were detected above residential preliminary remediation goals at this site. At Site 14, Landfill 19, investigation identified surface soils containing polychlorinated biphenyls, arsenic, and lead identified. The ROD documenting the recommended remedial action is expected in 2010.

A groundwater monitoring program is conducted for all operable units. Groundwater sampling at the Main Base Operable Unit has identified volatile organic compounds, semivolatile organic compounds, polynuclear aromatic hydrocarbons, pesticides, and metals. Benzo(a)pyrene, PCE, TCE, and chromium have been detected above the MCL. Benzo(a)pyrene, PCE, TCE, and chromium are the only compounds in the long-term groundwater monitoring program for the Main Base Operable Unit. Chromium contamination has been attributed to non-contaminant sources such as well screen corrosion. During the Spring 2006, of the 19 wells sampled all TAL metals were below action level except one well, IRP-54, which was detected above the federal MCL of 100 µg/L at 104 µg/l. Table 2.2-17 lists the wells with TCE or PCE exceedances above MCLs between 1996 and 2006. IRP-3, IRP-39, IRP-51, U.S. Geological Service (USGS)-150 and IRP-50 are located downgradient from the parabasal zone in the Andersen subbasin. Well IRP-41 with TCE concentrations ranging from nondetect to 8 µg/L is located near the parabasal zone. Groundwater sampling would be conducted as part of production well installation to determine if treatment is required. Three of the wells with concentrations exceeding MCLs are located within an IRP sites (Site 8, Site 26, and Site 33). Information on the sites is provided in Table 2.2-25. Given the distance below ground surface, the TCE or PCE contamination may originate from a different location.

Table 2.2-25. TCE and PCE Concentration Ranges in Wells with Detections above MCLs

Well ID	*TCE Concentrations (µg/L)*	*PCE Concentrations (µg/L)*	*IRP Site Where Well is Located*
IRP-3	49 to 169	3 to 7.3	None
IRP-39	15 to 28	14 to 35	None
IRP-51	12 to 30	<MCL	Site 33 Drum Storage Area 2 Oil stained soil and drums of debris Soil removal completed in 2007
USGS-150	0.3 to 15	<MCL	Site 8 Landfill 10 Lead, pesticides and benzo(a)pyrene in soil ROD recommending LUCs awaiting signature
IRP-50	1.3 to 5	<MCL	None
IRP-41	ND to 8	<MCL	Site 26 Firefighter Training Area 2 Fuels, MOGAS, Petroleum, Oils, Lubricants and Solvents Vapor Extraction/Biovent System Operated until 2007

Notes: PCE MCL = 5 µg/L; TCE MCL = 5 µg/L.

Legend: ID = identification; IRP = Installation Restoration Program; LUC = Land Use Control; MCL = Maximum Contaminant Level; ND = non detect; PCE = tetrachloroethylene; ROD = Record of Decision; TCE = trichloroethylene; µg/L = micrograms per liter; USGS = United States Geological Service.

Groundwater sampling was discontinued at the Northwest Field Operable Unit and the Harmon Annex Operable Unit in 2003. Groundwater sampling is conducted at the Marbo Operable Unit for volatile organic compounds as a component of the monitored natural attenuation remedy for groundwater impacted by TCE and/or PCE. Several monitoring wells are sampled for all compounds of concern near Waste Pile 7 to monitor for potential contamination of groundwater by leachate from the capped waste pile. No production wells are proposed in the Northwest Field, Harmon Annex, or Andersen South Annex.

Estimates of Sustainable and Available Yield

Sustainable yield is defined as the rate at which groundwater can be continuously withdrawn from an aquifer without impairing the quality or the quantity of the pumped water. To sustainably approach the hypothetically available sustainable yield, the means of water withdrawal has to be optimized.

The NGLA is divided into six subbasins based on hydrological divides in the subsurface: Agafa-Gumas; Agana; Andersen; Finegayan; Mangilao; and Yigo. Figure 2.2-2 shows the location of the subbasins. Two estimates of the NGLA have been published, one by the Northern Guam Lens Study (NGLS) (CDM 1982) and one by Barrett Consulting with John Mink (Barrett 1992).

The NGLS estimates were based on a steady-state condition and relied on conservative assumptions such that future development and groundwater management programs could be easily implemented. The NGLS was the first to divide the aquifer into a series of six subbasins and 47 management zones. The subbasin division is based primarily on topographic expression of basement topography forming effective hydrological divides in the subsurface. Based on the position of the freshwater lens, the subbasins can be either basal (freshwater lens floating on top of saltwater) or parabasal (freshwater lens bottom in contact with basement rock, where the basement surface rises above the freshwater-saltwater interface). Management zones were established to optimally manage well fields within the basin.

The second estimate of sustainable yield was prepared by Barrett (1992), who revised the simulation to a transient system rather than steady-state. Barrett argued that the NGLA is best described as a transient system because the majority of the recharge comes during the wet season and transient conditions best represent seasonal variations in recharge. The revised estimate of sustainable yield using transient conditions increased sustainable yield to approximately 80.5 MGd (305 MLd).

Table 2.2-18 compares sustainable yield estimates of the NGLS (CDM 1982) and Barrett (1992) reports for each subbasin, and presents current estimates of well production and available yield. The majority of the Andersen and Agafa-Gumas subbasins lie beneath existing DoD land (Andersen AFB and Northwest Field). Additionally, a substantial portion of the Finegayan subbasin lies below the Naval Communication Station property abutting the Northwest Field to the south. The yield estimates presented here use the yield estimates presented by Barrett (1992) as the basis for determining available yield (Jensen 2006).

The management zones identified in the 1982 NGLS do not match the subbasin boundaries, which are based on the 1991 volcanic-basement contours. As a result of this discrepancy, the analysis presented here does not rely on the 1982 NGLS management zones. Additionally, the NGLS management zones were established as a means of managing well fields. With the changes to the number and location of wells since the early 1980s, the zones described by the NGLS in 1982 appear to be outdated.

University of Guam WERI provided an expert technical review of the assumptions used in the Barrett 1992 sustainable yield estimate for the NGLA in 2009. The study concluded that the approach and methodology used in Barrett 1992 to estimate the sustainable yield are still valid and are appropriate for initial planning; and the Barrett 1992 sustainable-yield estimates should be used instead of the earlier 1982 sustainable-yield estimates (CDM 1982) because the later values are based on an additional decade of field data. The 1982 sustainable-yield estimates are excessively conservative according to WERI.

The DoD is supporting a USGS study of the NGLA that would include a state-of-the-art groundwater model and verification of the sustainable yield on all relevant and available site-specific data collected to date. The study is expected to take three years to complete. Installation of the water system for the relocation would commence in 2011. By this time, the modeling effort would be advanced and preliminary results of this study would be reviewed by DoD and incorporated into the construction specifications as appropriate. The model would also be used in the long-term maintenance of the NGLA groundwater resource. This is consistent with the 2009 WERI review of the earlier studies. Specifically, the study concluded that while a revised state-of-the-art model would be a useful tool for long-term management of the aquifer, it is not likely to provide a significantly different outcome for sustainable yield. More information on the WERI 2009 study and the USGS modeling effort is provided in Section 2.2.5.

Based on these estimates of available yield presented in Table 2.2-26, it is clear that groundwater resources are underdeveloped within the Andersen and Agafa-Gumas subbasins. Assuming average daily demand for the base, use of the Andersen and Agafa-Gumas subbasins would be much less than even the more conservative 1982 estimates of sustainable yield. Well production from the Andersen and Agafa-Gumas subbasin would not significantly impact the GWA water system, even if the 1982 sustainable yield estimates are incorrect, because only a few percent of the combined well capacity of the GWA water supply falls within these subbasins.

Table 2.2-26. Estimates of Sustainable and Available Yield for Subbasins in the NGLS

Subbasin	*Well Production*	*NGLS (CDM 1982)*		*Barrett (1992)*	
		Sustainable Yield	*Available Yield*	*Sustainable Yield*	*Available Yield*
Agana	10.4	11.7	1.3	20.5	10.1
Mangilao	2.5	3.9	1.4	6.6	4.1
Andersen	0.7	6.2	5.5	9.8	9.1
Agafa-Gumas	0.3	10.1	9.8	12.0	11.7
Finegayan	8.9	6.4	-2.5	11.6	2.7
Yigo-Tumon	19.4	19.1	-0.3	20.0	0.6
Totals	42.4	57.4	15.0	80.5	38.1

Legend: NGLS = Northern Guam Lens Study.

Sources: CDM 1982, Barrett 1992, NAVFAC Pacific 2005, HHMI Corporation, Helber Hastert & Fee, Planners, Inc. 2006, GWA 2007.

Climate change is likely to negatively impact Pacific islands including Guam. The degree to which climate change and variability would affect Guam depends upon a variety of factors including geology, area, height above sea level, extent of reef formation, and the size of the freshwater aquifer (USEPA 2009c). *Because* Guam *i*s *a* small islands, *it* is considered vulnerable to c*limate change because extreme ev*ents can have a major impact on small islands. The climate studies conducted are global in focus or centered on particular regions or the earth*. However, studies s*pecific to Guam are not currently available. WERI plans to complete studies specific to Guam. *S*tudies *specific to Guam* would presumably be more relevant to predictions of future impacts on the NGLA because the characteristics and hydrogeology of the aquifer can be considered.

A parabasal zone exists in both the Andersen and Agafa-Gumas subbasins, meaning that these subbasins have the potential for increased production rates. The majority of these subbasins lie under DoD land (see Figure 2.2-2). They are also close to the proposed location for the Main Cantonment at Finegayan. Therefore, Basic Alternative 1 proposes to develop 19 new water supply wells within the Agafa-Gumas and Andersen subbasins. Three wells are proposed for the Finegayan subbasins. Additionally, five wells were recently installed at Andersen AFB.

Components of the Water Systems Figure 2.2-1 and Table 2.2-27 present the well capacity and subbasin location for each of the proposed wells needed to meet new demands for potable water at the Finegayan Base resulting from the military relocation on Guam. DoD would work with GWA during design and implementation of the DoD wells and during well operation to maximize use of the aquifer. DoD would attempt to locate water system components including wells and transmission mains within existing utility corridors to the extent possible.

Table 2.2-27. Basic Alternative 1—Proposed Well Details

Well Number	*Proposed Capacity (gpm)*	*Subbasin*
1	450	Agafa-Gumas
2	450	Andersen
3	250	Finegayan
4	450	Agafa-Gumas
5	450	Agafa-Gumas
6	450	Agafa-Gumas
7	450	Agafa-Gumas
8	400	Finegayan
9	450	Agafa-Gumas
10	250	Andersen
11	450	Andersen
12	250	Agafa-Gumas
13	250	Andersen
14	250	Agafa-Gumas
15	250	Agafa-Gumas
16	250	Finegayan
17	450	Andersen
18	250	Andersen
19	250	Agafa-Gumas
20	375	Agafa-Gumas
21	450	Andersen
22	300	Agafa-Gumas

Legend: gpm = gallons per minute.
Source: NAVFAC Pacific 2010h.

DoD is conducting a study to determine optimal well and well field configurations needed to meet the future Marine Corps base water demands. This study will develop groundwater source well-design criteria used in developing the Marine Corps base water supply system. Test wells would be installed to characterize the production capacity of well fields in the areas of interest. Step-drawdown, pumping tests, collection of salinity and basic water quality parameters data, and groundwater sample collection for primary and secondary drinking water standard contaminants will be conducted. The test wells may eventually be converted to production wells. Completion of the study with report documentation is anticipated at the end of 2010. Preliminary results will not be available in time for the Final EIS. The results of this study could change the location and number of wells or the water treatment requirements. DoD is complying with permit requirements. GEPA reviews well siting proposals. DoD has worked with GEPA to select the test boring locations, avoiding potential sources of hazardous materials. The LIDs study includes an assessment of existing and future contamination within the watershed drainage basin. A source water assessment is not required by regulatory agencies and is not planned. However, the planning and permitting efforts for base and water system design and construction meet the substantive requirements of a source water assessment.

Well Construction

Wells would be constructed in limestone. For wells in the parabasal zone, it is assumed that wells would be terminated approximately 50 ft (15 m) below msl, and for wells in the basal/transitional zones, well termination is assumed to be 30 ft (9 m) below msl. Estimates of total well depth range between 512 and 577 ft (156 and 176 m) below grade. Drilling of investigatory wells would be undertaken before installation of each production well to establish correct well placement based on accurate volcanic basement contours.

Rehabilitation of Navy Wells

Water from two of the three wells at the Navy Regional Medical Center are biologically contaminated. The existing disinfection process would be evaluated and improved. Two Navy wells on Navy Barrigada are currently being replaced. One Navy well on Finegayan could be rehabilitated or replaced. Additional Navy wells may be replaced in another location to permit construction of the base and associated road-widening.

Water Treatment

Groundwater would be extracted and disinfected and fluorinated prior to transmission to the new base.

Water Distribution and Storage

Pumps at each well station would pump water from the wells to a storage tank after disinfection and fluorination.

Well Pumping Stations

Wellhouses would be constructed to meet typhoon and local building code requirements. Sufficient standby power would be provided to ensure that the average daily demand at the new base could be met during power outages. Each well station would include a submersible well pump with an aboveground discharge pipe that would need to be protected. Wells would be installed with pitless adapters for security. The discharge pipe would have an air/vacuum relief valve, check valve, surge relief valve, and flow meter. The land area requirement for each well station is estimated to be a minimum of 1,000 ft^2 (93 m^2).

Transmission Mains

Transmission mains would convey water from the wells to the storage tanks. The mains are expected to range from 8 to 30 in (20-76 centimeters [cm]) in diameter and would be sized to provide velocities less than 6 ft (2 m) per second to minimize head losses from friction.

Water transmission mains would convey water from the wells to the water storage and distribution system. Interconnections with Andersen AFB and the Navy islandwide water system would permit the transfer of water between the DoD water systems. A connection to the GWA system shown in Figure 2.2-1 is also proposed.

Water Distribution Pipes

Water would be distributed throughout the Main Cantonment through both 8-in (20-cm) and 12-in (30-cm) water mains with valves and hydrants spaced at intervals no greater than 500 ft (152 m). It is assumed that the pipes would follow the preliminary street layout. The size and locations of distribution piping would need to be coordinated with expected land uses, estimated domestic demands, and fire flow requirements for the structures that would be constructed on the base.

Water Storage

Two new 2.5 million gallon (MG) (9.5 million liter [ML]) ground level and up to two 1 MG (3.8 ML) elevated water storage tanks would be constructed at Finegayan.

2.2.4.2 Basic Alternative 2

Basic Alternative 2 would support Main Cantonment Alternatives 3 and 8, which would locate housing areas at Finegayan and Navy and Air Force Barrigada. For Basic Alternative 2, new water supply wells would be installed at Andersen AFB and Navy Barrigada, existing wells would be rehabilitated, and the T&D systems would be upgraded. Basic Alternative 2 would require water supply, water treatment (disinfection and fluorination), water storage, and water distribution components, as summarized in Figure 2.2-5 and Table 2.2-28.

Table 2.2-28. Basic Alternative 2—Proposed Water System Components

Component	*Description*
Water Supply	• Development of well capacity of 11.7 MGd anticipated to be met by an estimated 31 new water supply wells (20 new water supply wells (including one contingency well) at Andersen AFB and 11 new water supply wells (including one contingency well) at Navy Barrigada.
Water Treatment	• Disinfection and fluoridation prior to transmission to storage, if deemed appropriate.
Water Storage	• Continued use of existing Navy Barrigada storage tank • Construction of new storage tanks at Finegayan • Construction of a new storage tank at Air Force Barrigada • Abandonment of existing Navy storage tanks at Finegayan
Distribution System	• Waterlines to transport the water from supply wells to storage tanks • An interconnect with the Navy's islandwide water system • Improvements to the Navy's islandwide water system between Air Force Barrigada and Finegayan (i.e., extend system to Air Force Barrigada, size pipes appropriately, replace corroded pipes, transport water to the south as well as north)

Legend: *AFB = Air Force Base.*
Source: NAVFAC Pacific *2010h.*

Alternative 2 addresses the water demands in northern Guam. Water requirements at Andersen AFB and the Navy bases are projected to be currently adequate under average daily demand conditions and are not discussed in this alternative. It is estimated that water from wells installed on Navy Barrigada would be sufficient to meet the demand at Air Force Barrigada. Additional Marine Corps relocation–related demand at Barrigada would be met by the Finegayan water supply via the Navy's islandwide water system. As presented in Table 2.2-29, this alternative would result in excess water of 0.6 MGd (2.3 MLd) at Marine Corps Finegayan. The maximum daily demand on Navy bases plus the GWA transfer from Fena Reservoir exceeds the planned supply for the Navy by 2.6 MGd (9.8 MLd). The maximum daily demand on Andersen AFB exceeds the planned supply for the AF by 0.2 MGd (0.8 MLd). Assuming average daily demand from the Navy bases and the GWA transfer, there is an excess water supply of 1.7 MGd (6.4 MLd) in the Navy's islandwide water system. Assuming average daily demand from the Andersen AFB bases, there is an excess water supply of 1.7 MGd (6.4 MLd) in the Andersen AFB water system.

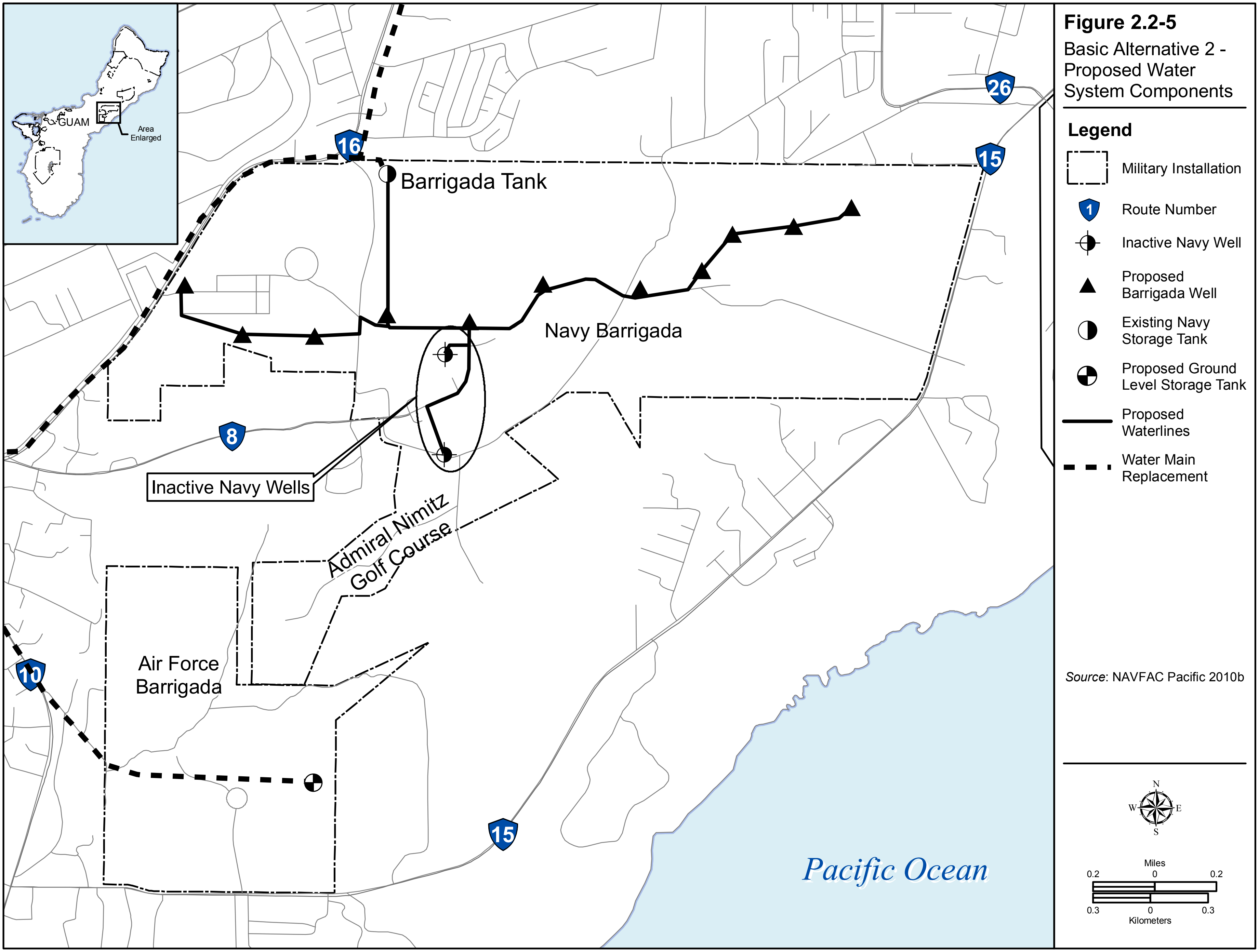


Figure 2.2-5
Basic Alternative 2 - Proposed Water System Components

Source: NAVFAC Pacific 2010b

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Table 2.2-29. Basic Alternative 2—Proposed DoD Water Supply and Demand

	Water Supply (in MGd)			
Water Supply Sources(Existing and Proposed)	*Marine Corps Finegayan*	*Andersen AFB*	*Navy*	*Total*
Main Cantonment Alternative 3 & 8				
Current Surface Water Supply			10.97	10.97
Current Groundwater Supply		4.73	2.21	6.94
Development of new water supply wells	11.68			11.68
Rehabilitation of existing Navy well			1.23	1.23
Planned Supply Cantonment Alternative 3 & 8	11.68	4.73	14.41	30.82
GWA Transfer From Fena Reservoir	0.00	0.00	4.00	4.00
Maximum Daily Demand using UFC Guidance	11.07	4.88	12.98	28.94
Maximum Daily Demand using UFC Guidance+ GWA Transfer	11.07	4.88	16.98	32.94
Maximum Daily Demand using Sustainability Principles	6.61	2.99	9.75	19.36
Maximum Daily Demand using Sustainability Principles+ GWA Transfer	6.61	2.99	13.75	23.36

Legend: AFB = Air Force Base; GWA = Guam Waterworks Authority; MGd = million gallons per day; UFC = Unified Facilities Criteria.
Source: NAVFAC Pacific 2010h.

Water Supply

Basic Alternative 2 would develop water supplies (water supply wells) in northern Guam and would include the capability to distribute water from Finegayan to Navy and Air Force Barrigada. The proposed locations for new water supply wells to be constructed under Basic Alternative 2 are based on information regarding the sustainable and available yield of aquifer subbasins and other siting constraints as discussed for Basic Alternative 1 in Section 2.2.4.1. Wells would be placed on Navy Barrigada within the parabasal region (Figure 2.2-5).

Estimates of Sustainable and Available Yield

For Basic Alternative 2, wells are proposed at Andersen AFB in the Andersen and the Agafa-Gumas subbasins, which are underdeveloped compared to the southern subbasins. A parabasal zone exists in both the Andersen and Agafa-Gumas subbasins, meaning that they have the potential for increased production rates. The majority of these subbasins lie under DoD land (see Figure 2.2-2). They are also close to the proposed location for the Main Cantonment at Finegayan. Therefore, Basic Alternative 2 proposes to develop 20 new water supply wells within the Agafa-Gumas and Andersen subbasins.

Navy Barrigada is located within the Agana and Mangilao subbasins. Based on either the 1982 or 1992 estimate of sustainable yield (Table 2.2-16), sufficient yield remains available to meet the 2.5 MGd (9.5 MLd) required supply for Air Force Barrigada. Therefore, Alternative 2 proposes to develop up to 11 new water supply wells within the Agana and Mangilao subbasins.

The number of wells for Basic Alternative 2 is greater than the number of wells for Alternative 1 to meet the higher UFC system requirement. The causes of the higher water demand are as follows: lower expected yield from the new supply wells at Barrigada versus the wells at Andersen AFB, and additional water supply to accommodate the active duty population that lives on Navy Barrigada or Air Force Barrigada, but works on the Marine Corps base.

Components of the Water Systems

Figure 2.2-5 and Table 2.2-30 present the well capacity and subbasin locations for proposed wells needed to meet new demands for potable water at the Finegayan Base Complex and Barrigada housing areas resulting from the military relocation on Guam.

Well Construction

Wells would be constructed in limestone as discussed for Basic Alternative 1 (see Section 2.2.4.1).

Table 2.2-30. Alternative 2—Proposed Well Details

Well Number	*Proposed Capacity (gpm)*	*Subbasin*
Located on Andersen AFB		
1	**450**	**Agafa-Gumas**
2	350	Andersen
3	150	Finegayan
4	200	Agafa-Gumas
5	400	Agafa-Gumas
6	400	Agafa-Gumas
7	400	Agafa-Gumas
8	100	Finegayan
9	350	Agafa-Gumas
10	350	Andersen
11	350	Andersen
12	350	Agafa-Gumas
13	355	Andersen
14	400	Agafa-Gumas
15	350	Agafa-Gumas
16	350	Finegayan
17	350	Andersen
18	350	Andersen
19	350	Agafa-Gumas
20	250	Agafa-Gumas
Located on Navy Barrigada		
1	200	Mangilao
2	200	Mangilao
3	150	Mangilao
4	150	Mangilao
5	150	Mangilao
6	100	Agana
7	100	Agana
8	100	Agana
9	150	Agana
10	100	Agana
11	100	Agana
NCTS #3 *(rehab.)*	50	Agana
NCTS #8 *(rehab.)*	200	Agana

Legend: AFB = Air Force Base; gpm = gallons per minute; NCTS = Naval Computer and Telecommunications Station.
Source: NAVFAC Pacific 2010a.

Water Treatment

Water treatment would be the same as discussed for Alternative 1 (see Section 2.2.4.1).

Water Distribution and Storage

Water distribution and storage would be constructed as discussed for Alternative 1 in Section 2.2.4.1, except as described below.

Water Transmission Mains

The water from these wells on Navy Barrigada would be transported from the storage tank on Navy Barrigada to Air Force Barrigada through the Navy islandwide system (30-in [76-cm] main) and a planned connection from the Navy islandwide system to a planned reservoir on Air Force Barrigada (24-in [61-cm] main). Water from the wells on Finegayan would be conveyed to Barrigada housing areas through the Navy islandwide system main. The cost includes replacement of the Navy islandwide system water main in sections, which are planned for use in Alternative 2 because the water mains are more than 50 years old and substantial water loss is expected in these water lines from leakage. Distribution of treated water to users within the bases is not included in this plan.

Water Storage

Water storage at Finegayan would be the same as Basic Alternative 1.

For Navy Barrigada, it is assumed that the existing 3-MG (11 ML) Barrigada reservoir can be used to meet the 1.6-MG (6.1 ML) minimum required storage for Alternative 2.

For Air Force Barrigada, a new 1-MG (3.8 ML) ground level tank is planned to meet the 0.95-MG (3.6 ML) minimum required storage. There is no existing storage in this area.

2.2.4.3 Long-Term Alternatives

The long-term alternatives would require follow-on analysis and tiered NEPA documentation. This may substantially change which long-term alternatives are pursued. Therefore, while a preliminary description of the long-term alternatives is presented in the following subsections, impacts related to these long-term alternatives are not assessed in this EIS because they are not ripe for analysis.

Long-Term Alternative 1

Development of the Lost River (Tolaeyuus River) is considered a long-term alternative to provide additional supply to the Navy water system during the dry season. It is estimated that the Lost River supply would yield 1.7 to 5.6 MGd (6.4 to 21 MLd) during the dry season, based on the USGS data collected between 1998 and 2001. Supply from the Lost River would be limited by downstream habitat considerations. The U.S. Fish and Wildlife Service has identified a minimum conservation flow of 1 cubic foot per second (0.03 cubic meters per second). The existing cofferdam would be rehabilitated, the reservoir area dredged, and a pump station and discharge pipeline would be installed for distributing the supply to the existing Fena Reservoir pump station. The water would be delivered either to the Navy reservoir or the Fena WTP. The capacity of the WTP and Navy distribution system would not be expanded, because the added supply is needed to compensate for the drawdown on the Navy reservoir during the dry season. Additional study is required to define the conceptual design of this alternative.

Long-Term Alternative 2

Desalination (removal of salt) of brackish water by reverse osmosis is a long-term alternative to meet projected DoD water demands in the event that the supply from freshwater wells is insufficient to meet DoD demand. Desalination of brackish water would replace the development of new freshwater potable water supply wells at Andersen AFB and Barrigada.

Under the desalination option, a WTP would produce up to a total of 12 MGd (45 MLd) of potable water. To supply the remaining approximately 12 MGd (45 MLd) of potable water, it is assumed that 18 MGd (68 MLd) of brackish water would be required. Brackish water wells would be placed at Andersen AFB, toward the coastline.

Brackish water would be supplied by up to 28 new brackish water wells and one contingency well, each with a capacity of 450 gallons per minute (1,700 liters per minute). Wells would be separated by a distance of at least 1,000 ft (305 m) to avoid interference and upconing, and would be located within 1,000 ft (305 m) of the shoreline to avoid influencing existing freshwater wells. Well water extracted from the new wells would be collected, desalinated, and treated for water supply to the end user.

Desalination would include options for new brackish-water supply wells (up to 28 wells at Andersen AFB) and upgrades to T&D systems. Desalination would require water supply, water treatment, water storage, and water distribution components as summarized in Table 2.2-31 and presented in Figure 2.2-6.

Table 2.2-31. Desalination—Proposed Water System Components

Component	*Description*
Water Supply	• Development of up to 28 new brackish-water supply wells plus one contingency well at Andersen AFB
Water Treatment	• One 12-MGd WTP at Andersen AFB
Water Storage	• Construction of new storage tanks at Finegayan
Distribution System	• Waterlines to transport the water from supply wells to treatment plants • Waterlines to transport treated water to storage tanks • Waterlines to distribute water throughout Finegayan • Replace water mains connecting existing Navy wells to the water system

Legend: AFB = Air Force Base; MGd = million gallons per day; WTP = Water Treatment Plant.
Source: NAVFAC Pacific 2010h.

Water Supply

Brackish-water wells would be planned to supply the treatment plant with enough water to produce a total of 12 MGd (45 MLd) of potable water. It is assumed that 18 MGd (68 MLd) of brackish water (3,000-4,000 mg/L TDS) would be required. The brackish-water supply wells would be designed with a higher capacity, 450 gallons per minute (1,703 liters per minute), because these wells would be drawing saline water. This limit is consistent with the recommendations for supply wells presented in the 1982 NGLS. To meet the supply, 28 supply wells would be required. Consistent with the constraints for the freshwater wells, the brackish-water supply wells would be separated by a distance of at least 1,000 ft (305 m) to avoid interference and upconing. To avoid influencing existing freshwater wells, the supply wells would be placed within 1,000 ft (305 m) of the shoreline. The brackish-water wells would be screened within the brackish-water zone.

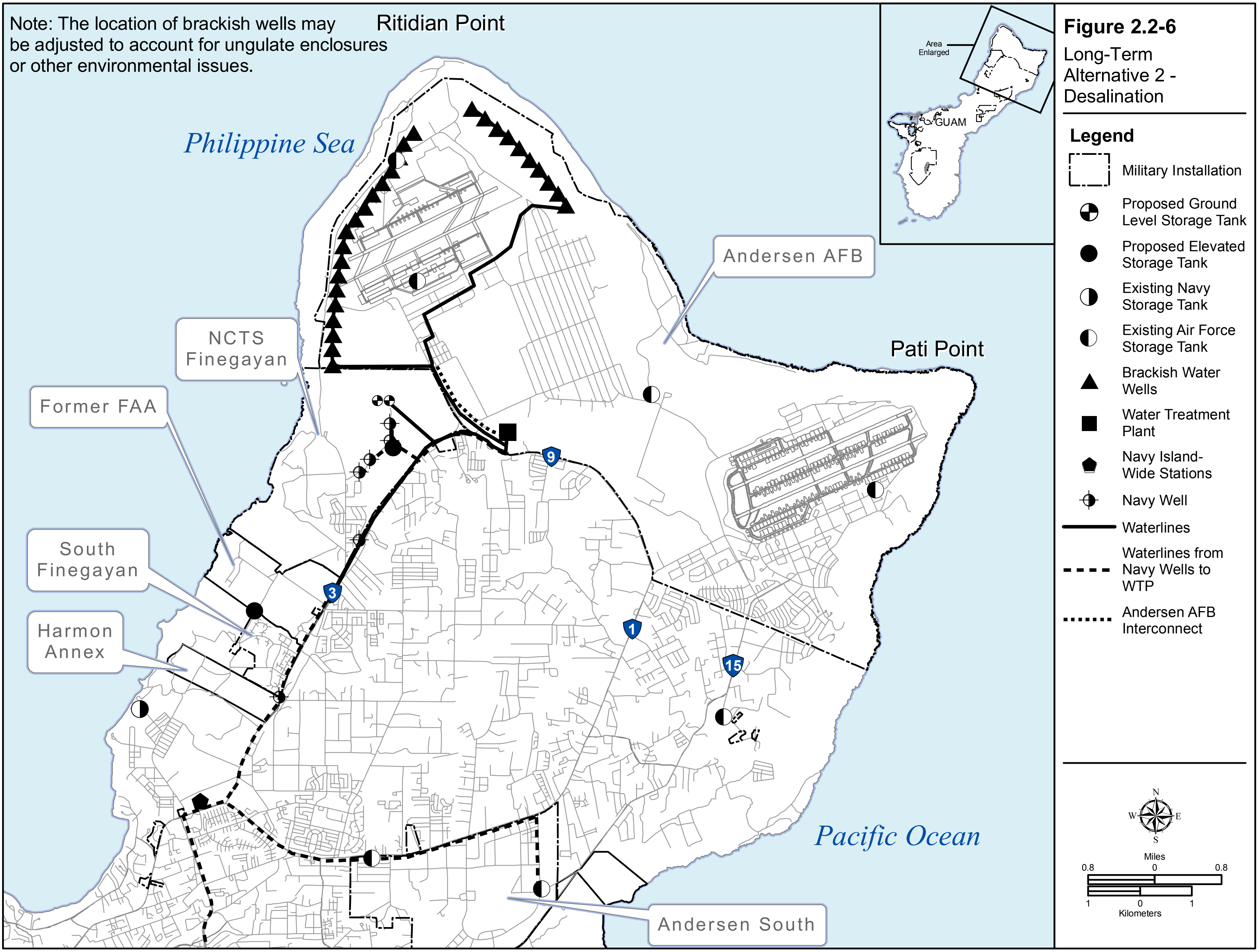

Figure 2.2-6
Long-Term Alternative 2 - Desalination

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Proposed brackish-water supply well locations are shown in Figure 2.2-6. Most of the wells located near the northwest shoreline would be within the fenced area of the military reservation. The wells located outside of the fenced area might be relocated for security. The wells along the northern shoreline would be located in a limestone forest. These wells may need to be relocated because of habitat considerations. Most of the area around the Northwest Field is considered important habitat by the regulatory agencies. This area is home to the island's last known nesting area of the endangered Mariana fruit bat. Well locations may need to be adjusted be outside of the ungulate enclosure. The area to the northeast is prime limestone forest, which is important habitat for many species. It may be necessary to identify alternate well locations in areas of Andersen AFB that are outside of the Andersen AFB constraints shown in Figure 2.2-6 or other limitations to be specified by the base.

Components of the Water Systems

Water system requirements would be the same as described for Alternative 1 in Section 2.2.4.1 except as noted below.

Well Construction

It is assumed that the well construction for the brackish-water wells would be similar to construction for the freshwater wells described in Section 2.2.4.1, but the wells in the brackish-water zone would be screened.

Water Treatment

Well water extracted from the proposed 28 new wells would be collected, desalinated, and treated for use as water supply by end users. This section presents a design basis for desalination, water treatment, treatment technologies and processes, and costs. The plant is designed for a peak treatment capacity of 12 MGd (45 MLd). Before design, the water quality of the brackish water would be tested to determine the optimal treatment processes. The area required for installation of the proposed process units and support systems is estimated to be approximately 225,000 ft^2 (21,000 m^2).

Desalination plants produce liquid wastes (brine) that may contain high salt concentrations, chemicals used during defouling of plant equipment, and pretreatment residues. Brine may be discharged directly into the ocean, combined with other discharges (e.g., power plant cooling water or sewage treatment plant effluent) before ocean discharge, discharged into a sewer for treatment in a sewage treatment plant, or dried and disposed of in a landfill.

Long-Term Alternative 3

Dredging of sediment from the Navy Reservoir is included as a long-term option. This option is retained as part of the ongoing maintenance of the reservoir and to provide additional supply to DoD in southern Guam by increasing the storage capacity of the reservoir up to the original design capacity. Additional assessment is required to address potential obstacles related to mobilizing a dredge over long distances to the project site, which is in a remote location, as well as logistical difficulties in managing dredged material on Guam.

2.2.5 Supplemental Water Source Supply Studies

Additional studies have been completed or are planned to better define the elements of the Marine Corps base water supply sources. These studies evaluate the available information on NGLA sustainable yield, gather design-level information on well locations, and update the demand and supply requirements based on the latest population estimate (February 2009). The studies are as follows:

- Guam Water Utility Study (NAVFAC Pacific 2010h)
- Barrigada Utility Study to Support Marine Corps Off-Base Housing Facilities Requirements (NAVFAC Pacific 2010a)
- University of Guam – Water and Environmental Research Institute of the Western Pacific Review of Northern Guam Lens Aquifer Sustainable Yield – Guam Water Utility Study for Proposed Marine Corps Relocation (NAVFAC Pacific 2009b)
- Guam Water Well Testing Study (NAVFAC Pacific 2010i)
- NGLA groundwater under the direct influence of surface water (GWUDI) Evaluation
- Ground-Water Availability in Guam
- Sustainability Program Summary Report
- Guam Low Impact Design (LID) Study

These studies are described in the sections below. Also discussed are the time frames when information is expected to be available and the ways in which the resulting information would be incorporated into the design of the water system for the Marine Corps base, including location of the wells and protection of groundwater resources.

2.2.5.1 Guam Water Utility Study (NAVFAC Pacific 2010h)

This report identified all reasonable alternatives for potable water supply to support the proposed Marine Corps relocation to Guam and provide sufficient and detailed information to support the EIS process. In 2007, AECOM Technical Services, Inc. staff visited NAVFAC Pacific facilities on Guam and met with decision makers within NAVFAC and several other agencies on Guam to discuss the regulatory requirements and design features for this project. The water utility report presents the findings of the evaluations conducted based on the information gathered during the field study, and subsequent detailed analysis of the recommended water supply options. The demand calculations are based on population data in the Navy memorandum of February 9, 2009, which are consistent with the DoD population estimates presented in Table ES-2 of the Final EIS. Water supply for Main Cantonment Alternatives 1 and 2 and DoD water requirements throughout Guam are addressed in the water utility report. The recommended alternative consisted of developing groundwater resources, rehabilitating selected DoD wells, providing an interconnection with GWA, and dredging sediment from the Navy Reservoir. Proposed well placement incorporated the sustainable yield estimates from Barrett 1992. Alternative 1, presented above, is based on the *Water Utility Study* report.

2.2.5.2 Barrigada Utility Study to Support USMC Off-Base Housing Facilities Requirements (NAVFAC Pacific 2010a)

The *Barrigada Utility Study* developed a detailed alternative to address water demand for Main Cantonment Alternatives 3 and 8. The water demand estimates were based on the February 9, 2009 population projections, which are consistent with the DoD population estimates presented in Table ES-2 of the Final EIS. The recommended alternative consists of groundwater resource development and well rehabilitation. Proposed well placement incorporated the sustainable yield estimates from Barrett 1992. Alternative 2 is based on this report.

2.2.5.3 University of Guam—Water and Environmental Research Institute of the Western Pacific Review of Northern Guam Lens Aquifer Sustainable Yield—Guam Water Utility Study for Proposed USMC Relocation (NAVFAC Pacific 2009b)

This WERI report provides an expert technical review of the sustainable yield estimates for the NGLA contained in Groundwater in northern Guam: Sustainable Yield and Groundwater Development (Barrett 1992) to assess the validity of the estimates in sufficient detail and objectivity to assist in obtaining public and professional acceptance of the conclusions of the study. The sustainable yield estimates are a basis for determining the proposed well locations presented in the Guam Water Utility Study (NAVFAC Pacific 2010h) and the Barrigada Water Utility Study (NAVFAC Pacific 2010a) described above. Additionally, the study addresses other related questions from DoD and USEPA on the proposed well locations. The main conclusions of the study related to the Guam water utility studies are as follows:

- The approach and methodology used in Barrett 1992 to estimate the sustainable yield are still valid. The recommendations in Barrett 1992 are appropriate for initial planning.
- The Barrett 1992 sustainable-yield estimates should be used instead of the earlier 1982 sustainable-yield estimates (CDM 1982) because the later values are based on an additional decade of field data. The 1982 sustainable-yield estimates are excessively conservative.
- A revised analysis would be more accurate because there is currently a larger data set available on well performance, recharge, and water table response.
- A state-of-the-art model would be a useful tool for long-term management of the aquifer, but is not likely to provide a significantly different outcome for sustainable yield.
- Use of the updated basement contour maps to locate the parabasal zone for well placement provides a higher degree of confidence in the productivity of the proposed wells.
- The wells would be located or “clustered” in the parabasal zone to maximize groundwater yield and water quality:
- In this zone the freshwater lens is most likely to be thickest, have the lowest chloride content, and be least vulnerable to saltwater intrusion.
- The subbasins are hydrologically separate entities. Therefore, withdrawal from one subbasin does not affect the adjacent subbasins.
- Additional field studies and incremental assessment of well performance as the wells are installed would increase the likelihood of optimal yield, water quality, and sustainability of the resource.
- Sustainable-yield confirmation studies should be performed.

No revisions to the proposed well placement for Basic Alternative 1 or Basic Alternative 2 (Section 2.2.4) are required based on the conclusions of the WERI review.

2.2.5.4 Guam Water Well Testing Study (NAVFAC Pacific 2010i)

The purpose of the Guam Water Well Testing Study is to locate and design wells for potable water supply in support of the proposed United States Marine Corps relocation. The goal of the water well testing study is to support the evaluation of improvements to the potable water system. Optimal well and well field configurations needed to meet the future Marine Corps base water demands will be determined. The project has produced a point paper which outlines the process for evaluating test well sites.

The results of this study could change the location and number of wells on Andersen AFB and Navy Barrigada or the water treatment requirements. If required, follow on NEPA documentation would be prepared for the wells.

The Point Paper is a planning document which includes an evaluation of historical and current water system; geologic, hydrogeologic, water quality, and water quantity data; and recommends locations for test well sites. The final Point Paper is provided in Volume 9, Appendix K. At the completion of the field study, a separate report will be prepared that includes discussions of the boring testing methodologies employed, results of logging and pump testing activities, results of water quality tests, and recommendations for well design criteria, construction details, well development procedures, and the estimated number of wells required to meet future demands. This report will also support the recommended water supply options that were discussed in the Water Utility Study (NAVFAC Pacific 2010h).

The scope of work for the study is provided below.

- Visit the University of Guam Water and Environmental Research Institute of the Western Pacific (WERI) to review readily available wells/boring logs from the Navy, Air Force, GWA, and Guam Environmental Protection Agency (GEPA) and update the volcanic basement contour map (Vann 2000).
- Review unexploded ordnance (UXO)/munitions and explosives of concern (MEC) records at University of Guam, the War in the Pacific National Historical Park, and NSA Andersen and Navy explosive ordinance disposal offices.
- Prepare this point paper to evaluate historical and current water system; geologic, hydrogeologic, water quality, and water quantity data; and recommend locations for further study.
- Acquire permits necessary for test boring drilling and testing.
- Drill 11 pilot test borings to characterize the production capacity of well fields in the areas of interest. The objective is to have some test borings eventually converted to production wells.
- Mobilize equipment to perform drilling and testing operations including: utility and UXO/MEC avoidance, surveying, and clearing the site, if necessary.
- Perform the following actions for each proposed pilot test boring:
    - Drill test boring.
    - Determine borehole plumbness.
    - Perform geophysical logging of borehole.
    - Perform step-drawdown and 72-hour constant-rate pumping tests at appropriate pumping rates to determine well capacity.
    - Log salinity and basic water quality parameters of the saturated zone at appropriate intervals.
    - Collect groundwater samples at the conclusion of each constant-rate pump test and have the samples analyzed by a USEPA–certified laboratory for primary and secondary drinking water standard contaminants.
    - Supply and install a test boring cover and 20 feet (ft) of steel casing at each of the 11 boreholes at the conclusion of testing.
    - Survey each test boring site to determine the groundwater elevations.
- Deepen one of the 11 test borings (AECOM 3) (before installing the cover) to a depth of 250 ft below mean sea level (msl) to allow future monitoring (outside this contract) of depth and thickness of the transition zone between fresh and salt water.
- Prepare a report documenting the water well study and include details on the testing methodologies employed, logging and pump testing activities results, water quality test

> results, and suggestions for production well design criteria, construction details, and well development procedures. The report will recommend final production well locations and give anticipated production rates.

Well drilling permit applications were received from GEPA. Test well drilling activities commenced in May 2010. Completion of the study with report documentation is anticipated at the end of 2010. Preliminary results will not be available in time for the Final EIS.

2.2.5.5 Northern Guam Lens Aquifer (NGLA) GWUDI Evaluation

GWUDI is groundwater with inadequate natural filtration when surface water filters through soils into the groundwater table (called "recharge"). This inadequate filtration through soils may lead to contamination of the groundwater from microorganisms or contaminants in the soils. The concern for wells considered GWUDI is that protozoa (*Cryptosporidium, Giardia*) could contaminate the well water. Treatment in addition to chlorine disinfection could be required to comply with Surface Water Treatment Rule requirements such as filtration or disinfection using ozone, ultraviolet light, or chlorine dioxide.

GEPA is currently conducting a study to determine if wells extracting water from the NGLA are GWUDI. Soils in northern Guam are highly porous, and past sampling has indicated that contaminants may enter the aquifer during sewer pump station spills and rain events. If portions of the aquifer subbasins are identified as GWUDI, then treatment requirements may be imposed on individual wells, including filtration and/or disinfection.

The results of the GEPA study are expected in late 2010. GEPA has tentatively determined that the aquifer should be considered groundwater (not GWUDI). This determination stands until the results of the study are completed. This EIS was developed assuming that the proposed and existing DoD wells are not subject to GWUDI based on the preliminary results provided in a March 2010 data workshop and June 2010 follow up workshop conducted by the Guam GWUDI Study group. DoD is a participant in the Guam GWUDI Study group. It is acknowledged that the information provided in the data workshop is not conclusive and the final decision may differ. More information from the March 2010 data workshop is provided below. The DoD decision to consider the new wells to be not subject to GWUDI requirements is speculative until GEPA makes a final determination. If the GWUDI determination is made in the future for the DoD wells, a separate NEPA document would be developed to address the additional water treatment requirements.

A data workshop was conducted by the Guam GWUDI Study group to review the progress to date and present the status for field activities in March 2010. Data have been collected during one year for rainfall, turbidity, *Escherichia coli* (bacterium), and microscopic particulate analyses (MPA) data. The study group has developed preliminary analyses of the data.

The MPA data from the wells indicate a low probability of being GWUDI. The microorganisms *Cryptosporidium* or *Giardia* were not present in any sample and MPA levels are very low for the other indicators. However, the MPA monitoring frequency may be insufficient to confirm absence of *Giardia* or *Cryptosporidium* on Guam.

The available turbidity data indicate little or no surface influence with levels that are generally very low (<0.1 nephelometric turbidity unit). Spikes and elevated periods of turbidity may indicate equipment malfunctions. Turbidity is likely to result from particulates in the aquifer stirred up by water movement or seismic activity. Turbidity spikes did not correlate with rainfall events.

Fecal contamination was observed in most study wells. Detections of fecal contamination did not correlate with rain events. The type of fecal contamination detected does not by itself indicate surface influence. A few wells have been rapidly contaminated in the past following failures of adjacent sewage lift stations and resulting spills indicating GWUDI. However, this type of event was not monitored during the study.

Most of the study wells have evidence of occasional fecal contamination. Chlorination to achieve 4-log virus reduction and continuous chlorine residual monitoring are necessary to meet groundwater rule requirements. Wells considered to be GWUDI with low turbidities(<5 nephelometric turbidity unit) would need to have continuous treatment with two disinfectants (e.g., chlorine and ultraviolet [UV]), be monitored continuously for turbidity and disinfection, and Long Term 2 Enhanced Surface Water Treatment Rule monitoring would be conducted. A watershed control program to minimize *Giardia* and *Cryptosporidium* contamination would be required for wells designated GWUDI or occasional GWUDI.

The study group presented recommendations for new well siting and existing wells. New wells should be sited outside of the influence of lift stations, injection wells, and other potential sources of contamination. Wells located within the potential influence of contaminant sources should be monitored weekly for bacterial indicators, continuously for turbidity and conductivity, and as indicated for MPA. Control options should be considered for wells sited in proximity to potential contaminant sources which could result in massive fecal contamination events. Options for prevention include backup pumps, auxiliary power, and containment to prevent lift station failure; removal of injection wells or mitigation strategies in ponding basins to prevent sewage from rapidly entering the aquifer; and installation of a second disinfection system to provide additional treatment at the well head. Groundwater treatment at the well head should provide chlorination to achieve 4-log virus inactivation to the first customer and continuous monitoring for chlorine residual.

The Guam GWUDI Study group plans several next steps. Turbidity and MPA data will be collected to supplemental data lost through apparent instrument problems. Quality assurance and quality control procedures will be revised for adequate calibration of tubidimeters. GEPA wellhead assessments will be reviewed and mapping conducted to determine the proximity of potential contaminant sources, including wastewater lift stations, injection wells, septic systems, and cesspools, to production wells. The study group will develop mitigation strategies for wells potentially influenced by contaminant sources. Other research ideas may be pursued such as determining whether the fine particulate matter is the same material as the aquifer; and determine whether some turbidity spikes occur from a common event such as rainfall or a seismic event.

2.2.5.6 Ground-Water Availability in Guam

DoD is supporting a study of the groundwater availability on Guam to be conducted by USGS that will include a state-of-the-art groundwater model and verification of the sustainable yield on all relevant and available site-specific data collected to date. The study is planned for completion by the end of 2013. However, well installation is not expected to be complete until 2014. Preliminary findings from the study will be incorporated into the construction of the wells. The model is expected to be used in the long-term management of the NGLA groundwater resource.

2.2.5.7 Guam LID Study

The Guam LID Study (NAVFAC Pacific 2010c) was developed to determine the pre- and post-development hydrology of the site, which will be used to determine the stormwater runoff quantities and qualities that would need to be accommodated. This characterization of stormwater runoff will allow LID planning to proceed, using variety of natural and built features that reduce the rate of runoff, filter out pollutants, and facilitate the infiltration of water to the ground. LID planning will ultimately provide the foundation for the Basis of Design for permanent stormwater infrastructure at the site. The final Guam LID Study is provided in Volume 9, Appendix K.

The boundaries of the study are limited to the Marine Corps Base. Areas of development on Andersen AFB are not covered by this study. The scope of work for the study is listed below:

- For the predevelopment state, characterize stormwater runoff generation (rates, volumes, durations, overland flow patterns) and infiltration patterns using available topographic and soil/geologic information, for the following storm events:
  - 1-year and 2-year 24-hour storms;
  - 10-, 25-, 50-, 100-, and 500-year 24-hour recurrence event storms; and
  - 80 percent (%) (0.8-inch), 90% (1.5-inch), and 95% (2.2-inch) annual exceedances.
- Evaluate the contribution of offsite runoff into the area of interest for each storm event. Determine if there are discharges to the ocean from the area of interest during the storm events of interest. Characterize the relationships on site between stormwater and groundwater in terms of ranges of infiltration rates and percolation time to groundwater.
- Based on available references, provide preliminary grading schemes to accommodate the facilities depicted in the current version of the Guam Joint Military Master Plan (GJMMP) dated September 18, 2009 (NEPA Alternative 2) (Joint Guam Program Office 2009), including minimum and maximum site slopes; objectives to minimize cut and fill quantities; and preliminary grading schemes for the undetermined future uses of Smart Growth Areas.
- Based on the grading schemes developed, provide notional stormwater routing scenarios. Provide preliminary siting and sizing of stormwater detention basins based on the development plan and associated imperviousness. Address Smart Growth Areas in their interim undeveloped state and at buildout using a range of post development imperviousness. Address the need for dry wells and placement constraints, and stormwater routing near sinkholes.
- Assess drainage impacts resulting from the proposed site development and grading schemes. Provide the limits for site disturbance, including setbacks from the shoreline and steep slopes, and address wellhead protection setbacks.
- Address site contamination (runoff and/or leaching from installation restoration [IR] sites) and water quality issues. Based on the most current land use plan, estimate loading of total suspended solids (TSS), nutrients, and contaminants of concern from various areas. Address groundwater contamination issues related to sinkholes in terms of preferential pathways for percolation to groundwater.
- Address maintaining predevelopment hydrology to protect water quality (based on most current land use map). Based on available references, assess efficacy of bioretention, filtration, and other strategies for removal of pollutants. Address the potential impacts to groundwater from stormwater infiltration.
- Based on current available references, recommend best management practices (BMPs) and Integrated Management Practices (IMPs) best suited for the Northern Guam environment. Provide notional layouts of IMPs throughout the development. These should include potential layouts of site-specific IMPs at various sites and land uses within the development plan, and a conceptual configuration of “neighborhood level” IMPs at various areas within the base (with associated stormwater runoff routing requirements).

- Estimate the required sizing and placement of onsite stormwater detention basins and the interaction of the basins with stormwater routing and water quality improvement IMPs. Address the potential use of Anti-Terrorism/Force Protection setbacks, roadway shoulders, open space, and Smart Growth Areas for IMPs.
- Address strategies for avoiding/minimizing traditional underground storm drainage infrastructure.
- Provide Guam budgetary construction cost estimates for recommended IMPs identified.
- Prepare a sustainability study documenting stormwater resource issues associated with green building practices such as, preserving/enhancing site permeability; rainwater harvesting; stormwater adopting quantity and quality strategies; and using green roofs. The study should also provide recommendations for architectural and aesthetic stormwater elements.

Recommended IMPs as identified in this study include:

- Oil/sediment separators
- Dry swales
- Filter strips
- Bioretention basins
- Subsurface infiltration devices
- Subsurface TSS filter chambers
- Detention basins

The following IMPs and IMP accessory were identified as having limited or specific application:

- Green roofs
- Rain barrels and cisterns
- Porous pavement
- Inlet protectors (in the event a curb inlet is needed under special circumstances)

IMPs determined to have limited applicability for a variety of reasons include: organic filters, sand/gravel filters, infiltration trenches, and infiltration basins. These limited IMPs could be employed for use in treatment trains; however, based on the assessment described above, the recommended IMPs are more suitable for application in this study.

IMPs not recommended for use include: wet swales, micropool extended detention ponds, wet ponds, wet extended detention ponds, extended detention wetlands, pocket wetlands/pocket ponds, and shallow marshes.

2.2.5.8 Sustainability Study Program Summary Report

The purpose of the GJMMP Sustainability Program is to develop and define a program that delivers the highest level of environmental improvements to meet all applicable federal mandates at the lowest possible cost. The following goals were established:

- Reduce the total ownership cost of facilities
- Improve the energy efficiency and water conservation
- Provide safe, healthy and productive built environments
- Promote sustainable environmental stewardship

The Sustainability Program builds on the master planning effort underway and includes five primary tasks:

- Identify Unified Facilities Criteria that adversely impact sustainable efforts and propose alternative criteria;
- Develop a GJMMP Sustainable Systems Integration Model (SSIM);
- Integrate LEED New Construction;
- Integrate sustainability into the master plan; and
- Provide initial direction with regard to implementation and monitoring.

The Sustainability Program is founded on federal mandates and targets related to energy, water, transportation, green building/LEED and greenhouse gas (GHG) emissions. For water, the performance level to be achieved is established by the EPACT/EISA 2007 at a 26% reduction. This level is the minimum requirement to meet facility related mandates.

The water planning result provided by the SSIM water model are intended to provide guidance on possible strategies toward water conservation and are not intended to be a building specific design guide. Individual buildings may use the selected strategies as part of the design and construction process. The projected water savings would vary for individual buildings with some buildings achieving lower or higher levels of water savings compared to the predicted values.

Water conservation and reuse strategies were developed and applied to facility types (single family residences, bachelor enlisted quarters/bachelor officer quarters, high density commercial and low density commercial) to determine the most efficient and cost effective way to achieve the required water savings. The strategies applied consist of low flow fixtures and interior reuse of harvested rainwater and air conditioning condensate. Irrigation use is not anticipated or included in water consumption savings calculations based on Guam’s annual rainfall and direction from NAVFAC MAR. Reuse of harvested graywater and treated sewage effluent were not included in the analysis.

Performance and cost based analysis was optimized for the following packages:

- Standard Package: Minimum potable water use through water fixture flow rates for FY 2007 defined in EPACT 1992.
- Baseline Package: Minimum requirements that meet the water consumption reduction of 26%.
- Package A: Exceeds the Baseline package. Optimizes performance and minimizes the capital cost.
- Package B: Exceeds the Baseline package for sustainability and provides the quickest payback term for infrastructure.
- Package C: Exceeds the Baseline package and provides the highest life cycle cost savings over 42 years.

Package A is recommended. The detailed analysis of all packages is provided in the sustainability study.

Ongoing efforts would be required to maintain system efficiencies. All new infrastructure would be equipped with meters accommodating an advanced metering system according to Navy and Marine specifications.

2.3 WASTEWATER

2.3.1 Overview

The proposed military relocation on Guam would be potentially located at Andersen AFB, NCTS Finegayan, South Finegayan, Andersen South, Barrigada, and Naval Base Guam at Apra Harbor. These areas are currently serviced by three WWTPs owned by the GWA and the Navy. Of these plants, two are considered as alterative locations for wastewater treatment for the discharges directly associated with the military relocation, which inlcudes wastewater from the DoD population and new facilities on DoD land. These two plants are GWA's NDWWTP and Navy's Apra Harbor WWTP. Figure 2.3-1 shows the locations of these WWTPs that could receive wastewater from the direct DoD populations that would result from the military relocation. The NDWWTP could also potentially receive a portion of wastewater from the indirect construction workforce population and the induced civilian population resulting from the military relocation.

Table 2.3-1. Wastewater Treatment Facilities Servicing Areas of the Proposed Military Relocation

Area of Proposed Military Relocation	*Wastewater Treatment Facility*	*Region/Subregion*
Andersen AFB	NDWWTP	North/Andersen AFB
NCTS Finegayan	NDWWTP	North/Finegayan
South Finegayan	NDWWTP	North/Finegayan
Andersen South	NDWWTP	Central/Andersen South
Barrigada	Hagatna WWTP	Central/Barrigada
Naval Base Guam	Apra Harbor WWTP	Apra Harbor/Naval Base Guam

Legend: AFB = Air Force Base; NCTS = Naval Computer and Telecommunications Station; NDWWTP = Northern District Wastewater Treatment Plant; WWTP = Wastewater Treatment Plant.
Source: GWA 2007.

Table 2.3-2 and Table 2.3-3 show information for each of the WWTPs considered under the wastewater alternatives analysis, including design capacity, estimate of the current wastewater flow (demand), and the current maximum treated-wastewater disposal flow under each plant's National Pollutant Discharge Elimination System (NPDES) permit. NPDES permits are issued to WWTPs and include provisions for the following:

- The plant must meet minimum standards for removal of pollutants
- The plant cannot discharge pollutants into a water body above limits that are set in the permit
- The owner of the plant must properly operate and maintain the plant
- The plant must be operated by trained and certified workers
- Wastewater throughout the plant and at the discharge must be routinely sampled and tested
- Test results must be reported to USEPA Region 9 and GEPA in reports called Discharge Monitoring Reports

Table 2.3-2. Existing Wastewater Treatment Capacities and Demand for Plants Direct Populations

Treatment Plant	*Owner/ Operator*	*Treatment Level*	*Design Average Capacity (MGd)*	*Current Average Demand (MGd)*	*Design Peak Capacity (MGd)*	*NPDES Permit Maximum Daily Flow (MGd)*
NDWWTP	GWA	Primary	12.0	5.7	27	6.0
Apra Harbor WWTP	Navy	Secondary	4.3	2.9	9.0	4.3 (Average daily flow)

Legend: GWA = Guam Waterworks Authority; MGd = million gallons per day; NDWWTP = Northern District Wastewater Treatment Plant; NPDES = National Pollutant Discharge Elimination System; WWTP = Wastewater Treatment Plant.

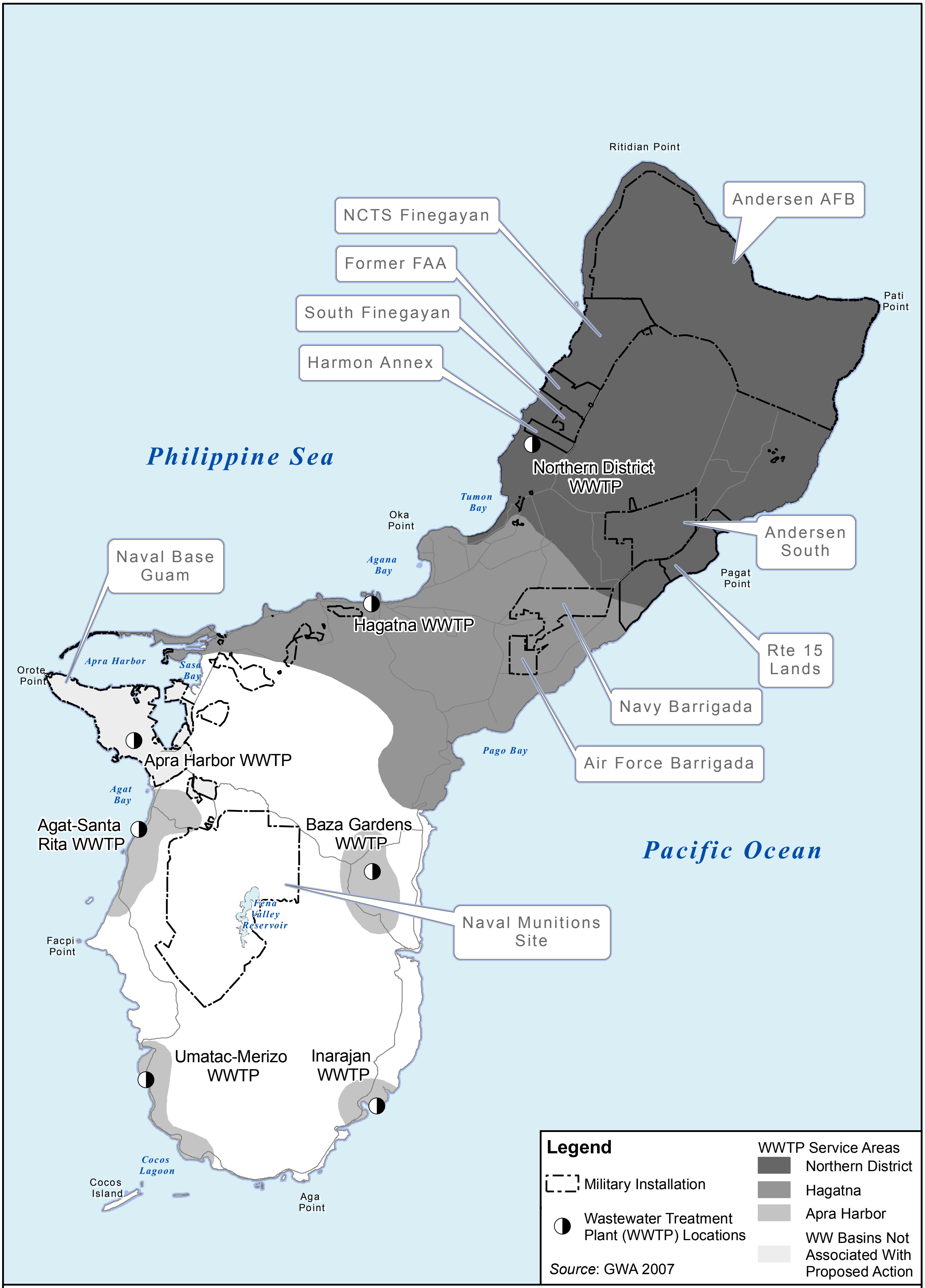

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Figure 2.3-1
Wastewater Treatment Plant Locations and Service Areas, Guam

GWA owns five other WWTPs on Guam, which along with the NDWWTP treat the majority of domestic sewage generated on Guam. These are are the Hagatna WWTP in central Guam, and the Agat-Santa Rita WWTP, the Baza Gardens WWTP, the Umatac-Merizo WWTP, and the Inarajan WWTP in southern Guam. Figure 2.3-1 shows the locations of these WWTPs. These plants are not considered as alterative locations for wastewater treatment for the discharges directly associated with the military relocation (i.e.: wastewater from the DoD population and new facilities on DoD land). However, these plants could potentially receive wastewater from the indirect construction workforce population and the induced civilian population resulting from the military relocation.

Table 2.3-3 shows plant design capacities, estimate of the current wastewater flows (demands), and the current maximum treated-wastewater disposal flows under each plant's NPDES permit for these plants.

Table 2.3-3. Existing Wastewater Treatment Capacities and Demand for Plants, Indirect Populations

Treatment Plant	*Owner/ Operator*	*Treatment Level*	*Design Average Capacity (MGd)*	*Current Average Flow (MGd)*	*Design Peak Capacity (MGd)*	*NPDES Permit Maximum Daily Flow (MGd)*
Hagatna WWTP	GWA	Primary	12.0	4.7	21	12.0
Agat–Santa Rita WWTP	GWA	Secondary	0.75	1.81	2.2	0.75
Baza Gardens WWTP	GWA	Secondary	0.60	0.50	NA	0.60
Umatac Merizo WWTP	GWA	Secondary	0.39	0.41	NA	0.39
Inarajan WWTP	GWA	Secondary	0.19	0.07	NA	NA

Legend: GWA = Guam Waterworks Authority; MGd = million gallons per day; NA = not applicable; NPDES = National Pollutant Discharge Elimination System; WWTP = Wastewater Treatment Plant.

2.3.2 Available Wastewater Facilities

2.3.2.1 DoD Wastewater Facilities

Apra Harbor WWTP

The Apra Harbor WWTP could potentially receive wastewater flows from a portion of the direct DoD population that would result from the military relocation. The current average wastewater flow to the Navy's Apra Harbor WWTP is 2.9 MGd (11.0 MLd). Proposed increases in the Navy and U.S. Coast Guard population in the Apra Harbor area would increase the wastewater flow to the Apra Harbor WWTP by about 0.79 MGd (2.99 MLd), for a total projected flow of 3.69 MGd (13.96 MLd). With a design capacity of 4.3 MGd (16.3 MLd), the Apra Harbor WWTP would have enough capacity to treat the projected total wastewater flow (3.69 MGd [13.69 MLd]) to be generated as a result of proposed military relocation activities in the Apra Harbor area. Therefore, no additional wastewater treatment capacity would be needed at the Apra Harbor WWTP, and no changes to the NPDES permit would be necessary.

The Apra Harbor WWTP experiences violations of its permit effluent limits for aluminum, copper, nickel, total residual chlorine, biological oxygen demand, and total suspended solids. Compliance problems have been attributed capacity limitations, and to infiltration/inflow of stormwater into the sewer lines, which result in reduced pollutant removal efficiencies at the plant. Metals sources originating from the introduction of Fena WTP sludge supernatant to the Apra Harbor WWTP, and from metals in shipboard wastewater also contribute to violations of metals limits. The Navy conducted a study to investigate compliance strategies to address these violations at the Apra Harbor WWTP (NAVFAC Pacific 2010g). This study is under review by the Navy, GEPA, and USEPA Region 9 to determine the best course of action to address these violations. This study is discussed in further detail in Chapter 3, Section 3.1.3.2 of this Volume.

2.3.2.2 GWA Wastewater Facilities

Northern District WWTP

The NDWWTP could potentially receive the majority of wastewater flows from the direct DoD population that would results from the military relocation. It could also potentially receive a portion of the wastewater flows from the indirect construction workforce population and the induced civilian population. The NDWWTP is a GWA plant that services the areas where much of the direct military relocation would occur. GWA holds an NPDES permit for the NDWWTP which was issued by USEPA Region 9 in June 1986. The NDWWTP discharges to the Philippine Sea through an ocean outfall.

The NPDES permit for the NDWWTP expired in 1991. Since that time USEPA Region 9 administratively extended the permits. The permits contained a variance that allows plant to utilize only primary treatment processes instead of more advanced treatment processes that are typically required for sewage treatment plants. Primary treatment refers to sewage treatment that uses physical separation of solid material from the waste stream prior to discharge to a water body. More advanced treatment, called secondary treatment, provides for removal of organic matter and pollutants in sewage beyond what can be removed in primary treatment plants, typically by using bacteria as a means to digest and remove wastes. Secondary treatment variances are allowed under Section 301(h) of the Clean Water Act. Sewage treatment facilities that are granted a 301(h) secondary treatment variance must demonstrate that their discharge does not have an adverse impact on the environment or on water quality. They must also demonstrate that they adequately control industrial wastes that could enter the plant, and they must meet minimum standards for pollutants removal efficiencies in their treatment processes.

On September 30, 2009, USEPA Region 9 made a decision to deny the secondary treatment variance for the NDWWTP, which effectively requires GWA to install full secondary treatment at the plant. GWA has formally challenged USEPA’s decision to deny the secondary variance, so it is unclear at this time if secondary treatment would be required at the NDWWTP. However, the alternatives presented in this EIS were adjusted to recognize this secondary variance denial, and reflect the potential future need for secondary treatment plant upgrades for all alternatives evaluated by providing a phased approach to upgrading the plant. This is discussed in detail in Section 2.3.4 and Section 2.3.6 of this Volume.

Hagatna WWTP

The Hagatna WWTP could potentially receive wastewater flows from the indirect construction workforce population and the induced civilian population that would result from the military relocation. The Hagatna WWTP is a primary treatment plant with a similar permit as the NDWWTP. GWA holds an NPDES permits for the Hagatna WWTP which was issued by USEPA Region 9 in June 1986. The Hagatna WWTP discharges to the Philippine Sea through an ocean outfall.

Like the NDWWTP, the NPDES permit for the Hagatna WWTP expired in 1991, and USEPA administratively extended it. The Hagatna WWTP had a 301(h) secondary treatment variance like the NDWWTP, which was denied by USEPA at the same time as the NDWWTP. This variance denial effectively requires GWA to install full secondary treatment at the plant. Like the NDWWTP, GWA has formally challenged USEPA’s decision to deny the secondary variance, so it is unclear at this time if secondary treatment would be required at the Hagatna WWTP. Although changes to Hagatna WWTP are not part of DoD's proposed action, DoD is seeking funding from GoJ to make repairs and upgrades to this plant and its collection system (for more detail, see Volume 6, Chapter 1).

<u>Other GWA WWTPs</u>

Although the proposed military relocation would not occur off base in central and south Guam, the military relocation would result in induced civilian population growth that could generate wastewater flows to the following GWA wastewater treatment facilities: the Agat-Santa Rita WWTP, Baza Gardens WWTP, Umatac-Merizo WWTP, and Inarajan WWTP. All of these facilities are currently not in compliance with their effluent NPDES permits limits due to inadequate treatment capacity, deterioration of equipment, and lack of maintenance. More detailed information on these plants is provided in Volume 6, Chapter 3, Section 3.1.3.6 to Section 3.1.3.9.

2.3.3 Projected Wastewater Flows

The total projected wastewater flow from the direct DoD population related to the proposed military relocation consists of both domestic and industrial flows. The projected domestic wastewater flow was calculated using per capita wastewater generation criteria from UFC 3-240-02N, Wastewater Treatment System Augmenting Handbook (DoD 2004), and the industrial flows were calculated using criteria from the Water Pollution Control Federation's Manual of Practice No. FD-5, Gravity Sanitary Sewer Design and Construction (Water Pollution Control Federation 1982). The criteria are as follows:

- Resident Personnel, 120 gpcd
- Transient Personnel, 35 gpcd
- Civilian Workers living off base but working on base, 35 gpcd
- Construction Workers living in Camp, 70 gpcd
- Industrial Users, 15,500 gpd/acre
- Consistent with Navy and Marine Corps policies and existing laws related to sustainability and reductions in energy and water use at military bases, the Marine Corps would incorporate technology to improve wastewater efficiency to the degree feasible and economical. Attempts would be made to reduce wastewater quantities and improve treatment and conveyance efficiencies.

Per capita wastewater generation as shown above was applied to estimate wastewater flow generated by the indirect off base nonmilitary population, which includes the local Guam population, the construction workforce, and their dependents not living in construction workforce camps, and induced civilian population increases. Based on the socioeconomic analysis discussed in Volume 2, Chapter 16, two-thirds of the construction workforce was estimated to reside in northern Guam and one-third in central Guam. The induced civilian population growth was estimated to be distributed as follows: 38% in northern, 43% in central, and 19% in south Guam. This socioeconomic analysis took into account where construction workforce housing camp applications were being proposed, current housing availability, historic housing and development trends, and future housing and development trends projected by the Guam Land Use Commission. For more details on population distribution, see Volume 1, Chapter 4. Domestic wastewater flow is determined by multiplying per capita wastewater generation by respective population. Industrial wastewater flow is calculated by multiplying the above industrial wastewater generation per unit area by industrial used land acreage.

2.3.3.1 Wastewater Flows Associated with Proposed Main Cantonment Alternatives 1 and 2

Locating the Marine Corps Main Cantonment and the Army AMDTF at Finegayan would increase wastewater flows from the direct DoD population at NCTS Finegayan, South Finegayan, and Andersen AFB. Table 2.3-4 shows the current DoD population in these areas of northern Guam and the projected population at the end of the military relocation in 2019 for Main Cantonment Alternatives 1 and 2.

Table 2.3-4. Current and Projected DoD Population at Completion of Military Relocation in Northern Guam for Main Cantonment Alternatives 1 and 2

Service	*Active Duty (Direct)*	*Dependents (Direct)*	*Transient (Direct)*	*Civilian Workforce[a] (off-island) (Direct)*	*Civilian Workforce[b] (Guam) (Indirect)*
Current					
Marine Corps	3	2	0	1	0
Air Force	2,145	2,950	0	805	402
Navy	39	66	0	351	1,130
Army	30	50	0	11	5
Projected Increase					
Marine Corps	8,552	9,000	2,000	1,710	855
Air Force	120	210	1,780	25	12
Navy	0	0	0	0	0
Army	630	950	0	126	63
Total Future Population in 2019					
Marine Corps	8,555	9,002	2,000	1,711	855
Air Force	2,265	3,160	1,780	830	414
Navy	39	66	0	351	1,130
Army	660	1,000	0	137	68

Notes:
[a] Civilian Workforce (off-island) – Military civilian workers (coming off-island) living on the island and work on the base.
[b] Civilian Workforce (Guam) – On-Island residents who work on the base.
Source: Socioeconomic analysis in support of this EIS.

Wastewater from these locations is currently conveyed to the NDWWTP in northern Guam for treatment and disposal. Projected year 2019 increases in average daily wastewater flows to the NDWWTP for Main Cantonment Alternatives 1 and 2 are summarized in Table 2.3-5.

Table 2.3-5. Current and Projected Civilian and DoD Flows at Completion of Military Relocation for Main Cantonment Alternatives 1 and 2

Source	*Current Wastewater Flow (MGd)*	*Projected Increase in Wastewater Flow (MGd)*	*Total Projected 2019 Average Daily Flow (MGd)*
Northern District Wastewater Treatment Plant			
Civilian	5.20	1.88	7.08
Military	0.50	2.97	3.47
Marine Corps	0.00	2.56	2.56
Navy	0.13	0.00	0.13
Air Force	0.36	0.20	0.56
Army	0.01	0.20	0.21
Total	**5.70**	**4.85**	**10.55**

Legend: MGd = million gallons per day.
Sources: NAVFAC Pacific 2010g.

As a result of the proposed military relocation, the total year 2019 average daily flow to the NDWWTP from direct DoD sources and from indirect workforce housing is projected to increase to 3.47 MGd

(13.1 MLd). The total average flow to the NDWWTP in year 2019 from both direct DoD and indirect civilian sources would be 10.55 MGd (39.9 MLd). The year 2019 peak daily flow to the plant would be calculated at 23.74 MGd (89.9 MLd) (based on a ratio of 2.25 to 1 of peak flow to average flow from the original design calculations of the NDWWTP). Based on the current conditions of the existing structures and equipment at the NDWWTP, the plant would need to be refurbished and upgraded to restore its original design capacity of 12 MGd (45.4 MLd) average flow in order to meet the 10.55 MGd (39.9 MLd) total projected flow shown in Table 2.3-5. Also, a compliance agreement would need to be issued by USEPA Region 9 to GWA to allow the original design treatment capacity of 12 MGd (45.4 MLd) average daily flow and 27 MGd (102.2 MLd) maximum daily flow in order to accommodate the projected ultimate flow from the planned military relocation for Main Cantonment Alternatives 1 and 2. Currently, the NPDES permit allows only a 6 MGd (22.7 MLd) flow at the plant discharge, even though the plant design flow is 12 MGd (45.4 mild).

A socioeconomic analysis of the proposed military relocation has estimated that induced civilian growth could increase the islandwide population on Guam by up to approximately 80,000 in the peak year of 2014. This includes populations from DoD, construction workforce and induced civilian population growth associated with the proposed action, along with ordinary civilian population increases and other DoD population increases that are not associated with the military relocation (for more information, see Volume 6, Chapter 2, Table 2.0-1). This corresponds to a total wastewater peak average daily flow of up to 12.13 MGd (45.9 MLd) at the NDWWTP in year 2014.

Table 2.3-6 summarizes existing civilian and peak DoD flows for northern Guam for Main Cantonment Alternatives 1 and 2. Included in this table are projected increases in northern Guam's civilian flows as a result of natural population growth, projected DoD increases associated with the military relocation, increases associated with the imported construction workforce, and civilian increases that could result from induced population growth in northern Guam.

Table 2.3-6. Projected Peak Wastewater Flows for Main Cantonment Alternatives 1 and 2

Source of Wastewater Flow (MGd)	*Year*					
	2010	*2011*	*2012*	*2013*	*2014*	*2015*
Northern District Wastewater Treatment Plant						
Existing Guam Civilian	5.20	5.20	5.20	5.20	5.20	5.20
Existing DoD	0.50	0.50	0.50	0.50	0.50	0.50
Guam Civilian Increase	0.23	0.37	0.48	0.58	0.95	1.08
DoD Increase	0.23	0.46	0.51	0.55	2.56	2.79
Construction Workforce	0.28	0.67	1.10	1.31	1.40	0.91
Subtotal Direct DoD and Guam Civilian	**6.44**	**7.19**	**7.78**	**8.14**	**10.62**	**10.47**
Induced Civilian Increase	0.25	0.63	1.05	1.25	1.51	1.15
Total Average Daily Flow—all sources	**6.68**	**7.82**	**8.83**	**9.39**	**12.13**	**11.63**
Total Peak Daily Flow—all sources	**15.03**	**17.59**	**19.87**	**21.14**	**27.29**	**26.16**

Legend: DoD = Department of Defense; MGd = million gallons per day.

Peak daily flows in Table 2.3-6 are calculated from the plant-designed peak-to-average flow ratios for the NDWWTP (2.25 to 1). Under Main Cantonment Alternatives 1 and 2, both the projected peak increased average flow and maximum daily flow to the NDWWTP would be slightly over the NDWWTP originally designed treatment capacity of 12 MGd (45.4 MLd) average daily flow and 27 MGd (102.2 MLd) peak daily flow, but would far exceed the NPDES permitted flow of 6 MGd (22.7 MLd). Based on the current conditions of the existing structures and equipment, the plant would need to be refurbished and upgraded to restore its original design capacity to accommodate peak increased flow during the peak period not only to address flow and capacity limitations, but also to restore treatment processes that are currently bypassed or degraded, and improve overall pollutant removal. In addition to these upgrades, additional treatment in the form of chemical addition to enhance solids removal would be needed to ensure discharge permit limits would be met during the peak flow period. Lastly, the permit would need to be modified to allow the originally designed treatment capacity flows of 12 MGd (45.4 MLd) average daily flow and 27 MGd (102.2 MLd) maximum daily.

The projected peak wastewater flow generated from the proposed military relocation associated construction workforce and induced population, and on-island Guam population growth at 2014 in Central Guam would be about 7.86 MGd (29.8 MLd) average daily flow and 13.8 (52.2 MLd) maximum daily flow to the Hagatna WWTP, which are less than the plant designed treatment capacity.

2.3.3.2 Wastewater Flows Associated with Proposed Main Cantonment Alternatives 3 and 8

Locating the Marine Corps' Main Cantonment and the Army AMDTF at Finegayan and their housing at DoD Barrigada properties would increase wastewater flows generated from the direct DoD population not only at Finegayan in northern Guam, but also at Navy Barrigada and Air Force Barrigada in central Guam. Table 2.3-7 shows the current military population in the Barrigada area of central Guam and the projected population at the end of the military relocation in 2019 if Main Cantonment Alternatives 3 and 8 were to be selected.

Table 2.3-7. Current and Projected DoD Population at Completion of Military Relocation in the Barrigada Area of Central Guam under Main Cantonment Alternatives 3 and 8

Service	*Active Duty*	*Dependents*	*Civilian Workforce*
Current			
Marine Corps	0	0	0
Air Force	0	0	0
Navy	—	—	—
Army	0	0	0
Proposed Increase			
Marine Corps	2,181	5,683	1,058
Air Force	0	0	0
Navy	0	0	0
Army	342	950	166
Total Future Loading in 2019			
Marine Corps	2,181	5,683	1,058
Air Force	0	0	0
Navy	—	—	—
Army	342	950	166

Source: Socioeconomic analysis in support of this EIS.

Wastewater from DoD Barrigada properties is currently conveyed to the Hagatna WWTP in central Guam for treatment and disposal. However, the projected DoD wastewater increases associated with the military relocation at Barrigada would instead be conveyed to the NDWWTP for treatment under this alternative. Projected year 2019 increases in average daily wastewater flow increases to the NDWWTP under Main Cantonment Alternatives 3 and 8 are summarized in Table 2.3-8.

Under the proposed Main Cantonment Alternatives 3 and 8, the projected DoD wastewater increases from the proposed Barrigada housing would be conveyed to the NDWWTP for treatment. If the wastewater flows generated from military relocation, both at Finegayan area and Barrigada area, are still treated at the NDWWTP, the total year 2019 average flow to the NDWWTP would increase to 10.55 MGd (39.9 MLd). This is the same flow that is projected for the NDWWTP for Main Cantonment Alternative 1 and 2, and the flow to the Hagatna WWTP is also the same as projected for Main Cantonment Alternative 1 and 2 Therefore, recommendations for Main Cantonment Alternatives 3 and 8 would be the same as for Main Cantonment 1 and 2. These include refurbishing and upgrading the existing NDWWTP treatment processes to restore them to their original design capacity to address capacity limitations and improve overall pollutant removal, adding chemical treatment to enhance solids removal during peak flow years, and modifying the NPDES permit to allow for the increased flows.

Table 2.3-8. Current and Projected Civilian and DoD Flows at Completion of Military Relocation for Main Cantonment Alternatives 3 and 8

Source	*Current Wastewater Flow (MGd)*	*Projected Increase in Wastewater Flow (MGd)*	*Total Projected 2019 Average Daily Flow (MGd)*
Northern District Wastewater Treatment Plant			
Civilian	5.20	1.88	7.08
Military	0.50	2.97	3.47
Marine Corps (Finegayan)	0.00	1.65	1.65
Marine Corps (Barrigada)	0.00	0.91	0.91
Navy	0.13	0.00	0.13
Air Force	0.36	0.20	0.56
Army (Finegayan)	0.01	0.06	0.06
Army (Barrigada)	0.00	0.14	0.14
Total	**5.70**	**5.81**	**10.55**

Legend: MGd = million gallons per day.
Sources: GWA 2008, NAVFAC Pacific 2008*g*.

2.3.3.3 Projected Long-Range Wastewater Flows on Guam

Absent the military relocation on Guam, wastewater flows across Guam are expected to increase over time as part of normal civilian population growth. The wastewater flows presented in the previous section include expected wastewater flows that are part of normal civilian population growth during the period of time of the military relocation - years 2010 to 2019. After 2019, normal civilian population growth on Guam would continue, thereby generating additional wastewater flows from the population in the out years.

As part of DoD's ongoing consultation with GWA, GEPA, and USEPA Region 9, GWA has indicated that if DoD selects an alternative that involves using the NDWWTP, long-range wastewater flows at the NDWWTP beyond the military relocation (e.g., beyond the year 2019) would quickly exceed the 12 MGd design capacity of the plant. GWA projects a future capacity need at the NDWWTP between 12 and 18 MGd. As mentioned previously in Section 2.3.2, USEPA Region 9 recently issued a decision to deny GWA's secondary treatment 301(h) variance, effectively requiring GWA to upgrade its NDWWTP and Hagatna WWTP to secondary treatment. The treatment plant upgrades needed to meet this new requirement should be planned to ultimately provide plant capacity at the NDWWTP of between 12 and 18 MGd.

2.3.4 Screening Process

DoD developed numerous options for wastewater treatment to support the military relocation that addressed how wastewater could be managed and treated for each of the alternatives. Once developed, these options were screened to determine which ones were the most viable for implementation. These viable options were then carried forward in the analysis in the Volume to determine potential impacts from each.

In support of Main Cantonment Alternatives 1 and 2, eight alternatives for increasing the treatment capacity in northern Guam were evaluated to address treatment needs of wastewater resulting from the direct DoD population. These wastewater solutions were developed to support a Marine Corps Main Cantonment at Finegayan. All of the wastewater solutions involving an upgrade or tie-in to the GWA NDWWTP would necessarily be undertaken as joint ventures, and would require close coordination between DoD and GWA to ensure that planned facilities would provide capacity for total projected wastewater flows from both military and civilian sources. The eight wastewater alternatives evaluated are as follows:

- Restore and upgrade the existing primary treatment system at the GWA NDWWTP to accept the projected future flow and load from northern Guam (GWA facility and operation).
- Restore, expand, and upgrade the GWA NDWWTP to secondary treatment.
- Build a new DoD secondary treatment plant near the proposed development on DoD land and construct a new outfall (DoD facility and operation).
- Build a new separate DoD secondary treatment plant at the GWA NDWWTP site to treat the DoD load only (construction and operation of wastewater treatment facility not determined).
- Build a new DoD tertiary treatment plant near the selected Main Cantonment on DoD land and send effluent to a new or existing WTP (DoD facility and operation).
- Build a new DoD secondary treatment plant, and construct a new DoD outfall on the eastern coastline (DoD facility and operation).
- Build a new DoD tertiary treatment plant near the selected Main Cantonment and reuse the effluent; send the residual to the GWA NDWWTP outfall (DoD facility and operation; GWA outfall).
- Build a new DoD tertiary treatment plant near the selected Main Cantonment on DoD land and install injection wells (DoD facility and operation).

The eight wastewater alternatives to support Main Cantonment Alternatives 1 and 2 were initially evaluated through the screening process; three of them were retained as viable wastewater solutions for addressing projected increased wastewater flow. A summary of the eight wastewater alternatives for Main Cantonment Alternatives 1 and 2 and a fundamental evaluation of these alternatives are provided in Table 2.3-9.

Table 2.3-9. Summary of Alternatives Evaluated for Wastewater Systems in Support of Main Cantonment Alternatives 1 and 2

Wastewater System Alternative	*Evaluation Considerations*	*Recommendation*
Restore and upgrade the existing primary-treatment system at the GovGuam NDWWTP to accept the additional load	• Offshore construction would not be required, and a GWA outfall exists. • The discharge permit for the 301(h) waiver needs to be modified for additional flow. • The long-term impact of the primary effluent on the aquatic habitat is a concern. • No construction would occur on undeveloped land. • Public traffic disruption could occur during construction of relief interceptor. • GWA operates the NDWWTP. • Construction and operation costs would need to be shared with GWA. • Coordination with GWA on ongoing CIP projects would be required.	Retained
Restore, expand and upgrade the GovGuam NDWWTP to secondary treatment	• Offshore construction is not required and a GWA outfall exists. • The existing permit needs updating for secondary treatment limits. • The long-term impact of the secondary effluent on the aquatic habitat is a concern. • No construction would occur on undeveloped land. • Public traffic disruption could occur during construction of relief interceptor. • GWA operates the NDWWTP. • Upgrading to secondary treatment would increase GWA sewer rates for non-DoD users. • Construction and operation costs would need to be shared with GWA. • Coordination with GWA on ongoing CIP projects would be required.	Retained
Build a new secondary-treatment plant near the proposed development on DoD land and construct a new outfall	• Offshore outfall construction would be required. • A new NPDES permit from USEPA would be required. • Construction on undeveloped land may be required, causing habitat disruption. • The long-term impact of the treated effluent on the coral reef habitat is a concern. • The construction site may contain historical artifacts. • New sewer line construction would be required for diverting DoD wastewater. • DoD owns the outfall. • GWA treatment revenue would be reduced.	Retained

Wastewater System Alternative	*Evaluation Considerations*	*Recommendation*
Build a new separate DoD secondary-treatment plant at the GovGuam NDWWTP site to treat the DoD load only	• Offshore construction would not be required, and a GWA outfall exists. • The existing permit would require updating for revised limits. • Construction on undeveloped land may be required, causing habitat disruption. • The long-term impact of the blended primary and secondary effluent on the aquatic habitat is a concern. • The construction site may contain historical artifacts. • New sewer line construction is required for diverting DoD loads. • GWA owns the outfall. • GWA treatment revenue would be reduced.	Eliminated
Build a new tertiary-treatment plant near the proposed development on DoD land and send effluent to a new water treatment plant (or existing plant)	• Offshore construction would not be required. • GEPA regulates potable water supplies. • USEPA sets safe drinking water limits for local agencies. • Construction on undeveloped land may be required, causing habitat disruption. • The construction site may contain historical artifacts. • New sewer line construction is required for diverting DoD wastewater. • Construction of a new water line connection is required. • GWA purchases water from the DoD system, and monitoring requirements would be more stringent than current condition. • Construction and operation and maintenance costs would be high. • A longer planning effort and construction schedule would be required. • Public acceptance may be needed.	Eliminated
Build a new secondary-treatment plant and construct a new outfall on the eastern coastline	• Offshore construction would be required. • A new NPDES permit from USEPA would be required. • Construction on undeveloped land may be required, causing habitat disruption. • The new discharge would cause concern about the long-term impact of secondary effluent on aquatic habitat. • The construction site may contain historical artifacts. • New sewer line construction would be required for diverting DoD wastewater. • GWA treatment revenue would be reduced. • A longer planning effort and construction schedule would be required.	Eliminated

Wastewater System Alternative	*Evaluation Considerations*	*Recommendation*
Build a new tertiary-treatment plant near the proposed development and reuse the effluent; send the residual to the GWA outfall	• Offshore construction would not be required, and a GWA outfall exists. • GEPA would regulate reclaimed water. • The existing permit would require updating for revised limits. • Construction on undeveloped land may be required, causing habitat disruption. • The long-term impact of the blended primary and tertiary effluent on the aquatic habitat is a concern. • The construction site may contain historical artifacts. • New sewer line construction is required for diverting DoD wastewater. • Construction of a new reused-water line is required. • GWA owns the outfall. • GWA treatment revenue would be reduced. • Construction and operation and maintenance costs would be high. • A longer planning effort and construction schedule would be required.	Eliminated
Build a new tertiary-treatment plant near the proposed development and install injection wells	• Offshore construction would not be required. • High energy demands would result. • A new groundwater recharge permit would be required from GEPA. • Construction on undeveloped land may be required, causing habitat disruption. • The construction site may contain historical artifacts. • New sewer line construction would be required for diverting DoD wastewater. • New pipeline construction would be required for diverting effluent to injection wells. • GWA's potable water supply is from the same aquifer. • GWA treatment revenue would be reduced. • Construction and operation and maintenance costs would be high. • A longer planning effort and construction schedule would be required. • Public acceptance may be needed.	Eliminated

Legend: CIP = Capital Improvements Program; DoD = Department of Defense; GEPA = Guam Environmental Protection Agency; GovGuam = Government of Guam; GWA = Guam Waterworks Authority; NDWWTP = Northern District Wastewater Treatment Plant; NPDES = National Pollutant Discharge Elimination System; USEPA = United States Environmental Protection Agency.

In support of Main Cantonment Alternatives 3 and 8, six wastewater treatment solutions for increasing the treatment capacity were evaluated to address treatment needs of wastewater resulting from the direct DoD population. These wastewater solutions were developed to support the Marine Corps housing option at Barrigada. All of the wastewater solutions involving an upgrade or tie-in to the GWA NDWWTP and/or the GWA Hagatna WWTP would necessarily be undertaken as joint ventures, and would require close coordination between DoD and GWA to ensure that planned facilities would provide capacity for total projected wastewater flows from both military and civilian sources. The six wastewater alternatives evaluated are as follows:

- Restore and upgrade the existing primary treatment system at the GWA NDWWTP to accept the additional flow and load from both central and northern Guam (GWA facility and operation).
- Restore, expand, and upgrade the GWA NDWWTP to secondary treatment.
- Expand and upgrade the existing primary treatment system at the GWA Hagatna WWTP to accept the additional flow and load from central Guam.
- Expand and upgrade the GWA Hagatna WWTP to secondary treatment.
- Build a new secondary treatment plant near the proposed development on DoD land and construct a new outfall.
- Build a new separate DoD secondary-treatment plant at the GovGuam Hagatna WWTP site to treat the DoD load only.

Three wastewater alternatives supporting Main Cantonment Alternatives 3 and 8 are retained as viable wastewater solutions.

A summary of the five wastewater alternatives for Main Cantonment Alternatives 3 and 8 and a fundamental evaluation of these alternatives are provided in Table 2.3-10.

2.3.5 Alternatives Dismissed

The alternatives for wastewater solutions in support of Main Cantonment Alternatives 1 and 2 that were dismissed are summarized below. The rationale for dismissal is provided for each alternative.

2.3.5.1 Build a New DoD Tertiary-Treatment Plant near the Selected Main Cantonment on DoD Land and Send Effluent to a New or Existing Water Treatment Plant

Under this alternative, a new tertiary-treatment plant would be built near the proposed development on DoD land. Tertiary treatment falls into a category of direct potable reuse of reclaimed water; it normally consists of primary settlement, use of a submersible membrane bioreactor, disinfection, reverse osmosis, and advanced oxidation. The new tertiary-treatment plant would treat the DoD wastewater from existing sources and proposed future expansions in northern Guam, including the proposed Marine Corps relocation, and would inject treated effluent directly into the raw-water supply immediately upstream of a new WTP that would be constructed in northern Guam.

Although the discharge from the proposed tertiary-treatment plant would eliminate the need to construct an ocean outfall, the approach of discharging treated wastewater directly to a potable-water treatment plant does not have a proven track record. Only a few direct potable-water-reuse applications have been reported worldwide. Even without factoring in the extremely large capital investment required for this approach and its sophisticated process, gaining regulatory acceptance of direct potable-water-reuse application might be difficult. No direct potable-water-reuse programs currently operate in the U.S. All reclaimed treated wastewater has been used as potable water in an indirect way, with a natural buffer (e.g., either a stretch of river or a groundwater aquifer) between introduction of the reclaimed water and its distribution to the potable-water treatment plant.

Table 2.3-10. Summary of Alternatives Evaluated for Wastewater Systems in Support of Main Cantonment Alternatives 3 and 8

Wastewater System Alternative	*Evaluation Considerations*	*Recommendation*
Restore and upgrade the existing primary treatment system at the GWA NDWWTP to accept the additional flow and load from both central and northern Guam (GWA facility and operation).	• Offshore construction would not be required, and a GWA outfall exists. • The discharge permit for the 301(h) waiver needs to be modified for additional flow. • The long-term impact of the primary effluent on the aquatic habitat is a concern. • No construction would occur on undeveloped land. • Public traffic disruption could occur during construction of sewers. • GWA operates the NDWWTP. • Coordination with GWA on ongoing CIP projects would be required. • Requires force main from Barrigada housing to the NDWWTP.	Retained
Restore, expand, and upgrade the GWA NDWWTP to secondary treatment.	• Offshore construction is not required and a GWA outfall exists. • The existing permit needs updating for secondary treatment limits. • The long-term impact of the secondary effluent on the aquatic habitat is a concern. • No construction would occur on undeveloped land. • Public traffic disruption could occur during construction of relief interceptor. • GWA operates the NDWWTP. • Upgrading to secondary treatment would increase GWA sewer rates for non-DoD users. • Construction and operation costs would need to be shared with GWA. • Coordination with GWA on ongoing CIP projects would be required. • Requires force main from Barrigada housing to the NDWWTP.	Retained
Recondition and upgrade the existing primary treatment system at the GWA Hagatna WWTP to accept the additional flow and load from central Guam.	• Offshore construction would not be required, and a GWA outfall exists. • The discharge permit for the 301(h) waiver needs to be modified for additional flow. • The long-term impact of the primary effluent on the aquatic habitat is a concern. • No construction would occur on undeveloped land. • Public traffic disruption could occur during construction of sewers. • GWA operates the Hagatna WWTP. • Coordination with GWA on ongoing CIP projects would be required. • Require relief gravity sewer from the Barrigada housing to the Hagatna WWTP.	Eliminated

Wastewater System Alternative	*Evaluation Considerations*	*Recommendation*
Expand and upgrade the GWA Hagatna WWTP to secondary treatment	• Offshore construction is not required and a GWA outfall exists. • The existing permit needs updating for secondary treatment limits. • No construction would occur on undeveloped land. • Public traffic disruption could occur during construction of sewer. • GWA operates the Hagatna WWTP. • Upgrading to secondary treatment would increase GWA sewer rates for non-DoD users. • Construction and operation costs would need to be shared with GWA. • Coordination with GWA on ongoing CIP projects would be required. • Require relief gravity sewer from the Barrigada housing to the Hagatna WWTP.	Eliminated
Build a new secondary-treatment plant near the proposed development on DoD land and construct a new outfall	• Offshore outfall construction would be required. • A new NPDES permit from USEPA would be required. • No construction would occur on undeveloped land. • The long-term impact of the treated effluent on the coral reef habitat is a concern. • New sewer line construction would be required for diverting DoD wastewater. • DoD owns the outfall. • GWA treatment revenue would be reduced. • Requires force main from Barrigada housing to the DoD stand along WWTP.	Retained

Legend: CIP = Capital Improvements Program; DoD = Department of Defense; GWA = Guam Waterworks Authority; NDWWTP = Northern District Wastewater Treatment Plant; NPDES = National Pollutant Discharge Elimination System; USEPA = United States Environmental Protection Agency; WWTP = Wastewater Treatment Plant.

Brine generated through reverse osmosis requires some kind of discharge. Typical brine disposal routes include evaporation, crystallization to solidify the salts, deep underground injection, and ocean or sewer discharge. From an economic standpoint, only the last two options may be feasible, and they require permission from either USEPA or GWA. Because no regulations have been promulgated on the potable reuse of reclaimed water, the process of establishing treatment requirements and performance monitoring standards for this option would add time and cost resulting in the determination that this alternative should be eliminated.

2.3.5.2 Build a New DoD Secondary-Treatment Plant and Construct a New Ocean Outfall on the Eastern Coastline

Under this alternative, a new secondary-treatment plant would be built on the eastern side of Guam to treat DoD wastewater from existing sources and future sources (wastewater from the proposed military relocation in northern Guam, including the proposed Marine Corps relocation), and a new outfall would be constructed along the eastern coastline. This option would be feasible only if the majority of Marine Corps relocation were to occur on the east side of northern Guam. This alternative would require all existing wastewater flow and future flow associated with the Marine Corps relocation to be routed and diverted to the new treatment plant.

The construction of a new outfall would likely require implementation of mitigation measures to satisfy both the Guam Bureau of Statistics and Planning Office and the Guam Division of Aquatic and Wildlife Resources. The entire northeast coastline around Andersen AFB is designated as the Pati Point Marine Preserve. The Pati Point Marine Preserve contains 8 square miles (21 square kilometers)—approximately 4,900 acres (ac) (2,000 hectares [ha])—of reef environment, which would be restricted as a potential site for an ocean outfall. Also, construction of the plant on a site located in forested or preservation areas that are populated by native species of animals and vegetation may require implementation of mitigation measures to satisfy the Guam Division of Aquatic and Wildlife Resources. With little chance to get a new ocean outfall discharge permit along northeast coast of Guam and all other above presented detrimental impacts, this alternative should be eliminated.

2.3.5.3 Build a New DoD Tertiary-Treatment Plant near the Selected Main Cantonment and Reuse the Effluent; Send the Residual to the GovGuam NDWWTP Outfall

Under this alternative, a new tertiary-treatment plant would be built near the proposed development on DoD land. This new plant would treat DoD wastewater from both existing sources and the future proposed military relocation in northern Guam, including the proposed Marine Corps relocation. The treated effluent from the tertiary-treatment system would be reused for toilet flushing, wash water for vehicles and aircraft, landscape irrigation, and cooling water for building climate control; it could also be provided to other non-DoD end users. Excess effluent that is produced would be discharged to the existing NDWWTP outfall. To achieve the level of treatment required for these reuse practices, a wastewater treatment process would be needed, consisting of primary treatment, a membrane bioreactor, disinfection, and color removal. DoD would be responsible for the treatment, effluent reuse, and biosolids disposal associated with this alternative.

The total reclaimed water produced under this alternative could be an estimated 3.77 MGd (14.27 MLd); however, the Finegayan area lacks sustainable and reliable demand for reuse of reclaimed water. A study assessing the demand for reclaimed-water usage and identifying a sustainable water-reuse rate structure would be required. In addition, a separate water distribution and dual plumbing system would be required, and the cross-connection risk would need to be addressed. These steps would add time and cost to the project. The installation of a dual plumbing system for existing buildings may not be economically feasible. All these result in the determination that this alternative should be eliminated.

2.3.5.4 Build a New DoD Tertiary-Treatment Plant near the Selected Main Cantonment on DoD Land and Install Injection Wells

Under this alternative, a new tertiary-treatment plant would be built near the proposed development on DoD land. The new plant would treat DoD wastewater from existing sources and future proposed military relocation in northern Guam, including the Marine Corps relocation. Treated effluent would be injected into the underground aquifer for groundwater replenishment, increasing the sustainability of the groundwater in the NGLA. DoD would be responsible for treatment, groundwater monitoring, and biosolids disposal.

The NGLA is a sole-source aquifer that is located directly underneath northern Guam. Northern Guam is underlain by a karst limestone plateau with high water conductivity that results in low retention times between injection wells and withdraw wells, and a minimum of soil aquifer treatment. Under these conditions, a very high degree of treatment (normally beyond USEPA primary drinking water standards) has to be achieved. In practice, even if tertiary treatment of effluent were applied for this kind of indirect potable reuse of reclaimed water, it is expected that this alternative would not be readily accepted by regulatory agencies. Because no regulations are promulgated on Guam regarding the indirect potable reuse of reclaimed water, the process of establishing treatment requirements and performance monitoring standards for this option would consume time and increase project costs. Therefore, this alternative should be eliminated.

2.3.5.5 Build a New Separate Secondary Treatment Plant at the GWA NDWWTP Site to Treat DoD Load Only

This option would build a new secondary treatment plant at the NDWWTP site, and treat the DoD wastewater from the DoD land at Finegayan including proposed Marine Corps housings. The existing NDWWTP would be upgraded to have two separate and independent treatment process trains. The existing primary treatment would continue to treat flow from civilian population in northern Guam. The new process train consists of primary and secondary treatment, as well as UV disinfection, and solids treatment. The new treatment plant would have separate headworks, primary treatment, secondary treatment, UV disinfection, and sludge handling facilities to treat the load from the DoD land at Finegayan. The new process train, including both liquid treatment and solids treatment, is a self-contained and complete secondary treatment system from the start to the end, and it would require jointly utilizing the existing NDWWTP ocean outfall for its secondary treated effluent disposal. This alternative requires constructing a new independent sewer main to convey all military generated wastewater from the DoD land at Finegayan to the NDWWTP site. GWA does not agree on a separate DoD treatment facility to use its outfall and NPDES permit to discharge DoD treated flow, as a result this alternative should be eliminated.

The alternatives for wastewater solutions in support of Main Cantonment Alternatives 3 and 8 that were dismissed are summarized below. The rationale for dismissal is provided for each alternative.

2.3.5.6 Recondition and Upgrade the Existing Primary Treatment System at the GWA Hagatna WWTP to Accept the Additional Flow and Load from Central Guam

In this Interim Alternative, the primary-treatment facilities of the NDWWTP would be refurbished and upgraded to accept the additional DoD flows and military relocation–related flows from Finegayan area.

The effluent pump station of the Hagatna WWTP would be refurbished to accept the additional DoD flows and military relocation–related flows from proposed Barrigada housing area. A new UV disinfection system would also be added for effluent disinfection. This interim alternative would require modification of the Hagatna WWTP’s existing NPDES permit by USEPA Region 9 to increase the effluent-discharge limit from a maximum daily flow of 12.0 MGd (45.4 MLd) to 21.0 MGd (79.5 MLd). The proposed modifications to the Hagatna WWTP should be completed by 2011.

In addition, new sewer lines would need to be installed from the Barrigada to the Hagatna WWTP.

2.3.5.7 Expand and Upgrade the GWA Hagatna WWTP to Secondary Treatment

Under this alternative, the existing Hagatna WWTP would be upgraded to secondary-treatment plant. By expanding and upgrading the existing primary system, the Hagatna WWTP can be converted to a new secondary treatment process. A trickling filter system was selected as the secondary treatment process not only because of its lower power requirement and less sludge production compared with a suspended growth system (such as Activated Sludge System) but also because of its simple and reliable operational nature. It is desirable to have a simple process to minimize future operation and maintenance requirements on the island of Guam.

This plant would treat DoD wastewater from existing sources and future sources (wastewater from the proposed military relocation in Barrigada, including the proposed Marine Corps relocation). This option would be feasible only if the majority of Marine Corps relocation were to occur in Barrigada area. This alternative would require all existing wastewater flow and future flow associated with the Marine Corps relocation to be routed and diverted to the Hagatna treatment plant.

2.3.5.8 Build a New Separate Secondary Treatment Plant at the GWA Hagatna WWTP Site to Treat DoD Load Only

This option would build a new secondary treatment plant at the Hagatna WWTP site, and treat the DoD wastewater from the DoD land at Barrigada including proposed Marine Corps housings. The existing Hagatna WWTP would be upgraded to have two separate and independent treatment process trains. The existing primary treatment would continue to treat flow from civilian population in Central Guam. The new process train consists of primary and secondary treatment, as well as UV disinfection, and solids treatment. The new treatment plant would have separate headworks, primary treatment, secondary treatment, UV disinfection, and sludge handling facilities to treat the load from the DoD land at Barrigada. The new process train, including both liquid treatment and solids treatment, is a self-contained and complete secondary treatment system from the start to the end, and it would require jointly utilizing the existing Hagatna WWTP ocean outfall for its secondary treated effluent disposal. This alternative requires constructing a new independent sewer main to convey all military generated wastewater from the DoD land at Barrigada to the Hagatna WWTP site.

Alternatives discharging wastewater from Barrigada Housing to Hagatna WWTP were eliminated because of the following reasons:

- The majority of the improvements due to Marine relocation to Guam would be located in northern Guam, where wastewater is routed to the NDWWTP. Collection of all DoD flows at one WWTP allows for efficient management of the wastewater treatment.
- Concentrating WWTP improvements associated with DoD wastewater at one plant owned by GWA would help with efficient utilization of GWA’s limited Capital Improvement Program budget resources. This approach also relieves the logistical burden of upgrading two WWTPs in the same time period.
- The ocean outfall for the Hagatna WWTP does not have a diffuser installed, and is in a heavily populated area of Guam. The NDWWTP has a newly installed ocean outfall with a diffuser system that is currently undergoing design evaluation based on future flow forecasts and the effluent discharges in a relatively remote area of the island. It is preferable to route the wastewater flows to the NDWWTP to minimize the environmental impacts from the effluent discharge.

2.3.6 Alternatives Developed Forward for Wastewater

As discussed in Section 2.3.2, the alternatives presented in this EIS were adjusted to recognize the secondary treatment variance denial, and reflect the need for secondary treatment plant upgrades for all alternatives evaluated. Based on the evaluation, the Preferred Alternative (Basic Alternative 1) was selected to meet the interim wastewater needs and to meet the year 2019 projected DoD demand at the completion of the military relocation. Under Basic Alternative 1, in addition to providing restoration and upgrades to NDWWTP’s primary treatment system to meet the short-term wastewater demand, this alternative provides upgrading the NDWWTP to secondary treatment. Two options for Basic Alternative 1 are provided to support the Main Cantonment Alternatives 1 and 2 (Basic Alternative 1a), and Main Cantonment Alternatives 3 and 8 (Basic Alternative 1b).

Basic Alternative 1a focuses improvements for DoD wastewater services at one plant, the NDWWTP, and is fully supportive of the preferred cantonment alternative 2. Existing treatment plant facilities would be expanded at the current location, not requiring new stand alone treatment facilities. Basic Alternative 1b supports cantonment alternatives 3 and 8, which are not preferred. This alternative would require a long new force main from the Barrigada housing area to the NDWWTP. Since Basic Alternative 1a supports the preferred cantonment alternative, it was chosen as the preferred alternative. See below for additional details.

Basic Alternative 1a (Preferred Alternative) supports Main Cantonment Alternatives 1 and 2; Basic Alternative 1b supports Main Cantonment Alternatives 3 and 8. The difference between Alternatives 1a and 1b is a requirement for a new sewer line and associated pumping stations from Barrigada housing to NDWWTP for Alternative 1b.

Induced civilian growth as a result of the military relocation could increase the islandwide civilian population on Guam by up to approximately 33,000 in the peak year of 2014. Therefore, to provide the capacity to treat the near-term wastewater flow generated by a portion of the indirect construction workforce and induced population growth that would be expected in northern Guam, this wastewater alternative would address near-term wastewater flow as well as wastewater flow at the NDWWTP. It does not address the wastewater generated by the indirect construction workforce and induced population growth that could be sent to other GWA WWTPs on Guam.

Under Basic Alternative 1a, the NDWWTP would be refurbished and the plant’s primary treatment capacity would be upgraded to accept the additional DoD flows and military relocation–related flows and loads. Additionally, expansion of the plant to secondary treatment would be completed. Refurbishment of the primary system, upgrade of the primary system, and installation of a secondary system would be constructed in separate phases. This refurbishment would result in improved pollutant removal at the plant and overall improved water quality of the discharge effluent.

Near-term wastewater flows to the NDWWTP from military and civilian sources are projected to increase to a peak of 12.13 MGd (45.91 MLd) in 2014, which would slightly exceed the design capacity of 12 MGd (45.4 MLd). DoD and GWA are assessing options to enhance treatment until primary treatment upgrades can be implemented. One option being investigation is to add chemical coagulants (enhanced primary treatment) or increase the surface overflow rate (within the normal design range) of the clarifier, which would improve plant operations so that the primary clarifier would be able to treat the additional flow without adverse effect on the NDWWTP. Normally, a chemically enhanced primary treatment system can significantly increase overflow rate of a conventional primary clarifier as recommended by the Manual of Practice 8 (Water Environment Federation 2010). However, the permit limit of 6 MGd (22.7 MLd) would still be exceeded and the plant would still need some refurbishment and upgrades to restore it to the original design capacity and pollutant removal efficiencies.

The existing NPDES permit for the NDWWTP is based on a maximum daily flow of 6 MGd (22.7 MLd). Under this alternative, the liquid treatment system of the NDWWTP would be refurbished to restore the plant’s originally designed treatment capacity of 12 MGd (45.4 MLd) so that the plant would comply with regulations associated with treating the increased wastewater flow from the military relocation. At the same time, the plant’s solids treatment system would be refurbished and upgraded to process sludge produced by treatment of 12 MGd (45.4 MLd) of influent wastewater. The solids treatment system has two anaerobic digesters and a dewatering complex that are currently nonfunctional and in disrepair; the system would need to be rehabilitated and upgraded with sufficient capacity to treat solids generated at the plant. The dewatered stabilized solids would then be hauled away, most likey to a landfill. Potential future beneficial use of the dewatered stabilized solids somewhere on Guam could be explored in the future.

The Navy has completed an evaluation of capacity and required improvements needed at NDWWTP entitled Evaluation of Northern District Wastewater Treatment Plant Capacity (NAVFAC Pacific 2009a). Based on the plant's current capacity, to accommodate anticipated near-term flow and loadings while still achieving the existing primary-treatment requirement, the following necessary improvements would have to be implemented at the NDWWTP to restore its primary treatment capacity and pollutant removal efficiencies:

- Septage (liquid and solid material pumped from a primary treatment source) and fat/oil/grease receiving station
- Headworks improvement
- Primary clarifier rehabilitation
- Sludge digester rehabilitation
- Centrifuge building and one centrifuge replacement
- Sludge-drying bed rehabilitation
- Standby power
- Hydraulic improvements to the chlorine contact tank
- Third digester
- Second centrifuge
- Odor control
- Digester gas utilization
- Administration/laboratory, office, and workshop/storage areas rehabilitation

The new ocean outfall that was put into service in December 2008 at the NDWWTP enables the plant to discharge a peak-hour treated flow of 27 MGd (102.2 MLd) to the Philippine Sea. This would be enough capacity to handle the increased flow during the peak period.

Under Basic Alternative 1a, all DoD-generated wastewater, either from Andersen AFB or from the proposed Marine Corps relocation, would be conveyed to the NDWWTP for treatment. All flows from the current and proposed future military relocation at Andersen AFB would be conveyed through the existing GWA sewer to the NDWWTP, while wastewater flow generated from the proposed Marine Corps relocation at Finegayan would be conveyed via a new relief sewer line to the NDWWTP (Figure 2.3-2). A new 24-in (61-cm), 7,500-ft (2,300-m) gravity relief sewer would be connected from the collection system of the Marine Corps Finegayan area on the west side of the planned Marine Corps Finegayan development to the headworks of the NDWWTP. The proposed modifications to the NDWWTP and collection system should be completed by 2013.

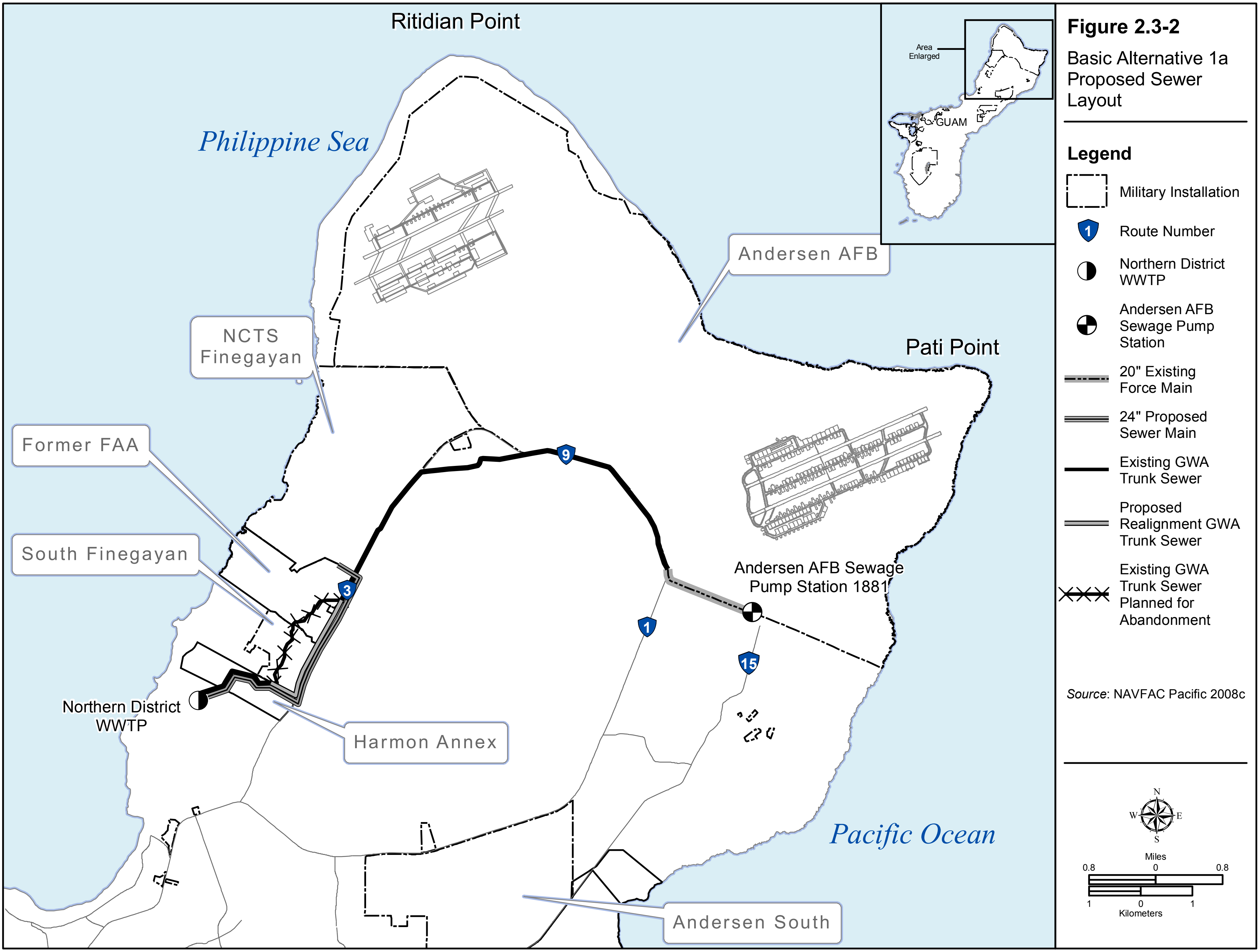

Figure 2.3-2
Basic Alternative 1a Proposed Sewer Layout

Source: NAVFAC Pacific 2008c

Printing Date: May 24, 2010; M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_6\2.3-2_may2010.mxd

The Navy would coordinate with GWA to expedite the required plant improvements so that the NDWWTP would have enough capacity to bridge the gap between existing conditions and the final long-term wastewater solution. The proposed necessary improvements to restore the primary treatment capacity of the NDWWTP should be completed by December 2012. The Navy would also need to coordinate with GWA and USEPA Region 9 to facilitate a compliance agreement that allows an increase in the effluent discharge limitation from 6.0 MGd (22.7 MLd) to 12 MGd (45.4 MLd) average daily flow and the maximum daily discharge to 27 MGd (102.2 MLd).

The DoD's strategy to deliver reliable utility support for the military relocation was shaped based on the potential use of SPEs, which would likely be SPEs formed to finance, operate, manage, upgrade, or develop utility plants and associated infrastructure. It is anticipated that the SPEs would utilize GoJ financing. DoD is seeking funding from GoJ for the needed improvements to the NDWWTP.

Basic Alternative 1a would also upgrade the refurbished primary treatment system at the NDWWTP to secondary treatment with a capacity between 12 and 18 MGd (46.4 and 61.8 MLd) as determined by GWA and DoD, to treat both current wastewater flow and projected future flows from both civilian and military sources. It is expected that a trickling filter system is the best option as the secondary treatment process. In addition to the above presented primary treatment improvements, the following new process components and upgrades would be required at the NDWWTP for this alternative:

- One primary clarifier (the same size as existing ones)
- Three trickling filters
- Four secondary clarifiers
- One chlorine contact tank
- Two additional anaerobic digesters (the same size as existing ones)
- One additional centrifuge solids-dewatering system and odor control
- Effluent monitoring and measurement expansion
- Outfall diffuser capacity expansion

The proposed secondary treatment upgrades to the NDWWTP should be completed by July 2013. This alternative would require modifications to the NPDES permit from USEPA Region 9 to set new discharge limits and permit conditions. It is anticipated that the PEs would utilize GoJ financing. DoD is seeking funding from GoJ for the needed improvements to the NDWWTP.

To support Main Cantonment Alternatives 3 and 8, Basic Alternative 1b includes upgrades to the existing primary treatment facility and expansion to secondary treatment at the NDWWTP would be needed to accept additional wastewater flow and load from both central and northern Guam.

Under Basic Alternative 1b, in addition to all the proposed improvements presented in Alternative 1a, a new sewer line and lift pump stations would need to be installed to convey wastewater generated at Barrigada housing to the GWA NDWWTP for treatment. Figure 2.3-3 indicates the most likely routing of the proposed sewer lines. The proposed sewer lines and pump station should be completed in 2013.

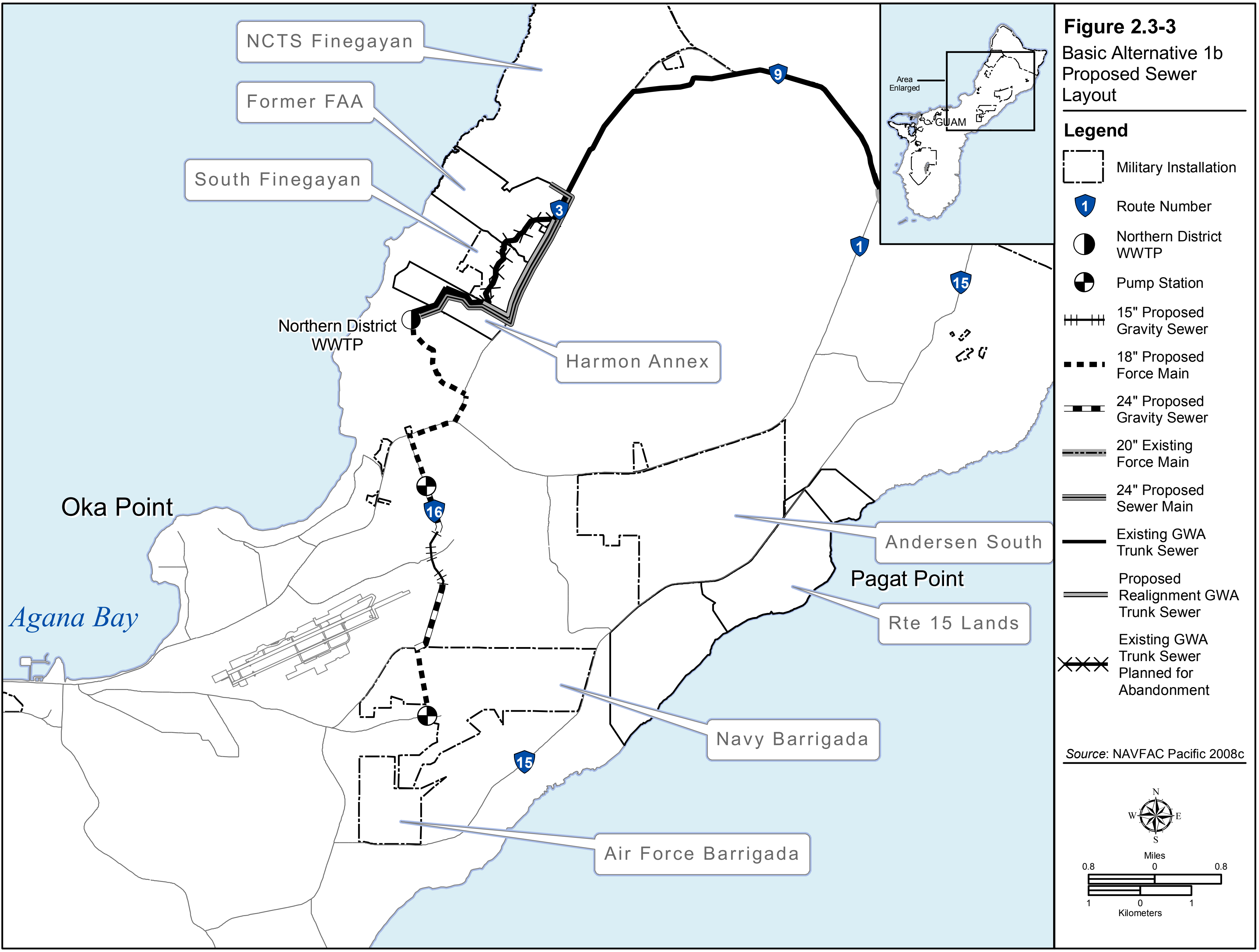

Figure 2.3-3
Basic Alternative 1b Proposed Sewer Layout

Source: NAVFAC Pacific 2008c

Printing Date: May 24, 2010; M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_6\2.3-3_may2010.mxd

2.3.7 Long-Term Alternatives

The wastewater alternative outlined below is considered to meet the year 2019 projected DoD demand at the completion of the military relocation, assuming that the Main Cantonment would be located at Finegayan (Main Cantonment Alternatives 1 and 2) or split between Finegayan and Barrigada (Main Cantonment Alternatives 3 and 8). The wastewater alternative supporting Main Cantonment Alternatives 3 and 8 would still require implementation of the alternative in support of Main Cantonment Alternatives 1 and 2 because Main Cantonment Alternatives 3 and 8 would still use the Finegayan area for military facilities. This long-term alternative would only be considered if the ultimate upgrade of NDWWTP to secondary treatment did not get implemented and the USEPA requirements to provide secondary treatment prevailed.

Long-Term Alternative 1: New DoD Only Stand Alone Secondary Treatment Facility on DoD Land at Finegayan Including a New Outfall in Support of all Main Cantonment Alternatives

Under Long-Term Alternative 1, to address interim wastewater needs, existing primary treatment facilities at the NDWWTP would have been refurbished to meet primary treatment standards as described in Basic Alternative 1 (Section 2.3.4). The NDWWTP would have been refurbished and the plant's primary treatment capacity would have been upgraded to accept the additional DoD flows and military relocation–related flows and loads in the short term. Construction of a new stand alone DoD secondary wastewater treatment facility on DoD land at Finegayan would be considered a long-term alternative and is discussed herein programmatically.

Interim wastewater flows to the NDWWTP would be handled in the same way as Alternative 1a.

Under Long Term Alternative 1a, all military-generated wastewater, either from Andersen AFB or from the proposed Marine Corps relocation, would be conveyed to the NDWWTP for treatment. All flows from the current and proposed future military relocation at Andersen AFB would be conveyed through the existing GWA sewer to the NDWWTP, while wastewater flow generated from the proposed Marine Corps relocation at Finegayan is planned to be conveyed via a new relief sewer line to the NDWWTP (as shown in Figure 2.3-2). A new 24-in (61-cm), 7,500-ft (2,300-m) gravity relief sewer would be connected from the collection system of the Marine Corps Finegayan area to the headworks of the NDWWTP. The proposed short-term modifications to the NDWWTP and collection system should be completed by December 2012.

The Navy would coordinate with GWA to expedite the required plant improvements so that the NDWWTP would have enough capacity to bridge the gap between existing conditions and the final long-term wastewater solution. The proposed necessary improvements to restore the primary treatment capacity of the NDWWTP should be completed by December 2012. The Navy would also need to coordinate with GWA and USEPA Region 9 to facilitate a compliance agreement that allows an increase in the effluent discharge limitation from 6.0 MGd (22.7 MLd) to 12 MGd (45.4 MLd) average daily flow and the maximum daily discharge to 27 MGd (102.2 MLd).

Long-Term Alternative 1 would require DoD to construct its own independent sewage interceptor to collect wastewater generated from military activities both at Andersen AFB and in the Finegayan area in support of Main Cantonment Alternatives 1 and 2. The interceptor sewer would connect to the Andersen AFB collection system at its main gate lift station, run west along Route 3, and then combine the flow generated by the Marine Corps and Army into the proposed DoD secondary treatment plant located at the southwest corner of the DoD proposed Finegayan development. Approximately 33,300 ft (10,000 m) of

21-in (53-cm) sewer and 8,700 ft (2,700 m) of 24-in (61-cm) sewer would be required to convey flow from the Andersen AFB and Finegayan areas to the new DoD plant (Figure 2.3-4).

Long-Term Alternative 1 also proposes to construct a new secondary-treatment plant on DoD land and construction of a new DoD ocean outfall. Under this alternative, a newly constructed independent sewer main would convey all military-generated wastewater in northern Guam to a DoD secondary-treatment plant near the proposed Marine Corps Finegayan development on DoD land in support of Main Cantonment Alternatives 1 and 2. The new sewer main would carry a total average daily wastewater flow of 3.77 MGd (14.27 MLd). The treated effluent from this secondary-treatment plant would be discharged via a new DoD ocean outfall into the Philippine Sea.

The new secondary-treatment plant would likely consist of the following components:

- Headworks (two screens and two aerated grit chambers with odor control)
- Three primary clarifiers
- Three trickling filters
- Three secondary clarifiers
- Two chlorine contact tanks
- Three anaerobic digesters
- Two centrifuge solids-dewatering systems with odor control
- Effluent monitoring and measurement
- New ocean outfall

Should Main Cantonment Alternatives 3 or 8 be selected, an additional sewer modification from wastewater Basic Alternative 1 would be required to convey wastewater generated at Barrigada from the connection at GWA’s NDWWTP sewer collection system to this new stand alone DoD secondary treatment facility. The new proposed forcemain sewer extension is shown on Figure 2.3-3. The proposed modified sewer lines and new pump station should be completed by 2015.

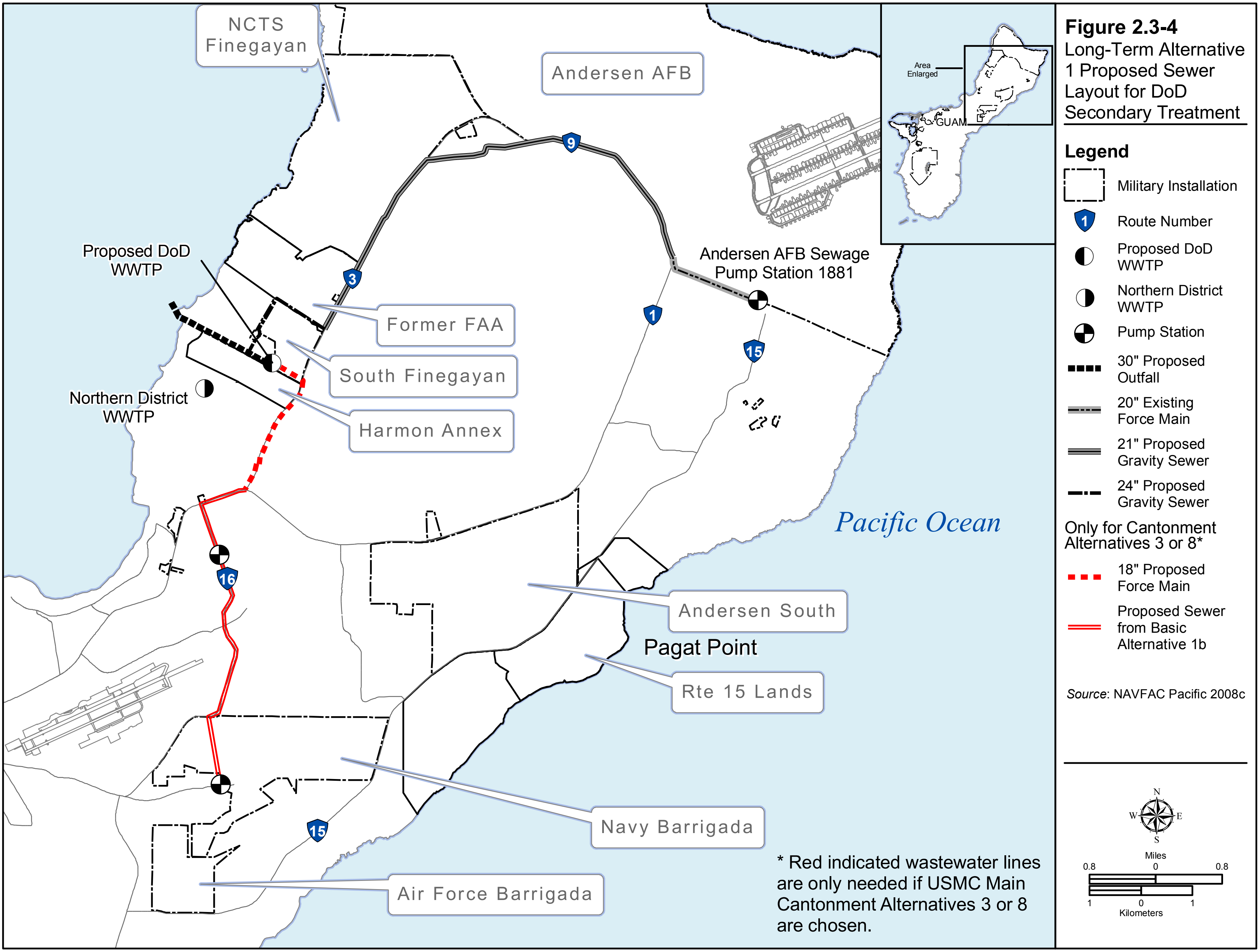

Figure 2.3-4
Long-Term Alternative 1 Proposed Sewer Layout for DoD Secondary Treatment

Source: NAVFAC Pacific 2008c

* Red indicated wastewater lines are only needed if USMC Main Cantonment Alternatives 3 or 8 are chosen.

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2.4 SOLID WASTE

2.4.1 Anticipated Demand

Projections for solid waste generation rates from the proposed military relocation on Guam are presented in Table 2.4-1. The table lists projected populations due to direct and indirect actions through year 2019 and the resulting annual tonnages of solid waste generated. The solid waste estimates are based on an assumed generation rate of 7.4 pounds (lb) (3.4 kilograms [kg]) per capita per day for on base personnel and 5.28 lb (2.39 kg) per capita per day for off base populations. The assumed generation rate for on base personnel includes residential; commercial; industrial; and construction waste streams not related to the military relocation (NAVFAC Pacific 2008). Table 2.4-1

also reflects the DoD's diversion requirement of 50% of solid waste by weight by 2015. Construction and demolition (C&D) debris that would be generated by base improvements to accommodate the military relocation are not included in these per capita estimates. The Navy recently completed a study that evaluates the C&D debris waste stream (NAVFAC Pacific 2010d) that provides recommendations for processing and disposing of this waste. The study estimates that approximately 469,000 tons (425,000 metric tons) of C&D debris would be generated as a result of new C&D of existing structures and a diversion goal of 50% can be achieved. Recycling and diversion initiatives for municipal solid waste and C&D debris as well as waste characterization are discussed further in Section 2.4.5.

2.4.2 Available Solid Waste Facilities

The current solid waste disposal sites on Guam are as follows:

- Navy Sanitary Landfill (accepts Navy-generated solid waste)
- Andersen AFB Landfill and Recycling Center (accepts Air Force–generated solid waste)
- GovGuam Ordot Dump (accepts all civilian solid waste)

The locations of the existing facilities are shown in Table 2.4-1.

The Navy Sanitary Landfill at Apra Harbor currently accepts solid waste from all of the Navy's military personnel, residents, DoD employees, and contractors located on base. This landfill also accepts commercial waste streams from base activities, including C&D waste. The unlined landfill has been in use since 1965 and is currently operated by the Base Operations Support contractor, under the terms of the administratively extended Solid Waste Management Permit, No. 95-1009, dated December 26, 1995. The Navy has applied for a permit renewal from GEPA. The Navy currently plans to continue to fill the landfill to an elevation of 54 ft (16 m) above msl. The current landfill ranges in height from 20 ft (6 m) up to 52 ft (16 m) above msl.

The Air Force owns and operates a landfill on Guam, located at Andersen AFB near Route 1 and the entrance road to Andersen AFB. The landfill provides service to military personnel and residents of the bases as well as commercial waste streams from base activities. Base operations personnel operate and maintain the facility under a current Resource Conservation and Recovery Act Subtitle D Permit. The landfill reached its original design capacity in September 2007; therefore, the Air Force recently constructed a 2-ac (0.81-ha) expansion to meet its disposal needs through 2009. Because the GovGuam landfill would not become available until July 2011, the Air Force has awarded a project to design and construct an expansion to the Air Force landfill to accommodate receiving of solid waste for an additional 18 months. This expansion would handle Air Force municipal and industrial waste streams.

Table 2.4-1. Projected Solid Waste Estimates

	2010		2011		2012		2013		2014		2015	
	Population	Solid Waste (tons/yr) [1]	Population	Solid Waste (tons/yr) [a]	Population	Solid Waste (tons/yr) [a]	Population	Solid Waste (tons/yr) [a]	Population	Solid Waste (tons/yr) [a]	Population	Solid Waste (tons/yr) [a]
DoD Project Related (with Transient Personnel from CSG and ESG)												
Active (USMC + Army)	510	689	1,220	1,648	1,220	1,648	1,220	1,648	8,602	11,617	9,182	12,400
Dependents (USMC + Army)	537	725	1,231	1,663	1,231	1,663	1,231	1,663	9,000	12,155	9,950	13,437
Transient (USMC + Army)	0	0	400	540	400	540	400	540	2,000	2,701	2,000	2,701
Transient (Navy) (up to 3 times/yr, 21 days/visit)	0	0	0	0	0	0	0	0	0	0	7,222	1,683
Civilian Work Force (on-base) (USMC + Army)[b]	102	0	244	0	244	0	244	0	1,720	0	1,836	0
DoD Project-Related Subtotal	**1,149**	**1,414**	**3,095**	**3,851**	**3,095**	**3,851**	**3,095**	**3,851**	**21,322**	**26,473**	**30,190**	**30,222**
DoD Non-Project Related												
Navy/USCG/Air Force												
Active	80	108	80	108	80	108	130	176	170	230	250	338
Dependents	118	159	118	159	118	159	148	200	240	324	290	392
Transient	900	1,215	900	1,215	1256	1,696	1,256	1,696	1,256	1,696	1,256	1,696
Civilian Work Force (on-base)[b]	17	0	17	0	17	0	27	0	35	0	38	0
DoD Non-Project Related Subtotal	**1,115**	**1,483**	**1,115**	**1,483**	**1,471**	**1,964**	**1,561**	**2,072**	**1,701**	**2,250**	**1,834**	**2,425**
DoD Baseline Population (USMC/Army/Navy/Air Force/USCG)	**17,581**	**20,366**	**17,581**	**20,366**	**17,581**	**20,366**	**17,581**	**20,366**	**17,581**	**20,366**	**17,581**	**20,366**
DOD SOLID WASTE STREAM TOTAL	**19,845**	**23,262**	**21,791**	**25,699**	**22,147**	**26,180**	**22,237**	**26,288**	**40,604**	**49,088**	**49,605**	**53,013**
Implement Recycling and Diversion (Percentage)		**10%**		**10%**		**20%**		**30%**		**40%**		**50%**
Quantity Reduced by Recycling and Diversion		**2,326**		**2,570**		**5,236**		**7,886**		**19,635**		**26,507**
NET DOD SOLID WASTE STREAM TOTAL	**19,845**	**20,936**	**21,791**	**23,129**	**22,147**	**20,944**	**22,237**	**18,402**	**40,604**	**29,453**	**49,605**	**26,507**
Non-Military (Operation-Related Non-DoD population) [c]												
Full-Time Equivalent Jobs (direct, from purchases)	122	118	278	268	278	268	278	268	1,620	1,561	2,254	2,172
Full-Time Equivalent Jobs (indirect and induced)	108	104	254	245	254	245	254	245	1,532	1,476	2,092	2,016
Dependents (includes dependents of civilian work force)	353	340	849	818	860	829	850	819	5,520	5,319	6,116	5,893
Non-Military (Operation-Related Non-DoD population) Subtotal	**583**	**562**	**1,381**	**1,331**	**1,392**	**1,341**	**1,382**	**1,332**	**8,672**	**8,356**	**10,462**	**10,081**
Non-Military (Construction Related Non-DoD Population) [c]												
Construction Jobs (direct, onsite)	3,239	3,121	8,202	7,903	14,217	13,699	17,834	17,184	18,374	17,705	12,140	11,698
Full-Time Equivalent Jobs (direct, from purchases)	1,518	1,463	3,749	3,613	6,380	6,148	7,795	7,511	8,037	7,744	5,284	5,092
Full-Time Equivalent Jobs (indirect and induced)	1,017	980	2,755	2,655	4,860	4,683	5,749	5,540	5,797	5,586	3,310	3,190
Dependents	3,534	3,405	8,651	8,336	14,355	13,832	16,719	16,110	16,974	16,356	10,753	10,362
Non-Military (Construction Related Non-DoD Population) Subtotal	**9,308**	**8,969**	**23,357**	**22,507**	**39,812**	**38,363**	**48,097**	**46,346**	**49,182**	**47,392**	**31,487**	**30,341**
NON-MILITARY OPERATIONS AND CONSTRUCTION RELATED TOTAL	**9,891**	**9,531**	**24,738**	**23,837**	**41,204**	**39,704**	**49,479**	**47,678**	**57,854**	**55,748**	**41,949**	**40,422**
TOTAL SOLID WASTE	**29,736**	**30,467**	**46,529**	**46,967**	**63,351**	**60,648**	**71,716**	**66,079**	**98,458**	**85,201**	**91,555**	**66,929**

Legend: CSG = Carrier Strike Group; ESG = Expeditionary Strike Group; USMC = U.S. Marine Corps; USCG = U.S. Coast Guard

1. SW generation estimates are based on population loading of 02-09-09.
2. DoD solid waste quantities are based on a generation rate of 7.4 lbs/capita/day (HDR/Hawaii Pacific Engineers 2008). This rate includes solid waste generated by on-base civilian work force.
3. Non-military (operation and construction related non-DoD population) solid waste quantities are based on a generation rate of 5.28 lb/capita/day (GEPA 2006).

	2016		2017		2018		2019	
	Population	Solid Waste (tons/yr) [a]	Population	Solid Waste (tons/yr) [1]	Population	Solid Waste (tons/yr) [a]	Population	Solid Waste (tons/yr) [a]
DoD Project Related (with Transient Personnel from CSG and ESG)								
Active (USMC + Army)	9,182	12,400	9,182	12,400	9,182	12,400	9,182	12,400
Dependents (USMC + Army)	9,950	13,437	9,950	13,437	9,950	13,437	9,950	13,437
Transient (USMC + Army)	2,000	2,701	2,000	2,701	2,000	2,701	2,000	2,701
Transient (Navy) (up to 3 times/yr, 21 days/visit)	7,222	1,683	7,222	1,683	7,222	1,683	7,222	1,683
Civilian Work Force (on-base) (USMC + Army)[b]	1,836	0	1,836	0	1,836	0	1,836	0
DoD Project-Related Subtotal	**30,190**	**30,222**	**30,190**	**30,222**	**30,190**	**30,222**	**30,190**	**30,222**
DoD Non-Project Related								
Navy/USCG/Air Force								
Active	250	338	250	338	250	338	450	608
Dependents	290	392	290	392	290	392	290	392
Transient	1,256	1,696	1,256	1,696	1,256	1,696	1,780	2,404
Civilian Work Force (on-base)[b]	38	0	38	0	38	0	45	0
DoD Non-Project Related Subtotal	**1,834**	**2,425**	**1,834**	**2,425**	**1,834**	**2,425**	**2,565**	**3,403**
DoD Baseline Population (USMC/Army/Navy/Air Force/USCG)	**17,581**	**20,366**	**17,581**	**20,366**	**17,581**	**20,366**	**17,581**	**20,366**
DOD SOLID WASTE STREAM TOTAL	**49,605**	**53,013**	**49,605**	**53,013**	**49,605**	**53,013**	**50,336**	**53,991**
Implement Recycling and Diversion (Percentage)		**50%**		**50%**		**50%**		**50%**
Quantity Reduced by Recycling and Diversion		**26,507**		**26,507**		**26,507**		**26,996**
NET DOD SOLID WASTE STREAM TOTAL	**49,605**	**26,507**	**49,605**	**26,507**	**49,605**	**26,507**	**50,336**	**26,996**
Non-Military (Operation-Related Non-DoD population) [c]								
Full-Time Equivalent Jobs (direct, from purchases)	2,254	2,172	2,254	2,172	2,254	2,172	2,356	2,270
Full-Time Equivalent Jobs (indirect and induced)	2,092	2,016	2,092	2,016	2,092	2,016	2,125	2,048
Dependents (includes dependents of civilian work force)	6,116	5,893	6,116	5,893	6,116	5,893	6,156	5,932
Non-Military (Operation-Related Non-DoD population) Subtotal	**10,462**	**10,081**	**10,462**	**10,081**	**10,462**	**10,081**	**10,637**	**10,250**
Non-Military (Construction Related Non-DoD Population) [c]								
Construction Jobs (direct, onsite)	3,785	3,647	0	0	0	0	0	0
Full-Time Equivalent Jobs (direct, from purchases)	1,634	1,575	0	0	0	0	0	0
Full-Time Equivalent Jobs (indirect and induced)	365	352	0	0	0	0	0	0
Dependents	2,704	2,606	0	0	0	0	0	0
Non-Military (Construction Related Non-DoD Population) Subtotal	**8,488**	**8,179**	**0**	**0**	**0**	**0**	**0**	**0**
NON-MILITARY OPERATIONS AND CONSTRUCTION RELATED TOTAL	**18,950**	**18,260**	**10,462**	**10,081**	**10,462**	**10,081**	**10,637**	**10,250**
TOTAL SOLID WASTE	**68,555**	**44,767**	**60,067**	**36,588**	**60,067**	**36,588**	**60,973**	**37,245**

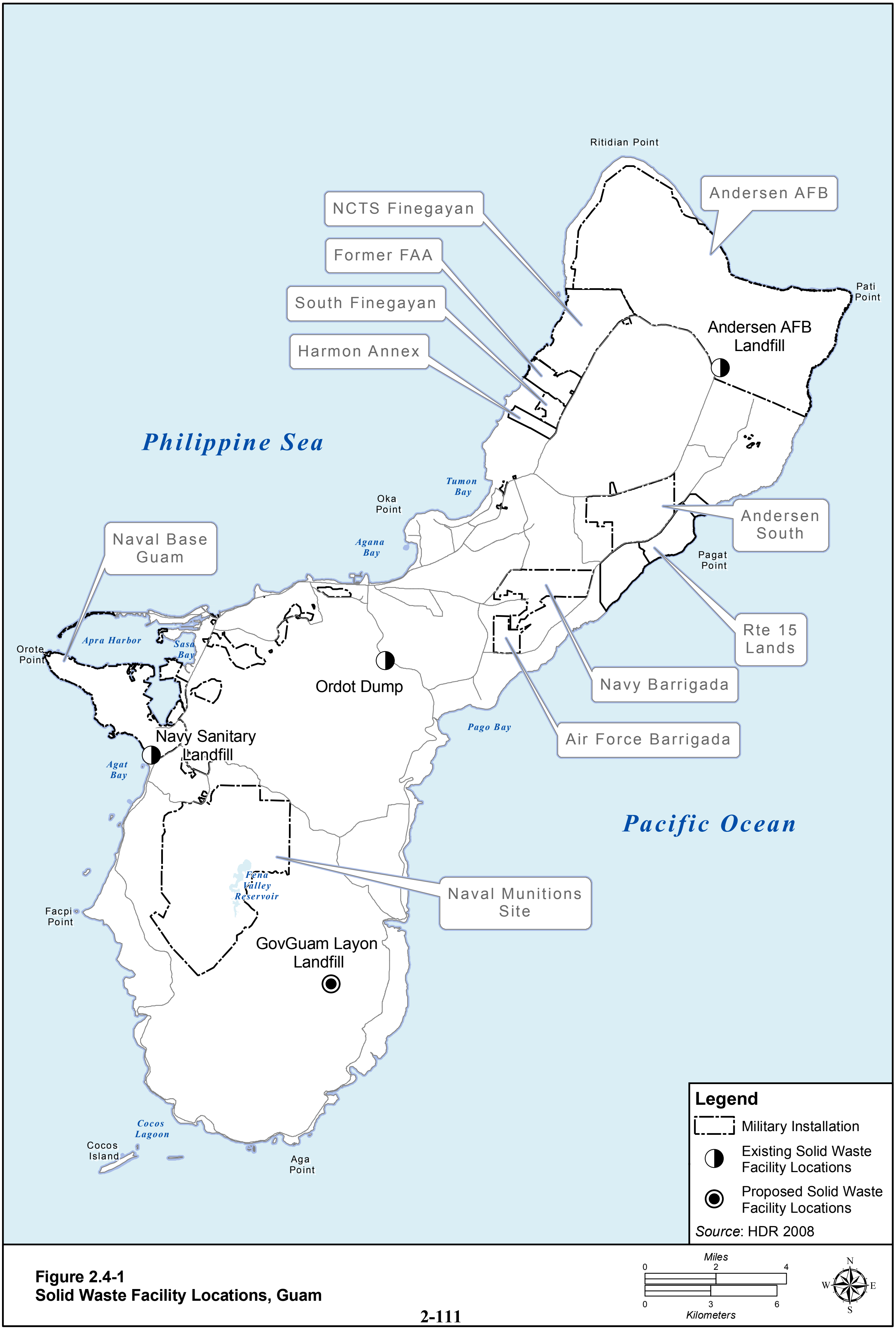

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Figure 2.4-1
Solid Waste Facility Locations, Guam

The remaining non-DoD waste stream on Guam is disposed of directly at the GovGuam Ordot Dump facility located in central Guam or via citizen drop-off transfer stations. The Ordot Dump does not accept construction or demolition debris; two on-island hardfills (i.e., for C&D debris) are currently permitted and available to accept this type of waste. The Northern Hardfill is a privately owned landfill that accepts C&D debris and is located on Route 15 (back road to Andersen AFB). Another privately owned facility allowed to accept C&D debris is the Eddie Cruz Hardfill Facility located in Yigo.

The planned replacement for the GovGuam Ordot Dump is the new GovGuam Layon Landfill. The proposed site is located in Layon near the village of Inarajan, in the higher badland (highly eroded rocky) areas on the west side of the Dandan parcel, southwest of the former National Aeronautics and Space Administration tracking station. Construction of the new facility began on February 25, 2009, and the landfill is expected to be ready for acceptance of solid waste by July 2011 (Gershman, Brickner, & Bratton, Inc. [GBB] 2009). The Layon Landfill was designed to accommodate solid waste from all current and future DoD sources as well as civilian and commercial sources. The Layon Landfill would have a capacity of 15.8 million cubic yards (CY) (12.1 million cubic meters [m^3]) of solid waste as presented in the GEPA Draft Municipal Solid Waste Landfill Facility Permit (GEPA 2009).

Table 2.4-2 presents a comparison of the expected solid waste that would be generated during the military relocation versus the potential design capacity of the existing DoD facilities. Because the Andersen AFB Landfill is essentially at full capacity, only the Navy Sanitary Landfill is presented. It is assumed that the Navy Sanitary Landfill can be filled to a height of 54 ft (16 m) above msl (NAVFAC Pacific 2008). The projection indicates that the Navy Sanitary Landfill would have the capacity to accommodate the on-base generated solid waste during the military relocation, assuming that the landfill was filled to a maximum height of 54 ft (16 m) above msl.

Table 2.4-2. Solid Waste Projections versus Available Capacity (tons)

Solid Waste Projections			*Available Capacity at Navy Sanitary Landfill, Fill Elevation = 54 ft msl*	*Difference between Solid Waste Projections and Available Capacity*
From On Base Baseline Population, 2010 to 2019	*From On Base Population Increase, 2010 to 2019*	*Total — On Base Baseline and Population Increase*		
130,340[a]	115,550 [a]	245,890	540,000 [b]	294,110

Notes:
[a] From

Table 2.4-1 assuming diversion requirement of 50% by 2015 is achieved;
[b] Based on computed volume from Guam Solid Waste Utility Study for Proposed U.S. Marine Corps Relocation (NAVFAC Pacific 2008), and converting to weight using an in-place density = 1,200 pounds/cubic yards and solid waste to cover material ratio of 3:1.
Legend: ft = feet; msl = mean sea level.

2.4.3 Screening Process

Although the solid waste disposal demand as a result of the proposed military relocation (on base) would not exceed DoD's current capacity for solid waste in the next 10 years, it would be exceeded shortly thereafter. In July 2009, a letter of intent between the Navy, GovGuam, and GBB was signed that establishes the Navy's intent to pursue a contractual arrangement for the use of GovGuam's new Layon Landfill (see Appendix C). With this additional alternative, the DoD community would have long-term capacity for solid waste disposal. Based on a comprehensive review of the available solid waste disposal alternatives for DoD on Guam in the Guam Solid Waste Utility Study for Proposed U.S. Marine Corps

Relocation (NAVFAC Pacific 2008) and the letter of intent mentioned above, the following alternatives were identified for evaluation:

- Install Liner and Other Improvements at Existing Navy Sanitary Landfill at Apra Harbor.
- Continue to use the Navy landfill at Apra Harbor for municipal solid waste until the new GovGuam Layon Landfill at Dandan is available for use. Disposal of other waste streams excluded from Layon Landfill would continue at the Navy landfill. C&D debris would continue to be disposed at the Navy hardfill.
- Construct New DoD Landfill in Central Guam.
- Construct a WTE Facility.
- Barge Waste off Guam to a Permitted Facility.
- Construct New DoD Landfill in northern Guam.
- Utilize Existing Landfill at Andersen AFB.
- Expand Existing Landfill at Andersen AFB.
- Use Potential New Private WTE Facility with Landfill at Atantano.

A preliminary screening analysis was conducted and the technical aspects of the alternatives were developed to a conceptual level to allow evaluation of the relative viability of the nine identified alternatives. The alternatives were screened on the basis of environmental and regulatory issues, implementation and policy issues, and potential scheduling issues. Based on the screening analysis, eight of the nine identified alternatives were judged as nonviable and were eliminated from further consideration, as discussed below in Section 2.4.4.

A summary of these alternatives and fundamental evaluation is included in Table 2.4-3.

2.4.4 Alternatives Dismissed

A description of the alternatives for solid waste solutions that were dismissed, and the rationale for their dismissal, is provided below.

2.4.4.1 Install Liner and Other Improvements at Existing Navy Sanitary Landfill at Apra Harbor

This alternative would consist of installing a liner system over the present Navy Sanitary Landfill at Apra Harbor. This landfill is operated by a Base Operations Support contractor for the Navy. The Guam Solid Waste Utility Study for Proposed U.S. Marine Corps Relocation (NAVFAC Pacific 2008) looked at three filling scenarios and concluded that the landfill could be filled vertically an additional 50 ft (15 m), to a height of 100 ft (30 m) above msl, after a new liner is installed. This alternative would provide capacity for 1,305,000 tons (1,183,900 metric tons) based on a volume increase of 2,900,000 CY (2,217,000 m^3), assuming that minor operational changes were made.

The utility study concluded that this alternative would provide 27 years of landfill life and was chosen as the Preferred Alternative; however, a new liner system would require approximately 3 years for design, permitting, and construction (assuming that the Navy would hire contractors to do this work) and therefore would not be ready by 2010 when the Marine Corps would begin to relocate. This alternative also assumes that the liner system could be installed at the Navy Sanitary Landfill at Apra Harbor simultaneously with active solid waste disposal operations that would need to continue until completion of the lined area. Conducting both operations very close to each other would be logistically challenging.

Table 2.4-3. Summary of Alternatives Evaluated for Solid Waste Disposal

Solid Waste Disposal System Alternative	*Evaluation Considerations*	*Recommendation*
Install Liner and Other Improvements at Existing Navy Sanitary Landfill at Apra Harbor	• *Environmental/Regulatory:* A solid waste permit application to GEPA would be required to expand the landfill. • *Environmental/Regulatory:* The current landfill is unlined and therefore the potential for leachate to affect groundwater exists. • *Implementation/Policy:* Installing a new liner system over an existing landfill would have high construction costs and construction of a new liner system while maintaining active solid waste disposal operations would be logistically difficult. • *Schedule:* Construction of the new liner system could not be completed before relocation of the Marine Corps.	Dismissed
Continue to Use Unlined Existing Navy Sanitary Landfill at Apra Harbor Until New Layon Landfill is Completed by GovGuam in 2011, then Use Layon Landfill for Disposal of All DoD Municipal Solid Waste	• *Environmental/Regulatory:* The Layon Landfill would be lined with a double liner meeting federal and GEPA requirements. • *Implementation/Policy:* GovGuam and GEPA favor use of a regional landfill for civilian and DoD solid waste disposal. • *Implementation/Policy:* The Navy, GovGuam, and GBB have reached an agreement documented in a letter of intent that DoD would be able to dispose of waste at the new GovGuam landfill facility. • *Implementation/Policy:* Layon Landfill has sufficient design capacity to handle increased solid waste generation by DoD and the civilian population. • *Implementation/Policy:* Using the existing Navy Sanitary Landfill at Apra Harbor provides a short-term, low-cost solution until a lined landfill (i.e., Layon Landfill) becomes available. • *Schedule:* Layon Landfill completion is expected sooner than improvements to the Navy Sanitary Landfill at Apra Harbor could be completed.	Retained
Construct New DoD Landfill in Central Guam	• *Environmental/Regulatory:* Development of a landfill in this area could significantly affect groundwater and surface water resources. • *Environmental/Regulatory:* Remnants of World War II structures exist at the site and would require a Section 106 consultation. Additionally, there is an active spring (Santa Rita) near the site that could require mitigation. • *Implementation/Policy:* A lengthy NEPA review process would be required and it is likely that public support for a new landfill in Guam would be low. • *Schedule:* A lengthy siting, planning, public review, and permitting process would be required.	Dismissed
Construct a WTE Facility	• *Environmental/Regulatory:* Per Guam Public Law 25-175, it is unlawful to operate a municipal solid waste incinerator or WTE facility on Guam. • *Schedule:* A lengthy schedule would be required (5 years) to bring a WTE facility online.	Dismissed

Solid Waste Disposal System Alternative	*Evaluation Considerations*	*Recommendation*
Barge Waste off Guam to a Permitted Facility	• *Environmental/Regulatory:* There are no nearby locations to dispose of waste that are able to handle the waste in an environmentally sound manner. • *Implementation/Policy:* There is a high probability for cargo handling and trucking inefficiencies, which could result in shipping delays, resulting in high costs and potential public health issues.	Dismissed
Construct New DoD Landfill in Northern Guam	• *Environmental/Regulatory:* The potential site is located over the NGLA, an environmentally sensitive potable groundwater source.	Dismissed
Use Existing Landfill at Andersen AFB	• *Environmental/Regulatory:* The site is located over the NGLA, an environmentally sensitive potable groundwater source. • *Implementation/Policy:* Very limited site capacity exists. • *Implementation/Policy:* This option would not provide sufficient capacity for the military relocation.	Dismissed
Expand Existing Landfill at Andersen AFB	• *Environmental/Regulatory:* The site is located over the NGLA, an environmentally sensitive potable groundwater source.	Dismissed
Use Potential New Private WTE Facility with Landfill at Atantano	• *Environmental/Regulatory:* The Final Site Selection Report, EIS for the Siting of a Municipal Solid Waste Landfill Facility for the island of Guam concluded that this site location was deficient based on the siting criteria (GDPW 2005). • *Implementation/Policy:* Permits have not yet been obtained, and the process could be long. • *Implementation/Policy:* Funding for the project is uncertain.	Dismissed

Legend: AFB = Air Force Base; DoD = Department of Defense; EIS = Environmental Impact Statement; GBB = Gershman, Brickner, & Bratton, Inc.; GDPW = Guam Department of Public Works; GEPA = Guam Environmental Protection Agency; GovGuam = Government of Guam; NEPA = National Environmental Policy Act; NGLA = Northern Guam Lens Aquifer; WTE = Waste-to-Energy.

Because the landfill is unlined, there is a potential for leachate to affect the underlying groundwater. Studies are currently under way to assess the nature and extent of contamination and would provide recommendations for additional sampling and installation of additional monitoring wells if necessary. Should additional investigation indicate substantial contamination, corrective action would be required. One of the corrective action alternatives could be closure of the landfill and installation of a final cover. Because of these challenges and the fact that DoD and GovGuam have reached an agreement to use the new GovGuam Landfill in Layon, this alternative was dismissed.

2.4.4.2 Construct New DoD Landfill in Central Guam

This alternative would consist of constructing a new DoD landfill in central Guam in the northwest portion of the Naval Munitions Site. This site has not been investigated in detail by the Navy, but was identified as a potentially suitable site. The utility study estimated that the site would provide a service life of 50 years. The conceptual design assumes a landfill footprint of approximately 50 ac (20 ha) that provides a design capacity of 6,350,000 CY (4,855,000 m^3) or 2,860,000 tons (2,595,000 metric tons) (assuming an in-place density of 1,200 lb/CY and a solid waste-to-cover material ratio of 3:1).

The utility study also concluded that a time period of approximately 4-5 years would be needed to design, permit, and construct this type of facility, assuming that no substantial challenges were encountered, which is unlikely. Remnants of World War II structures exist at the site and would require a Section 106 consultation. Additionally, there is an active spring (Santa Rita) near the site that could require permitting and mitigation. Because a new DoD landfill could not be designed, permitted, and built in time for the relocation of the Marine Corps, and because of the expected high capital cost of developing a new landfill site, this alternative was dismissed.

2.4.4.3 Construct a Waste-to-Energy Facility

This alternative would consist of constructing a WTE facility to dispose of the combustible portion of the DoD solid waste stream and reduce the volume of landfilled material. For the same reasons stated in Section 2.1.3.9, WTE power plants have conventionally been steam power plants that sort and burn solid wastes. Because the wastes are normally burned to generate steam, emissions of air pollutants are a primary issue. Combustion air emission controls and scrubbing of the waste exhaust air stream are normally required, and these add to the complexity and operating costs for the system.

For this alternative, the Guam Solid Waste Utility Study for Proposed U.S. Marine Corps Relocation (NAVFAC Pacific 2008) assumed that the WTE facility would be constructed by DoD on federal land, but with no specific location identified. The facility would need to be located near a landfill because the byproduct ash material would need to be landfilled. The utility study assumed that the facility would have a capacity of 150 tons per day to handle the anticipated increase in waste from the military relocation. An extended time period is required for permitting and construction of a WTE facility. Generally, 3-5 years are required before startup of a new facility can occur.

Per Guam Public Law 25-175, it is unlawful for any person to construct or operate a municipal solid waste incinerator or WTE facility on Guam, as defined by the rules and regulations of USEPA or the laws of the U.S. Because of the lengthy schedule required to bring a WTE facility online and because of Guam Public Law 25-175, this alternative was dismissed.

2.4.4.4 Barge Waste Off Guam to a Permitted Facility

This alternative considers disposal of solid waste generated on Guam by shipping it to a location outside Guam that is environmentally sound and is permitted for solid waste disposal by a governmental agency. A majority of the materials that result in waste generation on the island are brought to Guam in cargo containers, resulting in an excess capacity of shipping containers that are sent back empty. These excess containers could be used to ship the waste outside Guam. However, shipment of DoD's solid waste would be subject to the availability of excess containers. Therefore, this alternative included scheduled barge service dedicated to the movement of DoD solid waste to a location outside Guam. This alternative would require that DoD construct a facility to shred and bail the solid waste somewhere in Apra Harbor. The facility would be sized to accommodate the anticipated flow of solid waste from the military relocation. The utility study assumed a facility size of 210 tons (191 metric tons) per working day.

Landfill sites in Southeast Asia were considered to help reduce shipping costs; however, there is a lack of appropriate sanitary landfills equipped with U.S.-equivalent protection standards. Because of the lack of viable disposal alternatives near Guam that meet these criteria, disposal of barged waste was assumed to be at a landfill in the state of Washington. Preliminary assessment indicates that the life-cycle costs associated with this alternative are very high. In addition, there is a high probability for cargo handling and trucking inefficiencies, which could result in shipping delays, resulting in high costs and potential public health issues. For these reasons and because of potential sociopolitical concerns, this alternative was eliminated from further consideration.

2.4.4.5 Construct New DoD Landfill in Northern Guam

This alternative assumes that the Navy would construct a new lined landfill somewhere in northern Guam; however, a specific site was not identified. The utility study determined that DoD construction of a new landfill in northern Guam was nonviable because it would be located over the NGLA, an environmentally sensitive groundwater protection zone providing the only important source of potable groundwater and almost 80% of the potable water for the island. The NGLA area had been ruled out as a suitable area for siting a new landfill during an environmental impact study process conducted by GovGuam (Guam Department of Public Works [GDPW] 2005). GEPA may be unlikely to approve a new landfill over the NGLA given the availability of less-sensitive available locations on the island; this alternative was therefore eliminated from further consideration.

2.4.4.6 Use Existing Landfill at Andersen AFB

This alternative consists of continued use of the existing landfill at Andersen AFB. The landfill reached its original design capacity in September 2007, with the anticipation that the new GovGuam Layon Landfill would be available. Because development of the GovGuam Layon Landfill was not complete, the Air Force constructed a 2-ac (0.81-ha) expansion to meet its disposal needs through 2009. Because the GovGuam landfill would now not become available until July 2011, the Air Force is further expanding their landfill to provide 18 months of interim capacity until the Layon Landfill is opened.

Therefore, using the existing landfill at Andersen AFB as a long-term disposal alternative was judged as nonviable because its remaining site life is very limited. Similar to the previous alternative in northern Guam, the landfill is located above the NGLA, an environmentally sensitive groundwater protection zone providing the only important source of potable groundwater and almost 80% of the potable water for the island. For these reasons, this alternative was eliminated from further consideration.

2.4.4.7 Expand Existing Landfill at Andersen AFB

This alternative involves expanding the existing Andersen AFB landfill. As described above, Andersen AFB is expanding their landfill to provide 18 months of interim capacity until the GovGuam Landfill is opened. The existing landfill is located over the NGLA, a sensitive environmental area that provides almost 80% of the drinking water for Guam. A major expansion of the landfill at Andersen AFB was judged as nonviable because it would be located over the NGLA, an area that has been ruled out by GovGuam and GEPA in a previous landfill siting study. Similar to Section 2.4.4.5, it may not be advisable or possible to pursue permitting a large landfill expansion located above the NGLA; this alternative was therefore eliminated from further consideration.

2.4.4.8 Use Potential New Private WTE Facility with Landfill at Atantano

This alternative would involve using a planned WTE facility and landfill owned and operated by Guam Resource Recovery Partners located at Atantano. As described in the Guam Solid Waste Utility Study for Proposed U.S. Marine Corps Relocation (NAVFAC Pacific 2008), the landfill would have a projected life of 19-21 years, assuming that the WTE facility was utilized and based on current Guam non-DoD municipal solid waste generation rates. Permits have not yet been obtained for construction of either the landfill at Atantano or the private WTE facility. In a recent letter from GEPA to Guam Resource Recovery Partners dated December 2, 2009, GEPA indicated that Guam Resource Recovery Partners' 2008 solid waste permit application is incomplete, and that further information is required before it can be approved (GEPA 2009). Given these factors, this alternative is considered nonviable and was therefore eliminated from further consideration.

2.4.5 Alternative Retained

2.4.5.1 Preferred Alternative

Basic Alternative 1 would utilize planned and currently in construction new Gov Guam landfill at Layon for municipal waste. This addresses the DoD requirements for all cantonment alternatives including the preferred alternative as well as provides GovGuam additional customer base for its new landfill, enhancing the economic viability of this new landfill. Thus other alternatives were not considered and this is the preferred alternative. See below for additional details.

The Preferred Alternative would be to continue to use the Navy landfill at Apra Harbor for municipal solid waste (MSW) until the new GovGuam Layon Landfill at Dandan is available for use. Disposal of other waste streams excluded from Layon Landfill would continue at the Navy landfill. Construction and demolition (C&D) debris would continue to be disposed at the Navy hardfill.

As described in Section 2.4.2, the Navy Sanitary Landfill has the potential to provide more than 10 years of capacity based on the computed demand in Figure 2.4-2 and a capacity of 1,200,000 CY (917,500 m^3) or 540,000 tons (490,000 metric tons), assuming a landfill height of 54 ft (16 m) above msl and completion of minor operational improvements. The Navy Sanitary Landfill is shown in Figure 2.4-2. Such operational improvements include reducing the daily cover (which is required) and using larger compaction equipment to achieve greater densities. Because the landfill is unlined, there is a potential for leachate to adversely affect the underlying groundwater. Studies are currently under way to assess whether or not the underlying groundwater has been affected by leachate. Based on the conclusions of these studies, further action may be required.

Once the new Layon Landfill is opened, DoD would send its municipal solid waste to the GovGuam Layon Landfill. A site plan of the Layon Landfill is presented in Figure 2.4-3. The site selected for the Layon Landfill is approximately 317 ac (128 ha) in size, with a landfill footprint of 127.4 ac (51.6 ha) and a capacity of 15,808,794 CY (12,086,690 m^3) or 9,485,276 tons (8,604,898 metric tons), assuming an in-place density of 1,200 lb/CY (712 kg/m^3) (GEPA 2009). The construction of the Layon Landfill is proposed to occur in two phases. Phase 1 would include the reconstruction of approximately 1.3 miles (2.1 kilometers) of existing Dandan Road to provide safe and suitable access for heavy trucks, construction of approximately 2 miles (3 kilometers) of new road, and bulk excavation. Phase 2 would include the construction of the actual landfill facility.

The landfill site would be accessed from Route 4 by approximately 3.3 miles (5.4 kilometers) of reconstructed road and new road. The landfill would be designed, built, and operated in compliance with Guam Solid Waste Disposal Rules and Regulations and would incorporate the following:

- Access road
- Berms
- Liner system
- Leachate collection system
- Landfill gas collection system
- Stormwater collection and disposal system
- Seismic design appropriate to site conditions
- Monitoring wells
- Security system
- On site soil cover source
- Buffer zone

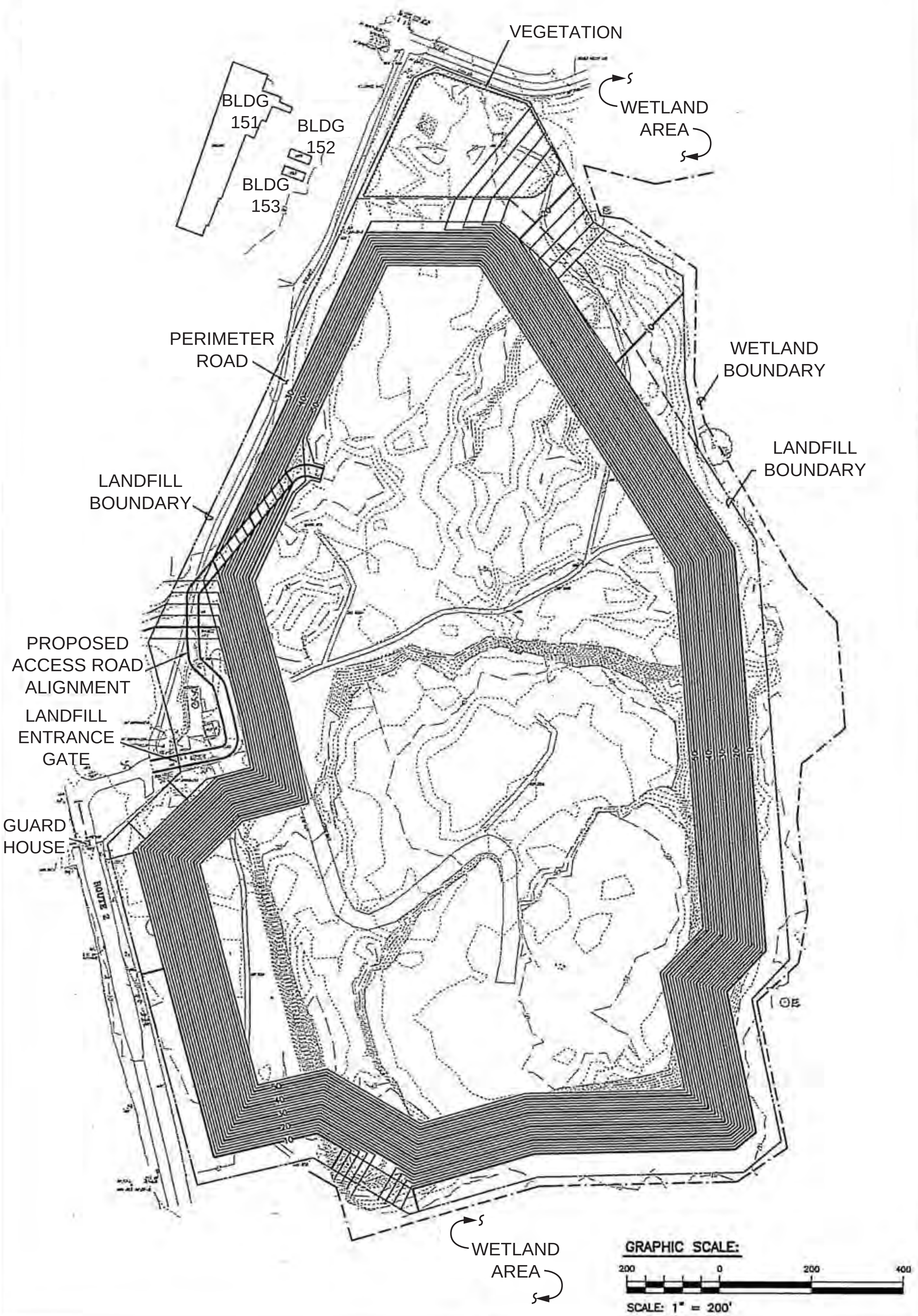

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Figure 2.4-2
Navy Sanitary Landfill with Maximum Elevation = 54 ft MSL, Guam

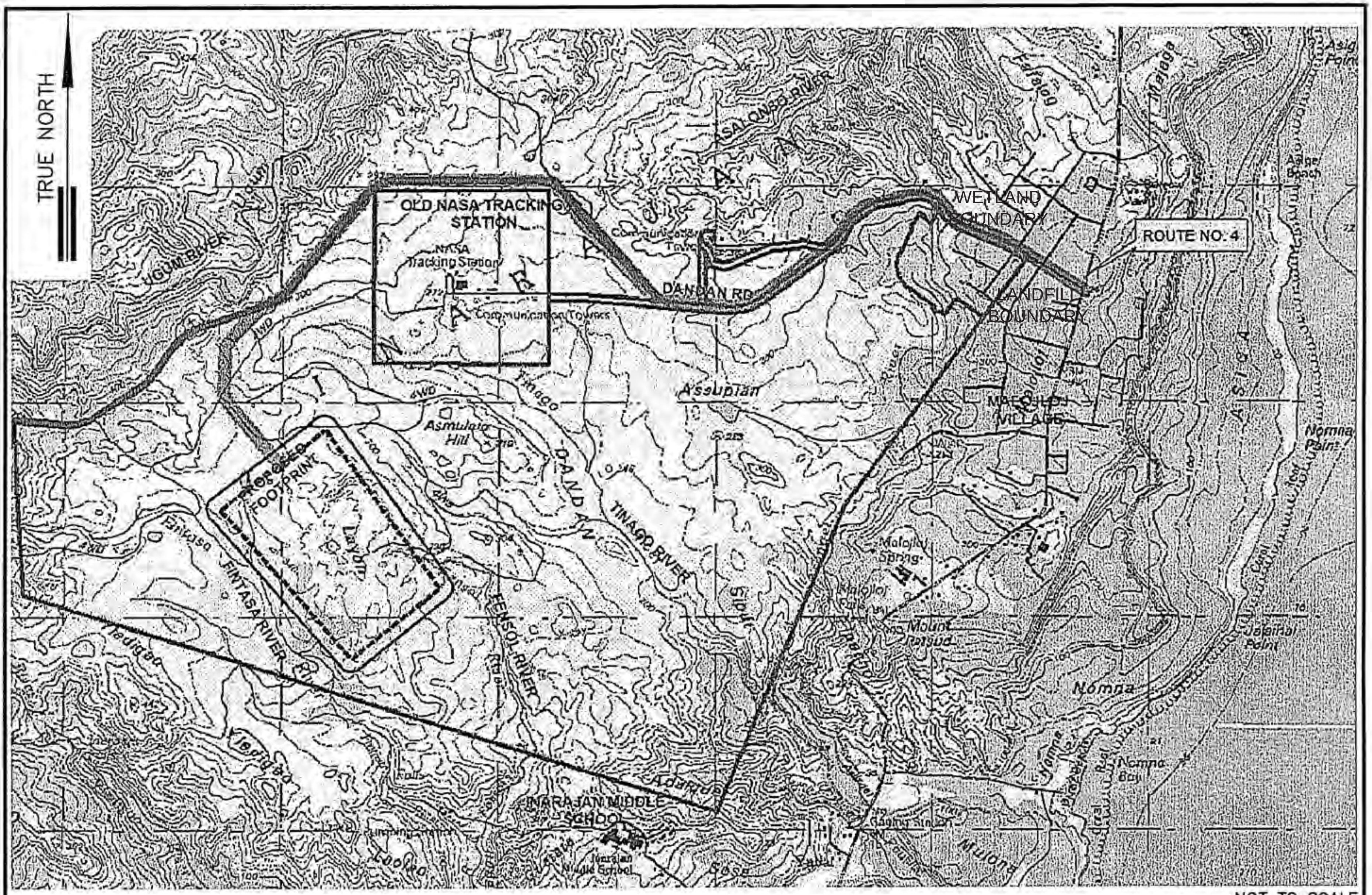

Figure 2.4-3
Layon Landfill Location, Guam

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The Layon Landfill would be constructed as a mounded landfill. The final top elevation of the landfill would be approximately 460 ft (140 m) above msl. The landfill would be excavated approximately 15.0 ft (4.6 m) below existing grade to provide cover soils. Support facilities, an entrance control structure, scale and scale house, administration facility, leachate storage and treatment facility, and equipment and maintenance storage facilities, would be located adjacent to the access road in the buffer area in the northeast corner of the site. An area of 5 ac (2 ha) would be reserved for these facilities within the buffer area of the landfill.

The proposed Layon Landfill and its impacts were evaluated in the Final Supplemental Environmental Impact Statement for the Siting of a Municipal Solid Waste Facility, Guam (GDPW 2005). The design, permitting, and construction of the new landfill is being managed by GBB, the firm assigned receivership of GovGuam’s solid waste program by the U.S. District Court of Guam as a result of a consent decree issued by USEPA. GBB recently awarded a construction contract for the initial phase of the landfill, and construction began on February 25, 2009. The current phase consists of constructing the landfill operations road and performing mass grading for landfill Cells 1 and 2. Invitations to bid on the construction of the Layon Municipal Sanitary Landfill Entrance Area Facilities and Cells 1 and 2 liner system were released on August 17, 2009.

Landfills are typically constructed in phases in accordance with an approved sequencing plan. The phases or “cells” are constructed to be large enough to handle waste for approximately 3-5 years. Once the active landfill phase is near capacity, a new landfill cell is constructed. The draft operations plan for the Layon Landfill (TG Engineers 2009) indicates that subsequent disposal cells would be constructed at intervals of 2-5 years. The initial phase at Layon Landfill would consist of Cells 1 and 2 that are 11.07 ac (4.48 ha) and 11.33 ac (4.58 ha) in size, respectively, with a combined waste capacity of 1,407,173 CY (1,075,861 m^3) (GEPA 2009). Table 2.4-4 presents the projected solid waste generation rates from both the military relocation and the civilian Guam population by year. These two categories were added together to determine total estimated solid waste in tons, which were then converted to cubic yards. As shown in the table, in year 2014, Cells 1 and 2 would have reached their capacity and would have provided about 4 years of useful life, which is consistent with the phasing presented in the Layon Landfill Operations Plan.

Table 2.4-4 also provides an estimate of when the Layon Landfill would reach its ultimate capacity from solid waste generated by DoD and the Guam general population. Using a landfill airspace capacity of 15,808,794 CY (12,086,690 m^3), the table indicates that the landfill would reach capacity in 2044, 33 years after opening.

The Layon Landfill is currently projected to be ready for acceptance of solid waste by July 2011 (GBB 2009). The Layon Landfill has been designed to accommodate solid waste from all current and future DoD sources, as well as civilian and commercial sources. The Layon Landfill is expected to enforce a ban similar to the current ban at Ordot Landfill for disposal of old corrugated cardboard, green waste, construction waste, wooden pallets, and inert waste. Layon Landfill is also expected to exclude junk vehicles, white goods, C&D debris, polychlorinated biphenyl wastes, petroleum contaminated soil, E-wastes, used motor oil, batteries, radioactive waste, solvents, paints, oily wastes, acids, corrosives, industrial wastes, explosives, asbestos, sludge, and asbestos containing materials.

Additionally, an important milestone was reached on April 3, 2009, when GEPA approved the Final Integrated Hydrogeologic Assessment for the Layon Municipal Sanitary Landfill Site (AMEC Geomatrix

Consultants, Inc. 2008). This document has established that the proposed landfill is not located over an important source of groundwater because of potential low yield and marginal back groundwater quality.

2.4.5.2 Construction and Demolition Debris

C&D debris would be generated as a result of proposed construction and proposed demolition of old structures to facilitate the proposed military relocation. The DoD recently completed a C&D Debris Reuse and Diversion Study for DoD Bases Guam (NAVFAC Pacific 2010d). The purpose of the study was to characterize the C&D waste stream and develop recommendations for diversion and reuse. DoD agencies must comply with EO 13514 which establishes a goal of diverting at least 50% of C&D materials and debris by the end of fiscal year 2015.

The study utilized available master plans, record drawings, and base maps to determine the types and quantity of C&D debris that would be generated. The study estimated that approximately 469,000 tons (425,000 metric tons) of C&D debris would be generated and that approximately 80% is potentially divertable. Table 2.4-5 provides a breakdown of C&D by category.

The C&D characterization determined that the largest category of C&D waste that could be diverted would be concrete (without lead-based paint) at 46% by weight. The next largest category of potentially divertable C&D was untreated wood at 15% by weight, followed by asphalt concrete at 13% by weight. Other significant categories included scrap metal (2%), and cardboard (4%).

Green waste would be generated by clearing of land and was evaluated separately from C&D debris. The study estimated that approximately 535,000 tons (485,000 metric tons) of green waste material would be generated from the military relocation and 100% is potentially divertable. The study divided the green waste material into a “woody material” category and a “leafy material” category. The woody material could be chipped to create mulch for onsite use at construction sites and the leafy material could be composted. Untreated and unpainted wood generated during construction activities could also be mulched; however, procedures would need to be developed to assure that treated wood generated during demolition activities be diverted and disposed separately at the hardfill portion of the Navy Sanitary Landfill. The Navy is currently preparing a C&D Waste Management Plan that will define procedures for keeping these and waste streams separate.

The major findings of the study were:

- Based on the characteristics of the projected C&D debris generated by the military relocation construction projects, diverting concrete without lead-based paint, untreated wood, asphalt concrete, cardboard, and scrap metal would achieve the DoD goal of a minimum of 50% diversion of C&D debris by the end of fiscal year 2015.
- Diversion goals could be achieved by having DoD contractors continue to process all C&D debris and DoD establishing a composting facility to process the leafy material portion of the green waste.
- GEPA would require contractors to obtain an Air Pollution Control Permit and Solid Waste Facility Permit for processing to crush concrete at construction sites or at processing facilities.
- DoD intends to construct a central processing facility to process and temporarily store C&D debris until it can be reused, recycled, or otherwise disposed. A permit from GEPA would be required to operate this type of facility.

- C&D debris that could not be diverted would be disposed of in the hardfill located at the Navy Sanitary Landfill at Apra Harbor. This debris would include any C&D debris containing asbestos since the Navy Sanitary Landfill is approved to accept this type of waste.

Table 2.4-4. Projected Solid Waste Generation Rates for the Military Relocation and Civilian Guam Population (by year)

Year	*DoD Related Solid Waste (tons/year)* [a,b]	*Guam General Population Solid Waste (ton/year)* [c,d]	*Total Solid Waste (tons/year)* [e]	*Total Solid Waste (CY/year)*	*Cumulative Total Solid Waste (CY)*
2011	46,967	176,417	223,383	372,306	372,306
2012	60,648	178,685	239,333	398,888	771,194
2013	66,079	180,920	246,999	411,665	1,182,859
2014 [f]	85,201	183,124	268,325	447,209	1,630,068
2015	66,929	185,302	252,231	420,385	2,050,453
2016	44,767	187,460	232,226	387,044	2,437,497
2017	36,588	189,595	226,183	376,971	2,814,468
2018	36,588	191,701	228,288	380,481	3,194,949
2019	37,245	193,775	231,020	385,034	3,579,983
2020	82,347	195,713	278,060	463,434	4,043,417
2021	82,347	197,670	280,017	466,696	4,510,113
2022	82,347	199,647	281,994	469,990	4,980,103
2023	82,347	201,643	283,991	473,318	5,453,421
2024	82,347	203,660	286,007	476,678	5,930,099
2025	82,347	205,696	288,044	480,073	6,410,172
2026	82,347	207,753	290,101	483,501	6,893,673
2027	82,347	209,831	292,178	486,964	7,380,637
2028	82,347	211,929	294,276	490,461	7,871,098
2029	82,347	214,048	296,396	493,993	8,365,091
2030	82,347	216,189	298,536	497,560	8,862,651
2031	82,347	218,351	300,698	501,164	9,363,815
2032	82,347	220,534	302,882	504,803	9,868,617
2033	82,347	222,740	305,087	508,478	10,377,096
2034	82,347	224,967	307,314	512,191	10,889,286
2035	82,347	227,217	309,564	515,940	11,405,227
2036	82,347	229,489	311,836	519,727	11,924,954
2037	82,347	231,784	314,131	523,552	12,448,505
2038	82,347	234,101	316,449	527,415	12,975,920
2039	82,347	236,442	318,790	531,317	13,507,237
2040	82,347	238,807	321,154	535,257	14,042,494
2041	82,347	241,195	323,542	539,237	14,581,732
2042	82,347	243,607	325,954	543,257	15,124,989
2043	82,347	246,043	328,390	547,317	15,672,307
2044 [7]	82,347	248,503	330,851	551,418	16,223,725

Notes:

[a] Assumes DoD waste generation of 7.4 lbs/per person/per day.

[b] Assumes DoD population after 2019 is constant.

[c] Assumes general population generation of 5.28 lbs/per person/per day.

[d] Assumes general population growth after 2019 increases at 1% per year.

[e] Assumes solid waste density of 1,200 lbs per cubic yard.

[f] 2014 indicates the year which Layon Landfill Cells 1 and 2 would reach capacity.

[7] 2044 indicates the year which the Layon Landfill would reach total capacity.

Legend: CY = cubic yards; DoD = Department of Defense.

Table 2.4-5. Projected Diversion of C&D Debris and Green Waste Generation, All DoD Bases

Material	*Estimated Volume (CY)*	*Estimated Weight (Tons)*	*Recyclable*	*Maximum Estimated Potentially Divertable Weight (Tons)*	*Maximum Estimated % Potentially Divertable (by Weight)*
Construction Debris					
Wood (untreated)	146,445	69,195	Yes	69,195	15%
Gypsum Board	57,998	39,540	No	0	0%
Scrap Metal	14,278	4,284	Yes	4,284	1%
Plastics	3,630	4,284	No	0	0%
Cardboard	659,003	16,475	Yes	16,475	4%
Miscellaneous	192,758	38,552	No	0	0%
Total Construction Debris	**1,074,112**	**172,330**		**89,954**	
Demolition Debris					
Concrete w/LBP	3,200	6,479	No	0	0%
Concrete w/o LBP	107,077	216,831	Yes	216,831	46%
Asphalt concrete	49,837	59,804	Yes	59,804	13%
Glass	132	280	Yes	280	0%
Wood (treated)	2,248	1,062	No	0	0%
Scrap Metal	7,804	8,427	Yes	8,427	2%
PVC	750	879	No	0	0%
VCP	17,008	597	Yes	597	0%
Gypsum Board	911	621	No	0	0%
Porcelain Plumbing Fixtures	185	94	No	0	0%
Miscellaneous	9,543	1,909	No	0	0%
Total Demolition Debris	**198,695**	**296,983**		**285,939**	
TOTAL C&D DEBRIS		**469,313**		**375,893**	**80%**
Green Waste					
Woody Material	453,069	113,267	Yes	113,267	21%
Leafy Material	3,322,505	415,313	Yes	415,313	78%
Grass	31,700	6,404	Yes	6,404	1%
Total Green Waste	**3,807,274**	**534,984**		**534,984**	**100%**

Note: Concrete w/LBP contains a concentration of lead above the USEPA LBP criterion of 0.5% lead by weight, concrete w/o LBP may contain lead in concentrations below 0.5%.

Legend: C&D = Construction and Demolition; CY = cubic yards; LBP = lead-based paint; PVC = polyvinyl chloride; USEPA = United States Environmental Protection Agency; VCP = vitrified clay pipe.

2.4.5.3 Integrated Solid Waste Management Plan

The DoD is in the process of preparing an Integrated Solid Waste Management Plan (ISWMP) for Joint Region Marianas, which incorporates all DoD services on Guam (including the New Marine Corps Base Guam and its facilities and activities). The ISWMP will reflect how solid wastes will be managed now and in the future. The ISWMP will include any new information from studies and reports that have been conducted as part of the military relocation and will combine the existing solid waste plans for Naval Complex Guam and Andersen AFB.

The new DoD ISWMP would potentially include discussion and analysis of existing facilities; applicable regulations and policies; source reduction; diversion; recycling and recycling facilities; solid waste and recycling diversion goals; service and construction contract requirements for solid waste; roles and responsibilities; detailed description and waste characterization of waste streams from all DoD facilities (including municipal waste, recyclables, green waste, wood, C&D debris, biological waste, asbestos containing materials, shipboard solid waste, asphalt, and special wastes); solid waste disposal facilities;

solid waste collection methods (including transfer stations); education, awareness and outreach; solid waste opportunities; and an implementation plan.

The ISWMP will comply with EO 13514 that expands upon the energy reduction and environmental requirements of EO 13423. EO 13514 states that the federal government must lead by example in safeguarding the health of the environment. To comply with EO 13514, DoD agencies shall promote pollution prevention and eliminate waste by:

- Minimizing the generation of waste and pollutants through source reduction;
- Diverting at least 50% of non-hazardous solid waste, excluding C&D materials and debris by the end of fiscal year 2015;
- Diverting at least 50% of C&D materials and debris by the end of fiscal year 2015; and
- Increasing diversion of compostable and organic material from the waste stream.

To support the ISWMP, the Navy recently completed the Final Report, Recycling and Solid Waste Diversion Study for DoD Bases, Guam (NAVFAC Pacific 2010e) that has established a diversion goal of 50%, not including C&D debris. The study recommends the following alternatives:

- DoD would construct two refuse transfer facilities, one in northern Guam and one in Southern Guam;
- DoD would implement a source separation recycling program at all facilities;
- DoD would construct recycling center(s); and
- DoD would construct a materials resource recovery facility.

In order to complete the recycling study, waste characterization data from Marine Corps Base (MCB) Hawaii were utilized. Due to the lack of solid waste characterization data for military installations on Guam, it was assumed that the solid waste characterization for MCB Hawaii would best represent the solid waste characteristics for military installations on Guam. Solid waste generation activities for a military installation on Guam and MCB Hawaii are similar. Both military installations have similar facilities including maintenance shops, administrative officers, commissary and exchange facilities, fast-food establishments, club operations, family housing, and unaccompanied personnel housing.

The results of the solid waste characterization were originally presented in the Guam Solid Waste Utility Study for Proposed U.S. Marine Corps Relocation (NAVFAC Pacific 2008). The waste characterization provides a breakdown of solid waste into major categories (aluminum cans, glass, ferrous and non-ferrous metals, newspaper, mixed paper, office paper, cardboard, plastics, compostable material, wood pallets, and miscellaneous waste) as well as residential and commercial/industrial categories.

The percentages observed at MCB Hawaii were then applied to the anticipated waste stream for Guam DoD facilities. Table 2.4-6 provides a breakdown of the anticipated waste stream from the military relocation. Regularly occurring construction waste for small projects not related to the military relocation are also included in Table 2.4-6 as a separate category. Given this waste characterization, if 100% of the recyclables from the residential/commercial/industrial waste streams are recovered, only 46.7% diversion would be achieved. While the estimated 46.7% does not meet the EO 13514 diversion goal of 50%, MCB Hawaii's waste characterization study indicated miscellaneous waste accounted for 53.3% of the solid waste stream. It is believed that miscellaneous waste contains additional recyclable materials. The MCB Hawaii's waste characterization study indicated that miscellaneous waste included material that was not segregated from solid waste during sorting. The miscellaneous waste category included discarded items such as clothing, shoes, small appliances, small furniture, and carpet. If an additional 3.3% of the 53.3% miscellaneous waste contains recyclable materials, the diversion goal can be met.

Table 2.4-6. Projected Average Daily Solid Waste Quantities and Composition, Total

	Residential		*Commercial/ Industrial*		*Composite*	
Per Capita Waste Generation (lbs/day)						7.4
2009 Military Population						15,080
Total Weight (lbs/day)						111,592
Projected Military Population						45,954
Total Projected Weight (lbs/day)						295,852
Residential/Commercial/Industrial Waste						
Percent of Total		19.7		42.6		
Total 2009 Computed Weight (lbs/day)		21,984		47,538		69,522
Total Projected Weight (lbs/day)		58,283		126,033		184,316
Composition	percent	lbs/day	percent	lbs/day	percent	lbs/day
Aluminum Cans	3.4	1,981.6	1.2	1,512.4	1.9	3,494.0
Glass (Brown)	4.0	2,331.3	0.5	630.2	1.6	2,961.5
Glass (Clear)	3.0	1,748.5	1.8	2,268.6	2.2	4,017.1
Glass (Green)	0.8	466.3	0.2	252.1	0.4	718.3
Ferrous Metals	0.8	466.3	5.0	6,301.6	3.7	6,767.9
Non-Ferrous Metals	1.4	816.0	1.4	1,764.5	1.4	2,580.4
Newspaper	1.3	757.7	0.9	1,134.3	1.0	1,892.0
Mixed Paper	1.9	1,107.4	4.0	5,041.3	3.3	6,148.7
Office Paper	0.3	174.8	3.0	3,781.0	2.1	3,955.8
Cardboard	6.6	3,846.7	2.3	2,898.8	3.7	6,745.4
Plastics	1.7	990.8	1.2	1,512.4	1.4	2,503.2
Compostable Material	6.2	3,613.5	15.7	19,787.2	12.7	23,400.7
Wood Pallets	11.3	6,586.0	11.3	14,241.7	11.3	20,827.7
Miscellaneous Waste	57.3	33,396.1	51.5	64,907.0	53.3	98,303.1
Total Collected Waste	100.0	58,282.9	100.0	126,033.0	100.0	184,315.8
Construction Waste						
Percent of Total						37.7
2009 Total Weight (lbs/day)						42,070
Total Projected Weight (lbs/day)						111,536

Legend: lbs/day = pounds per day.

Solid waste such as corrugated cardboard, green waste, construction waste, wooden pallets, junk vehicles, white goods, C&D debris, polychlorinated biphenyl wastes, petroleum contaminated soil, electronic wastes, used motor oil, and batteries would either be recycled or handled in accordance with Navy's existing Standard Operating Procedures for these types of waste. Management of hazardous wastes is discussed in Chapter 18 of this Volume.

DoD may construct and/or utilize non-DoD transfer stations to allow consolidation of solid waste before it is hauled to Layon Landfill. In general, transfer facilities consolidate waste from multiple collection vehicles into larger, high-volume transfer vehicles for more economical delivery to distant disposal sites. Typically, local waste collection vehicles deposit solid waste in a designated receiving area within the transfer facility. Waste is often compacted while being loaded into larger transfer vehicles. The transfer vehicles are used to transport the waste to the landfill for disposal. No long-term storage of waste occurs at a transfer station; waste is consolidated quickly and removed from the site. Transfer stations would require approval and permitting through GEPA prior to startup. Transfer stations also provide convenience to self-haulers who can dispose of solid waste at the transfer station rather than having to haul waste to Layon Landfill.

2.5 OFF BASE ROADWAYS

2.5.1 Introduction

This section provides a detailed description of the proposed action and alternatives comprising the off base roadway improvements that would support the relocation of the Marine Corps to Guam, transient berthing of nuclear carriers at Apra Harbor, and placement of an Army AMDTF on the island. This section had been prepared by Federal Highway Administration (FHWA). On base roadway improvements are described in the individual volumes for each proposed action.

The proposed off base roadway improvements are collectively referred to as the GRN, a related action to the relocation activity. The GRN also includes road projects that address organic growth on Guam without the military relocation (for analysis under the no-action alternative). The road projects for Tinian are discussed in Volume 3 and the access road impacts at Polaris Point for the proposed aircraft carrier action is covered in Volume 2.

2.5.1.1 Project Background

In response to the island's ongoing roadway problems, the 2030 Guam Transportation Plan (GDPW 2008) has programmed projects to address many of the immediate needs of Guam that have not been addressed in many years. The planned military relocation would include relocation of approximately 8,600 military personnel and 9,000 dependents from Okinawa, Japan; improvements to pier/waterfront infrastructure to support transient nuclear aircraft carriers on the island; and placement of an AMDTF on Guam, as well as related construction activities required to support these relocations. Troops would begin relocating to Guam in 2011; relocation would be complete by 2014. Military relocation activities related to military facility construction would occur from 2011 through 2017, with peak construction and population in 2014. Road construction to support the military relocation would also need to commence in 2011 and extend beyond 2017.

The existing traffic volumes, physical conditions, and designs of Guam's roads vary widely. As a result of the military relocation on the island, traffic volumes and congestion levels are anticipated to reach unacceptable levels. Military-related traffic would add to the congestion levels, worsening already poor conditions. In addition, the structural integrity of the roads and bridges would be compromised as a result of the increased number and weight of trucks.

The following subsections explain the need for the proposed action.

2.5.1.2 Roadway and Bridge Strength

The island of Guam has roadways and bridges with inadequate load capacity. An evaluation of background traffic loading and pavement condition of the existing roadways on Guam was conducted to identify the improvements that would be required to support the increased loading that is projected in the future (Parsons Brinkerhoff 2008). The increased traffic and specifically the volume of truck traffic, especially during the construction period, have been assessed relative to the impact on the integrity of the existing roadway infrastructure (pavement and bridges). A summary of the heavy military vehicle use that would occur is provided in Table 2.5-1.

Table 2.5-1. Travel Projections for Heavy Military Vehicles

Typical Military Heavy Vehicles	*Max. Weight (lb)*	*Designated Route*	*Frequency (movements)* [a]
MK48/16/870 With a D-7	122,775	Apra Harbor to Andersen AFB (Routes 1, 3, and 9 or Routes 1, 8, 16, and 1 or Routes 1, 8, 10, and 15)	4 – 6 times per year
		Apra Harbor to Andersen South (Route 1 or Routes 1, 8, 10, and 15)	
		Apra Harbor to NCTS Finegayan (Routes 1 and 3 or Routes 1, 8, 16, 1, and 3)	
		Apra Harbor to Naval Munitions Site (Routes 1, 2A, 5, and 12 or Routes 1, 2A, and 12)	
		NCTS Finegayan to Naval Munitions Site AFB South (Routes 3, 1, 2A, 5, and 12)	
MK48/15 Wrecker towing another MK48/15 Wrecker	121,752	Apra Harbor to Andersen AFB (Routes 1, 3, and 9 or Routes 1, 8, 16, and 1 or Routes 1, 8, 10, and 15)	8 – 10 times per year
		Apra Harbor to Andersen South (Route 1 or Routes 1, 8, 10, and 15)	
		Apra Harbor to NCTS Finegayan (Routes 1 and 3 or Routes 1, 8, 16, 1, and 3)	
		Apra Harbor to Naval Munitions Site (Routes 1, 2A, 5, and 12 or Routes 1, 2A, and 12)	
		NCTS Finegayan to Naval Munitions Site AFB South (Routes 3, 1, 2A, 5, and 12)	
MK48/18A1 With an ISO container	87,082	Apra Harbor to Andersen AFB (Routes 1, 3, and 9 or Routes 1, 8, 16, and 1 or Routes 1, 8, 10, and 15)	2 – 3 times per month
		Apra Harbor to Andersen South (Route 1 or Routes 1, 8, 10, and 15)	
		Apra Harbor to NCTS Finegayan (Routes 1 and 3 or Routes 1, 8, 16, 1, and 3)	
		Apra Harbor to Naval Munitions Site (Routes 1, 2A, 5, and 12 or Routes 1, 2A, and 12)	
		NCTS Finegayan to Naval Munitions Site AFB South (Routes 3, 1, 2A, 5, and 12)	
MK31/970 MTVR/Semi-Refueler	94,302	Apra Harbor to Andersen AFB (Routes 1, 3, and 9 or Routes 1, 8, 16, and 1 or Routes 1, 8, 10, and 15)	TBD
		Apra Harbor to Andersen South (Route 1 or Routes 1, 8, 10, and 15)	
		Apra Harbor to NCTS Finegayan (Routes 1 and 3 or Routes 1, 8, 16, 1, and 3)	
		Apra Harbor to Naval Munitions Site (Routes 1, 2A, 5, and 12 or Routes 1, 2A, and 12)	
		NCTS Finegayan to Naval Munitions Site AFB South (Routes 3, 1, 2A, 5, and 12)	
MTVR/EET trailer with a Back-hoe	87,441	Apra Harbor to Andersen AFB (Routes 1, 3, and 9 or Routes 1, 8, 16, and 1 or Routes 1, 8, 10, and 15)	TBD
		Apra Harbor to Andersen South (Route 1 or Routes 1, 8, 10, and 15)	
		Apra Harbor to NCTS Finegayan (Routes 1 and 3 or Routes 1, 8, 16, 1, and 3)	
		Apra Harbor to Naval Munitions Site (Routes 1, 2A, 5, and 12 or Routes 1, 2A, and 12)	
		NCTS Finegayan to Naval Munitions Site AFB South (Routes 3, 1, 2A, 5, and 12)	

Typical Military Heavy Vehicles	*Max. Weight (lb)*	*Designated Route*	*Frequency (move-ments)* [a]
MK36 Wrecker towing another MK36 Wrecker	98,758	Apra Harbor to Andersen AFB (Routes 1, 3, and 9 or Routes 1, 8, 16, and 1 or Routes 1, 8, 10, and 15)	TBD
		Apra Harbor to Andersen South (Route 1 or Routes 1, 8, 10, and 15)	
		Apra Harbor to NCTS Finegayan (Routes 1 and 3 or Routes 1, 8, 16, 1, and 3)	
		Apra Harbor to Naval Munitions Site (Routes 1, 2A, 5, and 12 or Routes 1, 2A, and 12)	
		NCTS Finegayan to Naval Munitions Site AFB South (Routes 3, 1, 2A, 5, and 12)	

Note:

[a] Frequency is based on normal situations and peace time in Garrison. Due to JCS, PACOM, MARFORPAC, III MEF Directed and Other Contingency Operations (OCO) movements may increase.

Legend: AFB = Air Force Base; EET = Energy Efficient Transport; ISO = International Organization for Standardization; lb = pound; MTVR = Medium Tactical Vehicle Replacement; NCTS = Naval Computer and Telecommunications Station; TBD = To Be Determined.

Source: Marine Corps 2009.

A pavement analysis was conducted to systematically identify and quantify the structural effects on Guam’s roadways that would result from military relocation, primarily those activities associated with constructing the infrastructure to support the relocation of Marines to Guam. The pavement analysis focused on the roadways that would be used during the construction and military relocation period. The pavement analysis included the following elements:

- An evaluation of the existing pavement (i.e., measuring pavement depth to determine structural properties)
- Calculations of truck loading on roadways connecting the Port of Guam to the Finegayan area, Andersen AFB, and rock quarries on the east side of the island
- A determination of the design thickness of the pavement
- Prioritization of projects based on planned construction-loading activities
- Determinations of constructability and the availability of materials for road and military construction

A functional evaluation of the pavement found that the overall condition of the pavement is very good, requiring only preventive maintenance (e.g., surface seal) under current traffic conditions; however, the structural pavement analysis found that the existing pavement is sound but not structurally adequate, the depth of the pavement base and subbase is inconsistent throughout the study area, and existing drainage is inadequate, with substantial areas where water flows over the roadway rather than through drainage structures. Flooding of roadways on Guam occurs primarily along Route 1. Inadequate drainage systems and structures can cause weakening of the base and subbase and premature failure of the pavement, and can be hazardous to the traveling public. As part of the pavement analysis, equivalent single-axle loading for trucks was calculated to determine projected future truck traffic.

The condition of 10 bridges within Guam’s transportation network was also evaluated. The locations of bridges on Guam are shown in Figure 2.5-1. These bridges would be essential to the construction and operational activities associated with the military relocation. The bridges were evaluated to determine structural adequacy for military and construction traffic before, during, and after redeployment (Table 2.5-2).

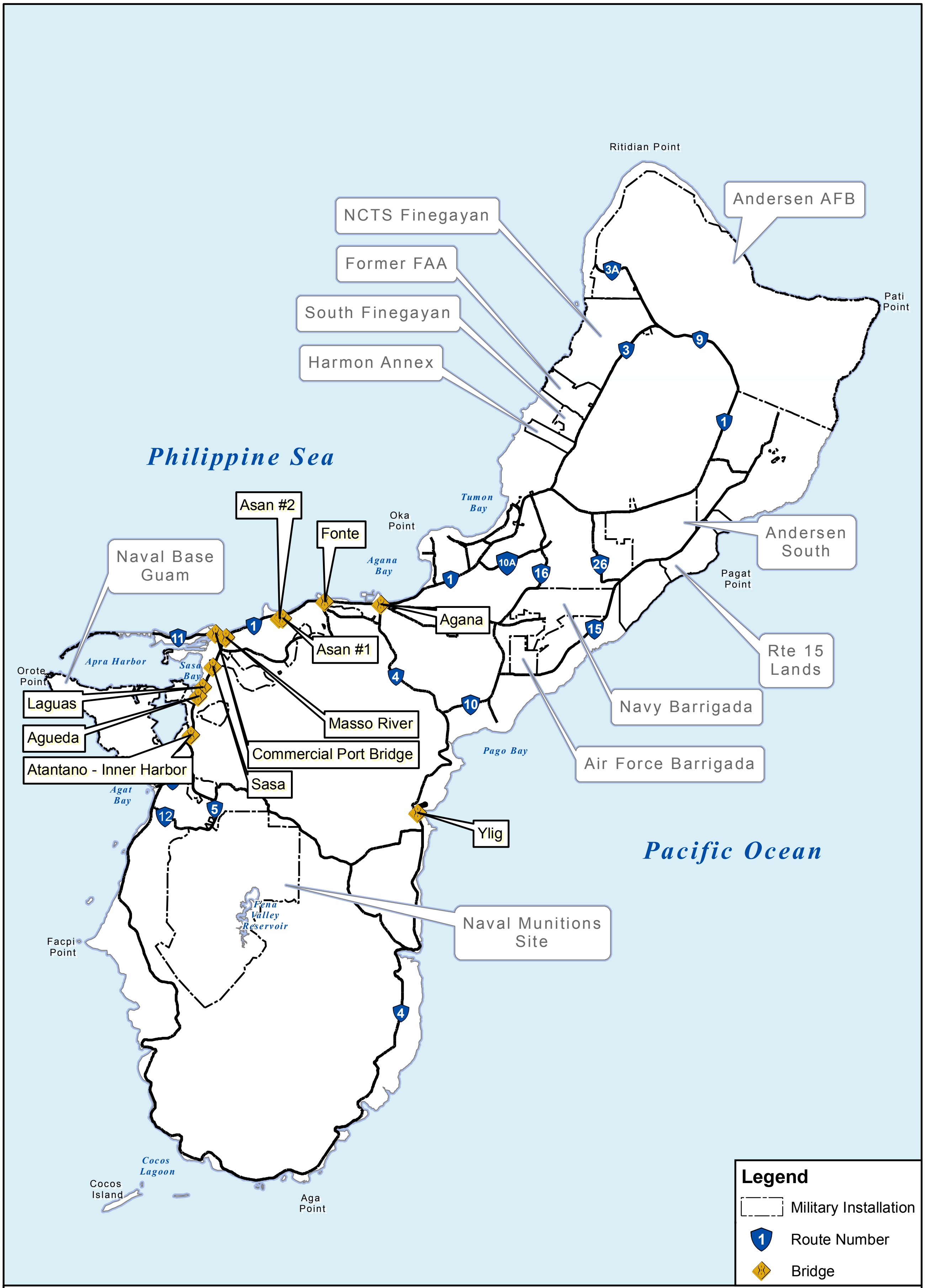

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Figure 2.5-1
Bridges on Guam

Table 2.5-2. Structural Data for Bridges on Guam

Route	*Structure*	*Year Built*	*Rating Factors**
1	Atantano Bridge	1970	0.68
1	Agueda Bridge	1987	0.48
1	Laguas Bridge	1985	0.81
1	Sasa Bridge	1985	0.62
1	Masso Bridge	1980	1.00
1	Asan Bridge #2	1985	0.67
1	Asan Bridge #1	1983	0.32
1	Fonte Bridge	1982	0.69
1	Agana Bridge #1	1945	0.32

Notes: * Rating Factors based on 2009 Guam Department of Public Works/Federal Highway Administration bridge inspection reports. Rating Factors shown are lowest from all the military vehicles.

The analysis found that Agana Bridge #1 has an insufficient rating factor and would not be able to support the proposed loadings associated with the hauling of construction materials and equipment. (The rating factor represents the live load capacity to demand ratio) For this reason, replacement of this bridge would be required. Six other bridges (Fonte, Asan #1, Asan #2, Sasa, Agueda, and Atantano) have rating factors below the appropriate load-bearing capacities for many of the military vehicles and require replacement. Laguas Bridge can support the military vehicles with certain restrictions and may require replacement. The structural integrity of the Commercial Port Bridge was not evaluated because it is a culvert. Unlike a culvert that also acts as a bridge, this culvert has fill on top of it and has a retaining wall that confines the roadway structure. Ylig Bridge is currently being replaced by GovGuam.

2.5.1.3 Roadway Capacity

The effect on the population of Guam during the period of peak construction and population (2014) and complete relocation of the Marines (2014) was determined. The analysis included a projection of the number of construction-related trucks and other traffic that would use roads connecting the Port of Guam to the Finegayan area, Barrigada area, Andersen AFB, and rock quarries on the island.

A traffic model was created to evaluate the need for additional traffic lanes (roadway widening) that would be required for the project. The traffic study found that traffic would double along segments of three primary routes: Route 3 (Route 28 to NCTS Finegayan), Route 3 (NCTS Finegayan to Route 9), and Route 9 (Route 3 to Andersen AFB North Gate). Certain roadways on Guam would lack sufficient capacity to handle the increased traffic load.

2.5.1.4 Roadway Access

To support the movement of cargo across the island and avoid normally congested corridors, new options for truck routes and access points are needed. A preferred truck route was identified (Routes 1, 3, 8, 9, 11, 16, and 27) for cargo being hauled from the Port of Guam to the northern part of the island. The route from the quarry was identified to include Route 15 and Chalan Lujuna. These preferred routes are shown in Figure 2.5-2. Preliminary transportation studies have identified individual projects to provide new intersections that would serve as MAPs along existing roadways. The MAPs were identified by the military and are for commercial and/or residential access.

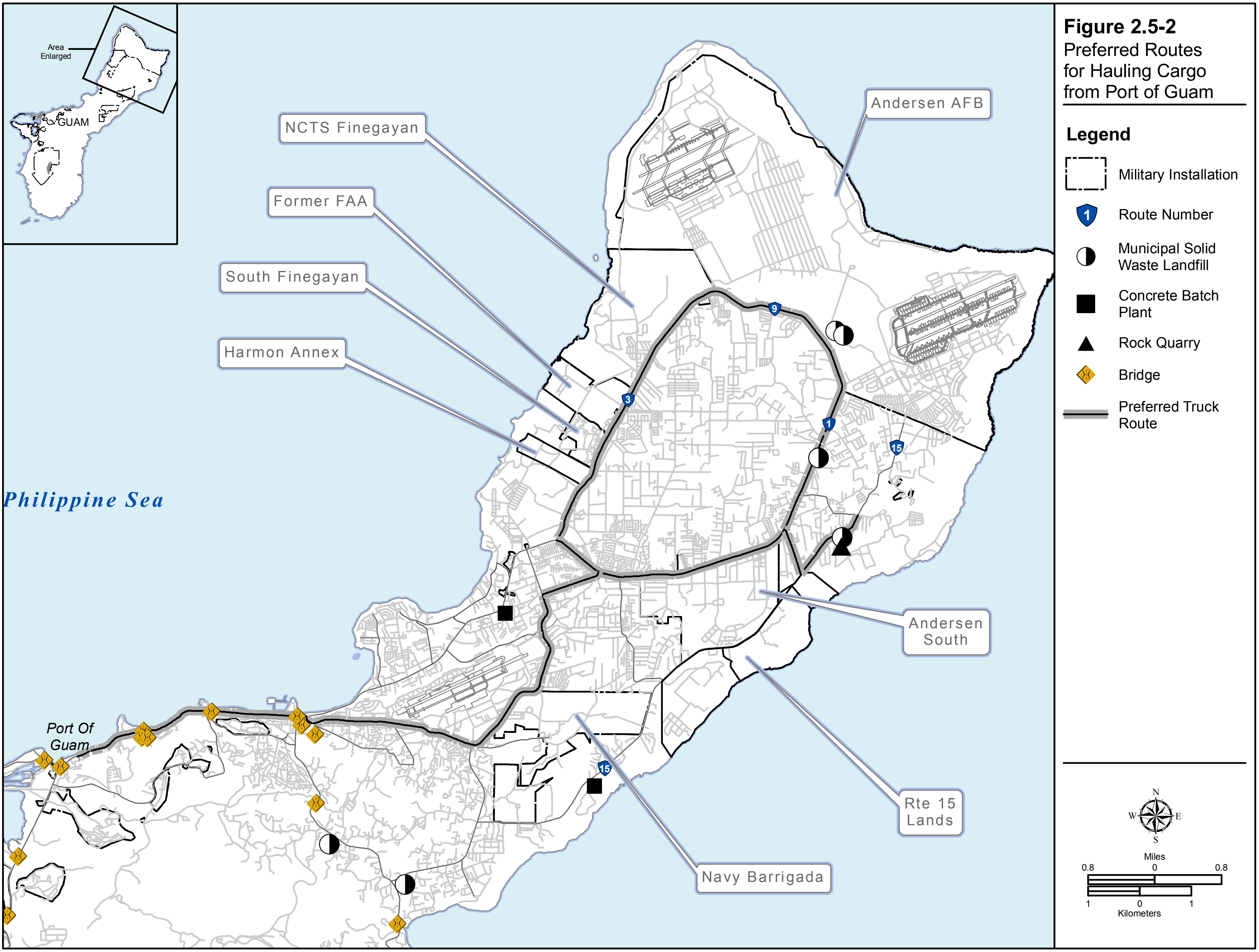

Figure 2.5-2
Preferred Routes for Hauling Cargo from Port of Guam

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2.5.1.5 Mass Transit

The traffic projections developed by the GDPW show that congestion levels in both the short term and the long term would result in substantial delays, as measured by the ratio of traffic volume to roadway capacity. Analysis indicated that it is unlikely that sufficient additional roadways or traffic lanes could be built to completely eliminate traffic congestion. Mass transit would help address this need. Existing mass transit routes and service areas are depicted in Figure 2.5-3.

As part of the 2030 Guam Transportation Plan (GDPW 2008), a new Core Bus System has been proposed to help support islandwide mobility during the 2010-2014 time period. Although most construction worker housing areas would be expected to include vans or buses to and from the work sites, the Core Bus System is expected to be operational by 2012. The new system is designed to connect major employment and population centers. The system consists of five new fixed routes. All major military facilities that house workers or are major employment destination points would be connected by this new system. The Dededo area (near NCTS Finegayan) would be especially well served because it is one of the major population centers; by 2030 it would experience a 50% increase in population. Projections show that ridership has the potential to reach 1.32 million annual trips.

The Core Bus System would also provide direct service between the Naval Base and Tumon Bay, which is the major tourist area on the island. A total of 50 buses are needed to operate this service, and GovGuam is pursuing a Federal Transit Administration Section 5309 discretionary grant to fund the acquisition of these vehicles. The proposed mass transit fixed-route network is depicted in Figure 2.5-4 and Figure 2.5-5.

2.5.1.6 Safety

Transportation safety on Guam is managed by the GDPW Office of Highway Safety which is funded through the National Highway Traffic Safety Administration to provide leadership by: developing, promoting, and coordinating programs; influencing public and private policies; and, increasing public awareness of highway safety. Highway safety means the reduction of traffic crashes, deaths, injuries, and property damage resulting on Guam's highways.

With the impact of the island's roadway expansion, the GDPW would be responsible for increasing enforcement activities and public awareness campaigns for highway safety. Outreach programs would continue and expand to educate the public on important laws pertaining to highway safety. Educational efforts would focus on: the dangers of driving under the influence, using cell phones and texting; use of seatbelts, safe bicycling; and, pedestrian educational training on crosswalks.

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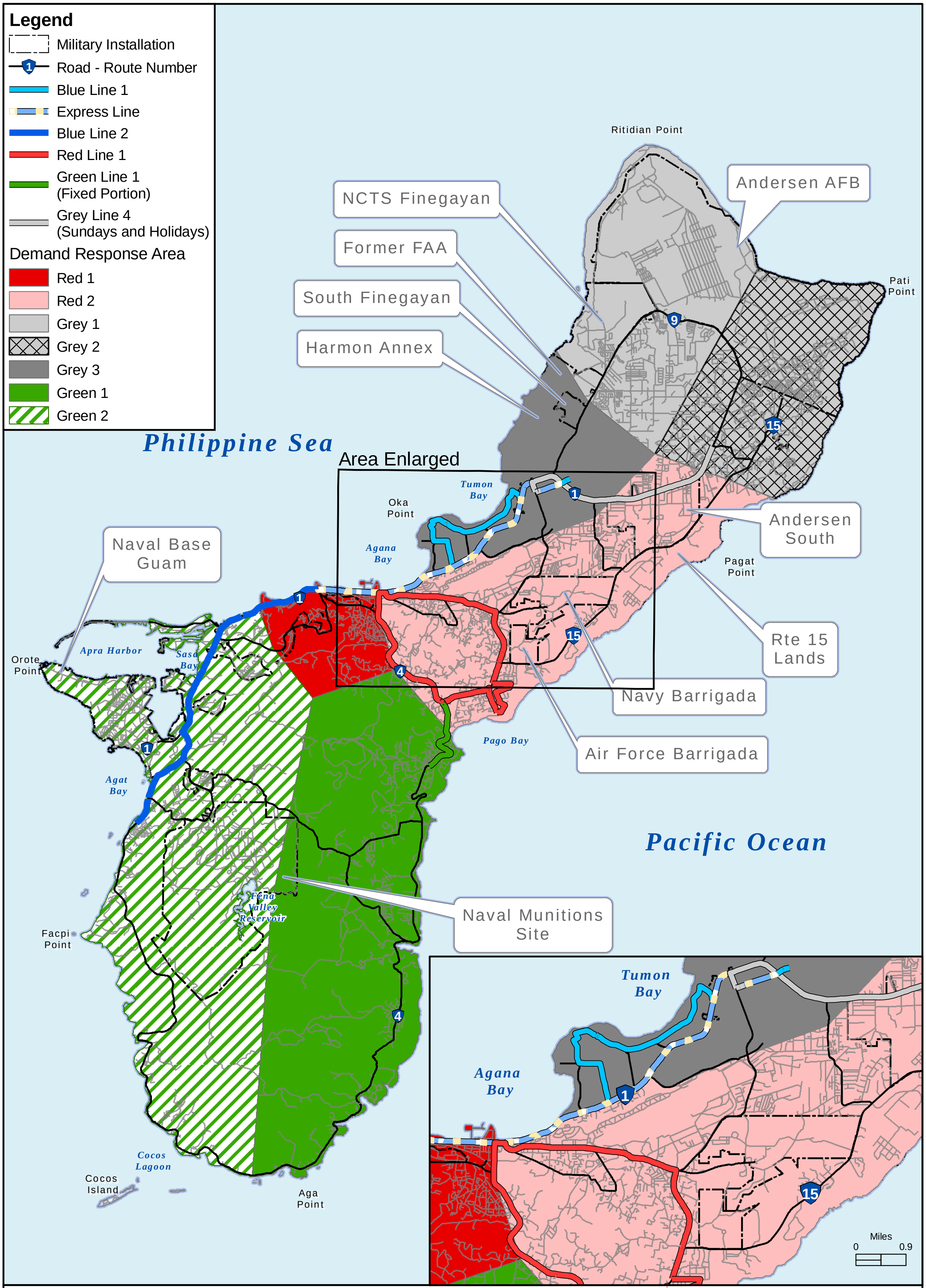

Figure 2.5-3
Existing Mass Transit Network and Demand Service Areas on Guam

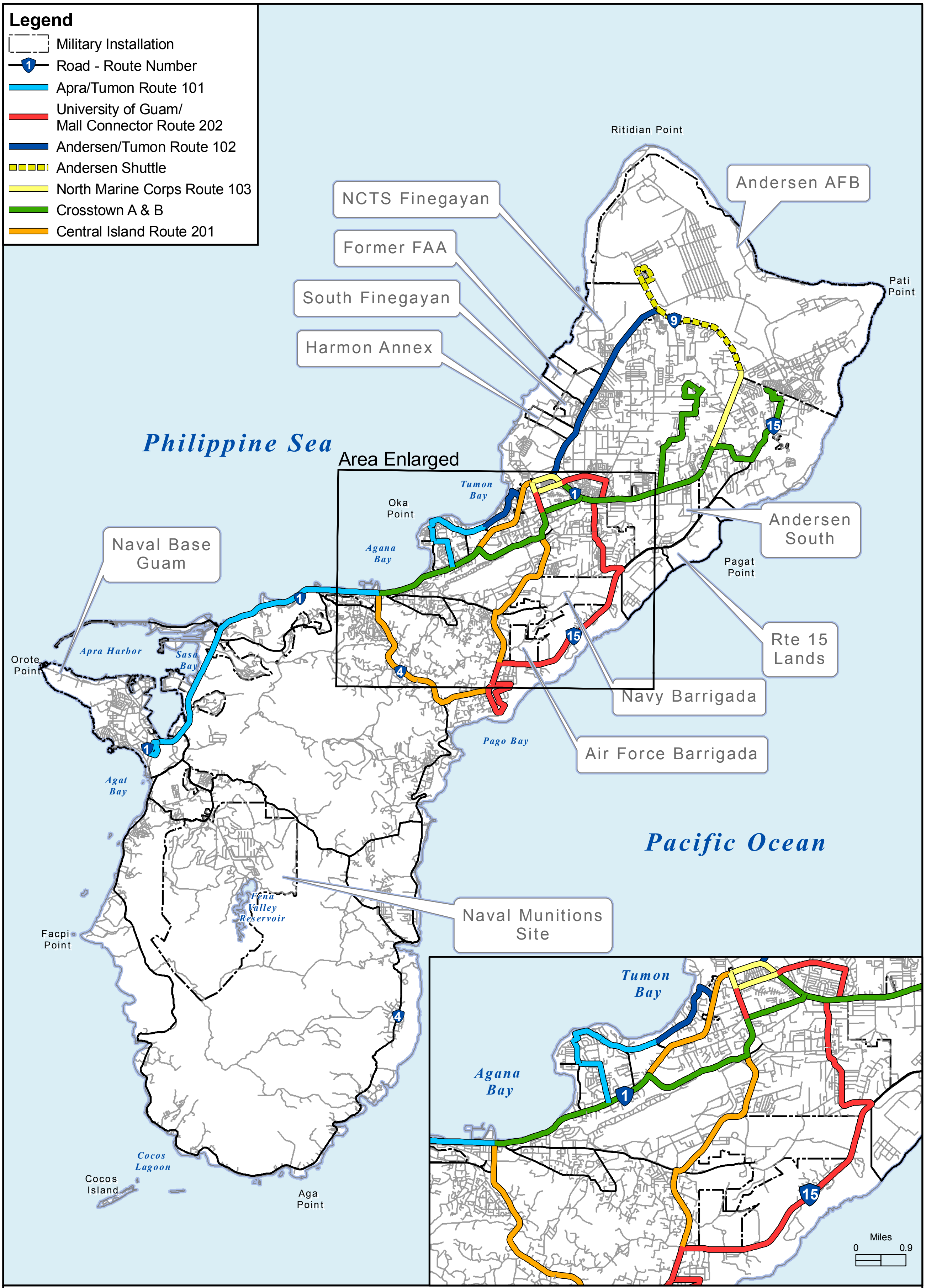

Figure 2.5-4
Proposed Mass Transit Network on Guam

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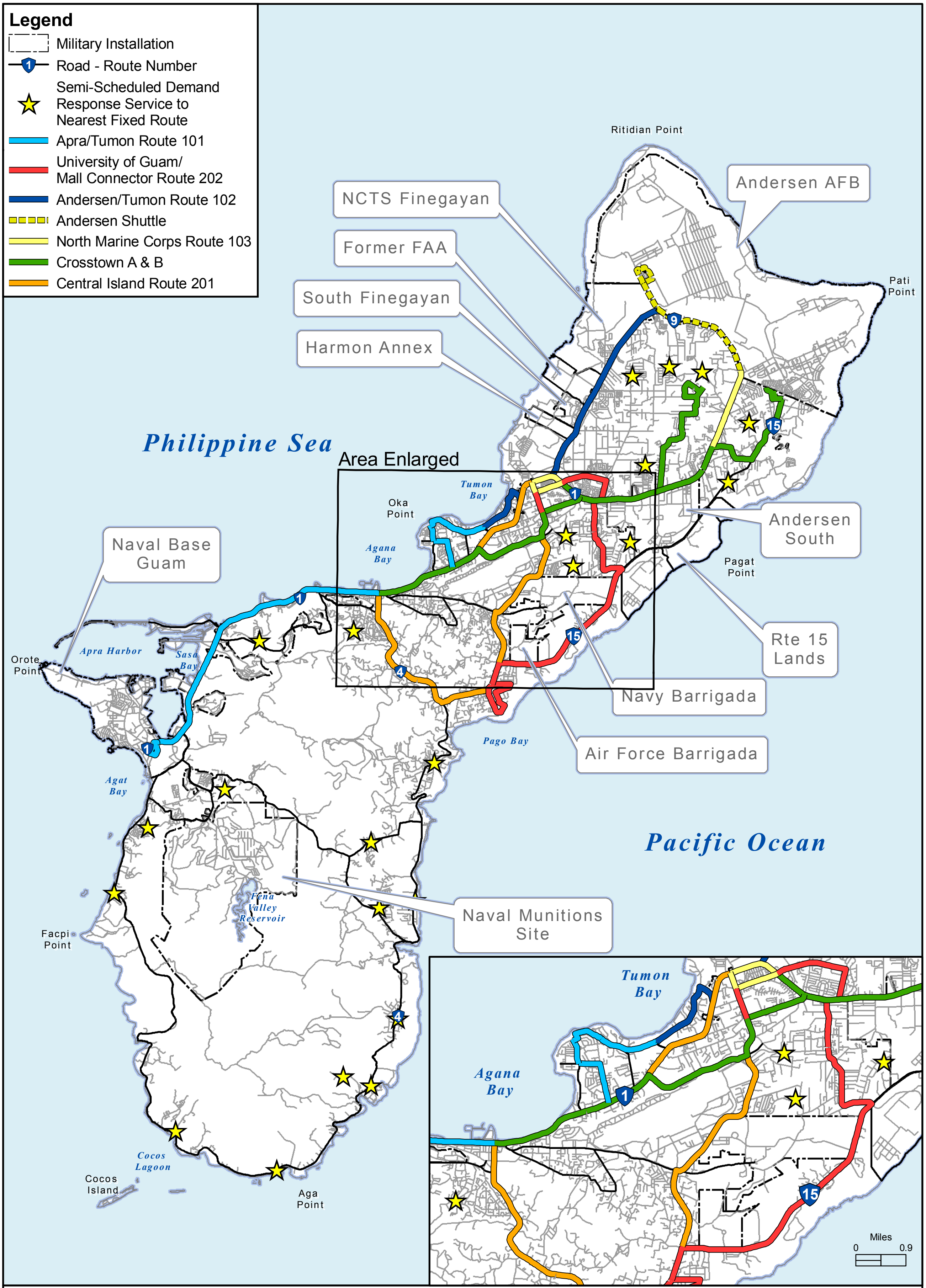

Figure 2.5-5
Mass Transit Network on Guam

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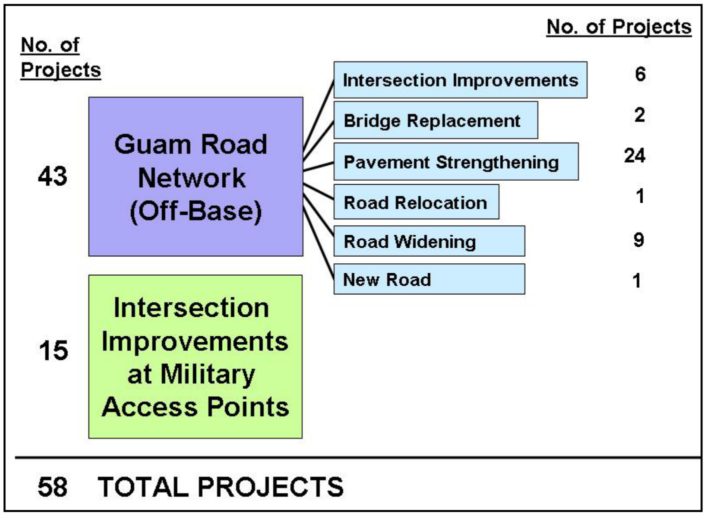
The 2030 Guam Transportation Plan (GDPW 2008) recommends that traffic information and data management systems are completely overhauled and upgraded with computerized systems and equipment. To provide efficient and safe access to military lands during the construction of relocation facilities, the proposed Guam road improvements would be designed in accordance with standards that would improve traffic safety. The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (23 U.S. Code 148) identifies key objectives of the core highway safety improvement plan. The GDPW is in the process of identifying hazardous traffic locations on the island and implementing safety on island roadways. The Guam Territorial Transportation Improvement Program (GovGuam 2009) contains 16 hazard elimination projects. Six of these projects are site-specific:

- Route 4, Jeff's Pirate Cove
- Route 14 Resurfacing
- Route 1 Pedestrian Safety Fence at John F. Kennedy High School
- Route 1 John F. Kennedy Pedestrian Underpass/Overpass
- Route 15 Santa Rosa Yigo, Road Hardening
- Route 1 Deadman's Curve
- The remaining 10 projects are islandwide:
- School zone signs
- Village road safety signs (newly paved local roads) and regulatory/warning signs
- Seashore protection
- Highway hazard elimination project
- Pavement markers for primary roads and Phase I markings replacement
- Construction for safety improvements
- Route sign installation
- Anti-skid surfacing and traffic signalization
- Skid-resistant surfacing and guardrails for Route 4 in Yona
- Highway barrier and rail rehabilitation

Hazard elimination projects on Route 1 (Jeff's Pirate Cove) and Route 4 (Deadman's Curve) are the only two specific location projects that have been funded. There is an existing safety hazard with key roadways on Guam and a need for safety improvements.

2.5.1.7 Proposed Action

The proposed action would enable and improve roadway connectivity, capacity, and pavement strength for military construction and deployment in support of the relocation. Logistical routes for construction-related transport would connect the Port of Guam with Navy and Air Force bases, the Finegayan area, the Naval Munitions Site, concrete batch plants, rock quarries, and precast concrete panel fabrication sites associated with the military relocation on the island. In addition to improvements to the construction routes,



traffic associated with the presence of the military personnel and their dependents would require roadway modifications, thus the collective roadway projects are called the GRN (see overview in Figure 2.5-6).

As shown in the adjacent chart, 58 individual projects have been identified from recent transportation and traffic studies on the island of Guam. These consist of 43 GRN (off base) projects and 15 intersection improvement projects at MAPs (gates). The 43 GRN (off base) projects are composed of six types of roadway improvements:

- Intersection improvement projects
- Replacement of five bridges and replacement of box culverts at three other bridges
- Pavement strengthening (combined with roadway widening at some locations)
- Roadway relocation (Route 15)
- Roadway widening
- Construction of a new road (Finegayan Connection)

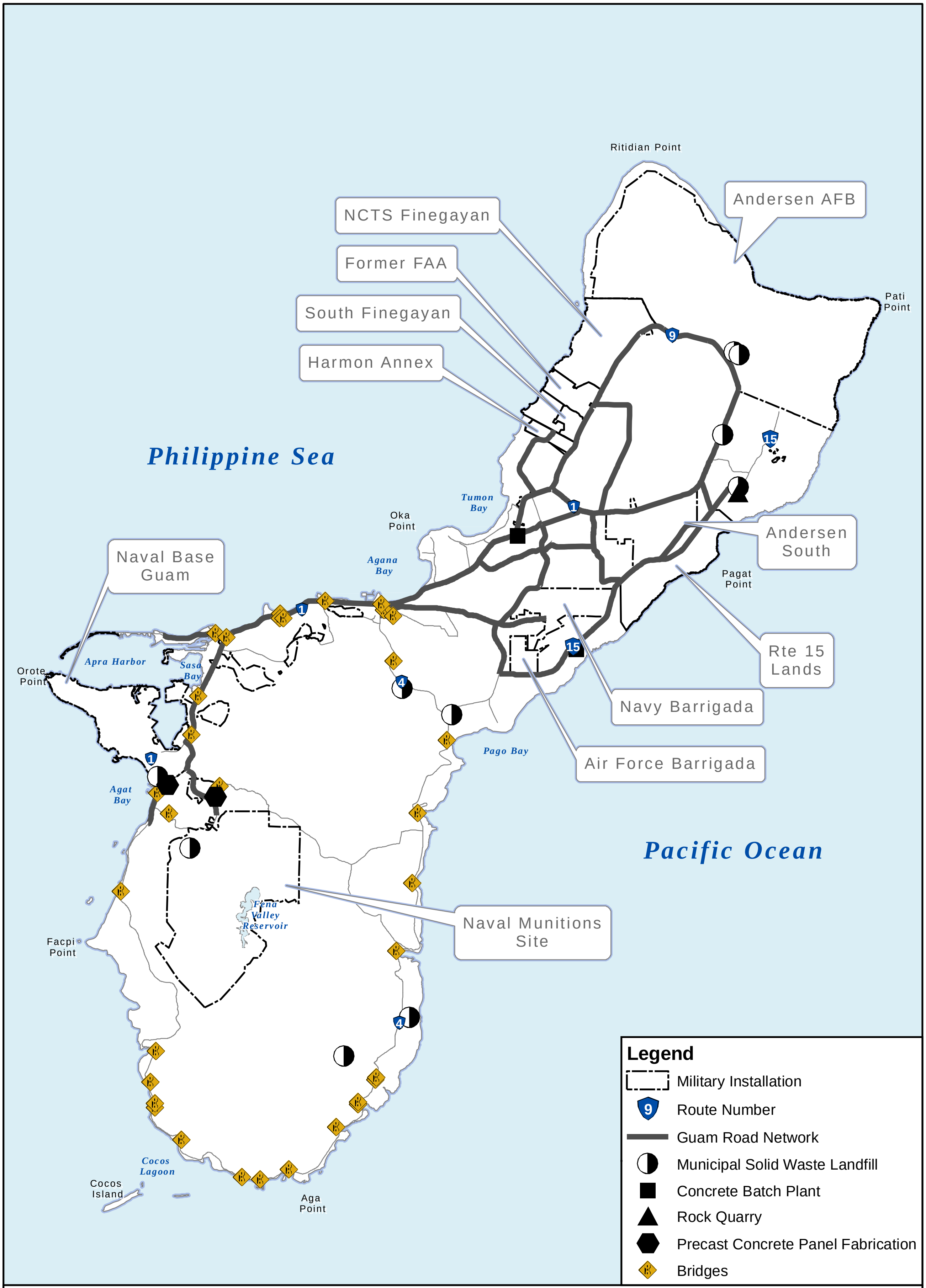


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Figure 2.5-6
Overview of Guam Roads Network

These 58 projects cover four geographic regions on Guam: North, Central, Apra Harbor, and South (Figure 2.5-7). The characteristics of each of the 58 projects are summarized in Table 2.5-3 (with each project assigned a GRN number). The locations of these GRN projects are shown in Figure 2.5-8.

Table 2.5-3. Guam Road Network Projects by Island Region

GRN No.	*Route*	*Segment Limits*	*Road Length ft (m)*	*Requirements*
North				
8	3	Route 28 to Route 1	13,500 (4,091)	Pavement strengthening (four lanes), including reestablishment of second southbound through lane at Okkodo High School access.
9	3	NCTS Finegayan to Route 28	11,900 (3,606)	Pavement strengthening (widen from two to four lanes), add median and shoulders. At the Route 3/28 intersection, add an additional southbound left-turn lane and add northbound right-turn lane.
10	3	NCTS Finegayan to Route 9	4,150 (1,258)	Pavement strengthening, widen from two lanes to four lanes, add median and shoulders. At the Route 3/3A intersection, eliminate Y-intersection, provide four-legged intersection with one right-turn lane on Route 3A, and a northbound left-turn lane on Route 3.
22	9	Route 3 to Andersen AFB (North Gate)	6,300 (1,909)	Pavement strengthening (widen from two lanes to four lanes), add median and shoulders.
22A	9	Andersen AFB North Gate to Route 1 (Andersen AFB Main Gate)	9,200 (2,788)	Pavement strengthening (two lanes), add median and shoulders.
23	1	Chalan Lujuna to Route 9 (Andersen AFB)	14,250 (4,318)	Pavement strengthening (four lanes).
38	3	NCTS Finegayan (Commercial Gate)	—	MAP 2, proposed location 0.5 mile (0.8 km) west of Route 9, across from Chalan Kareta would be signalized; eastbound, left-turn lane (300 ft [91 m], combined through/right-turn lane; westbound, left-turn lane (150 ft [46 m]), combined through/right-turn lane; northbound, left-turn lane (480 ft [146 m]), through/right-turn lane; southbound, left-turn (150 ft [46 m]), through, and combined through/right-turn lane.
38A	3	NCTS Finegayan (Commercial Gate)	—	MAP 2, proposed to be a T-intersection 1,215 ft (368 m) south of Flores Para Eso St. Would be signalized; eastbound, left-turn lane (300 ft [91 m]), combined through/right-turn lane; northbound, left turn (480 ft [145 m]), through, combined through/right-turn lane; southbound, through, and combined through/right-turn lane.
39	3	NCTS Finegayan (Main Gate)	—	MAP 3, would be located at Bullard Avenue; would be signalized; eastbound, two left-turn lanes (300 ft [91 m]), free right turn with acceleration lane on Route 3; northbound, two left turns (600 ft [183 m]), two through lanes, southbound two through lanes, right-turn lane (600 ft [183 m]).

GRN No.	*Route*	*Segment Limits*	*Road Length ft (m)*	*Requirements*
39A	3	NCTS Finegayan (Main Gate)	—	MAP 3, located across from signalized intersection with Route 28. Eastbound, two left-turn lanes (300 ft [91 m]), one through lane, free right turn with acceleration lane on Route 3; northbound, two left turns (600 ft [182 m]), two through lanes, and right-turn lane, southbound, two left-turn lanes, two through lanes, right-turn lane (600 ft [182 m]), westbound two left-turn lanes, through, and right-turn lane.
41	3	South Finegayan (Residential Gate)	—	MAP 5, aligned with Kamute Avenue, would be signalized; eastbound, two left-turn lanes (200 ft [61 m]), free right turn with acceleration lane on Route 3; northbound, two left turns (700 ft [213 m]), two through lanes, southbound, through and combined through right turn. A southbound left-turn lane for Kamute Avenue would also be needed (150 ft [46 m]).
41A	3	South Finegayan (Residential Gate)	—	MAP 5, located 680 ft (206 m) south of Hahasu Drive. Would be signalized; eastbound, two left-turn lanes (200 ft [61 m]), free right turn with acceleration lane on Route 3; northbound, two left turns (700 ft [212 m]), two through lanes, southbound, through and combined.
42	9	Andersen AFB (North Gate)	—	MAP 6, proposed between Routes 3 and 1 would be stop-controlled with stop for access from base; eastbound left-turn lane (600 ft [183 m]), two through lanes; westbound, one through lane and one right-turn lane (220 ft [98 m]); southbound, left-turn lane, free right-turn lane with acceleration lane (becomes second westbound through lane).
57	28	Route 1 to Route 3	21,000 (6,364)	Pavement strengthening, widen two to three lanes with shoulders. At the Route 28/27A intersection, provide northbound left-turn, through, combined through/right-turn, southbound left turn, through, and combined through/right-turn, eastbound left-turn, through, and right-turn lane.
117	15	Route 15/29 Intersection	—	Intersection improvements to signalize, additional northbound, southbound left-turn lanes, southbound right-turn lane.
124	New Road	Route 1/16 Intersection to South Finegayan	10,641 (3,225)	New two-lane road parallel to Route 3, with left-turn lanes at existing access points, with 4-ft (1.2-m) median and 4-ft (1.2-m) paved shoulders. At the Route 1/16 intersection, improve the existing at-grade intersection.
Central				
1	1	Route 1/8 Intersection	940 (285)	Intersection improvements (0.24 mile [0.24 km] on Route 1 and 0.09 mile [0.14 km] on Route 8) to provide two left-turn lanes and two right-turn lanes for northbound Route 8 approaching Route 1.
2	1	Route 1/3 Intersection	2,400 (727)	Intersection improvements (0.15 mile [0.39 km] on Route 1 and 0.04 mile [0.06 km] on Route 3) to provide southbound left, combined left/right, and free right with acceleration lane; east to north double left-turn lane.
3	1	East of Route 4	85 (26)	Agana Bridge replacement.

GRN No.	*Route*	*Segment Limits*	*Road Length ft (m)*	*Requirements*
6	1	Route 27 to Chalan Lujuna	18,200 (5,515)	Pavement strengthening (four lanes). At the Route 1/28 intersection, add an additional eastbound left-turn lane, southbound Route 28 approach to include two right-turn lanes and shared left/through lane. At the Route 1/26 intersection, add an additional westbound left-turn lane, eastbound right-turn lane. Northbound Route 26 approach should include left-turn, combined left-turn/right-turn, and right-turn lane.
7	1	Route 3 to Route 27	4,600 (1,394)	Pavement strengthening (six lanes). At the Route 1/27 intersection, provide double eastbound left-turn lanes, eastbound right-turn lane, and triple westbound left-turn lanes. Northbound Route 27 approach to include left-turn, combined left-turn/through and two right-turn lanes. At the Route 1/27A intersection, add an additional eastbound left-turn lane, additional northbound Route 27A right-turn lane.
11	Chalan Lujuna	Route 1 to Route 15	4,350 (1,318)	Pavement strengthening (two lanes), safety/operational improvements.
12	15	Smith Quarry to Chalan Lujuna	6,100 (1,848)	Pavement strengthening (two lanes), safety/operational improvements.
13	1	Route 11 to Asan River	8,472 (2,567)	Pavement strengthening (four lanes).
14	1	Asan River to Route 6	6,437 (1,951)	Pavement strengthening (four lanes).
15	1	Route 6 (Adelup) to Route 4	9,100 (2,758)	Pavement strengthening (six lanes).
16	8	Tiyan Parkway/Route 33 (east) to Route 1	8,290 (2,512)	Pavement strengthening, widen from four/six lanes to six lanes with median.
17	8	Route 10 to Tiyan Parkway/Route 33 (east)	7,904 (2,395)	Pavement strengthening (four lanes).
18	16	Route 27 to Route 10A	4,505 (1,365)	Pavement strengthening (six lanes). At the Route 16/27 intersection, add an additional northbound lane, southbound left-turn lanes, change westbound right-turn to combine through/right-turn lane.
19	16	Route 10A to Sabana Barrigada Drive	5,448 (1,651)	Pavement strengthening (four lanes). At the Route 16/10A intersection, add additional northbound and southbound off-ramps to provide one left-turn, combined left-turn/through/right-turn, and right-turn lane. Restripe to provide additional westbound left-turn lane.
20	16	Sabana Barrigada Drive to Route 8/10	8,691 (2,634)	Pavement strengthening (four lanes).
21	27	Route 1 to Route 16	5,448 (1,651)	Pavement strengthening (six lanes).
28	26	Route 1 to Route 15	12,900 (3,909)	Pavement strengthening, widen from two lanes to four lanes. At the Route 26/25 intersection, provide northbound left-turn, through, through/right, southbound left-turn, two throughs, and right-turn, eastbound left-turn, left-through, and right-turn lane. Southbound right-turn should have raised island and free right to westbound Route 25 curb lane.

GRN No.	*Route*	*Segment Limits*	*Road Length ft (m)*	*Requirements*
29	25	Route 16 to Route 26	8,050 (2,439)	Pavement strengthening, widen from two lanes to four lanes.
30	10	Route 15 to Routes 8 and 16	7,847 (2,378)	Pavement strengthening (four lanes)
31	8A	Route 16 to Navy Barrigada	8,865 (2,686)	Pavement strengthening (two lanes)
32	15	Route 10 to Connector (Chalan Lujuna end)	41,500 (12,576)	Pavement strengthening (two lanes). Signalize the intersection at the Route 15/26 intersection.
33	1	Route 8 to Route 3	31,647 (9,590)	Pavement strengthening (six lanes). At the Route 1/14 North San Vitores intersection, add southbound right-turn lane. At the Route 1/14A intersection, add northbound/southbound left-turn lanes, southbound right-turn lane. At the Route 1/10A intersection, add southbound left-turn lane, northbound right-turn lane. At the Route 1/14B intersection, change eastbound right-turn lane to shared right-turn/left-turn lane. At the Route 1/14 southern intersection (known as the ITC intersection), include southbound right-turn lane. At the Route 1/30 intersection, add an additional northbound left-turn lane, change existing lanes on eastbound approach to combine a left-turn/through, and two right-turn lanes.
35	1	Various	364 (110)	Replace Atantano, Laguas, Sasa, and Fonte bridges. Replace Asan #1, Asan #2 and Agueda box culverts.
36	15	Route 15 Realignment	11,200 (3,394)	Relocate Route 15 onto existing DoD land to allow firing range in vicinity.
44	1	Andersen South (Main Gate)	-	MAP 8 (Turner Street) would be signalized; westbound Route 1 left-turn lane (500 ft [152 m], restripe existing two-way left turn lane); eastbound Route 1 right-turn lane (1,000 ft [305 m]); and northbound two left-turn lanes (300 ft [91 m]) and right-turn lane.
46	15	Andersen South (Secondary Gate)	-	MAP 10, unnamed road, 1.16 miles (1.87 km) east of Route 26 would be stop-controlled with stop for access from base; eastbound Route 15 left-turn lane (250 ft [76 m]); southbound, left-turn lane (150 ft [46 m]) and right-turn lane.
47	16	Barrigada (Navy)	-	MAP 11, approximately 1,315 ft (401 m) north of northerly post office driveway. New four-lane access road connected to Route 16 as a T-intersection. Route 16/Access Road would be signalized. Northbound Route 16, two through lanes and combined through/right lane. Southbound Route 16, two left-turn lanes (one lane 425 ft [130 m], the other lane drop from third southbound through lane), and two through lanes; westbound, two left-turn lanes and free right-turn lane.
48	8A	Barrigada (Navy)	-	MAP 12, extension of north/south road from Route 16/Sabana Barrigada Drive to Route 8A with one lane in each direction.

GRN No.	*Route*	*Segment Limits*	*Road Length ft (m)*	*Requirements*
49	15	Barrigada (Air Force)	—	MAP 13, new access across from Chada Street would be signalized; eastbound left-turn lane (250 ft [76 m]), combined through/right-turn lane; westbound, left-turn lane (150 ft [46 m]), combined through/right-turn lane; southbound, left-turn lane (150 ft [46 m]), combined through/right-turn lane; northbound, combined left/through/right-turn lane.
49A	15	Barrigada (Air Force)	—	MAP 13A, new access across from Chada Street would be signalized; eastbound, two left-turn lanes (500 ft [152 m]), combined through/right-turn lane; westbound, left-turn lane (150 ft [46 m]), through lane, right-turn lane (1,000 ft [305 m]); southbound, two left-turn lanes (500 ft [152 m]), combined through/right-turn lane; northbound, combined left/through/right-turn lane.
63	16	Route 10A to Sabana Barrigada Drive	5,448 (1,651)	Pavement strengthening, widening from four to six lanes, with median.
74	8A	Route 16 to Navy Barrigada	8,865 (2,686)	Pavement strengthening (two lanes), widen to provide median and shoulders.
113	7	Route 7/Route 7A	—	Intersection improvements to add signing, striping, and minor intersection construction to establish two-lane circulation around Y-intersection.
Apra Harbor				
4	11	Port to Intersection with Route 1	9,150 (2,773)	Pavement strengthening of two lanes.
5	11	Route 1/11 Intersection	1,480 (448)	Intersection improvements (0.12 mile [0.19 km] on Route 1).
24	1	Route 11 to Route 2A	16,247 (4,923)	Pavement strengthening (four lanes).
26	2A	Route 1 to Route 5	4,577 (1,387)	Pavement strengthening (four lanes)
50	1	Naval Base Guam	—	MAP 14, at existing signalized intersection of Route 1/Route 2A
South				
25	5	Route 2A to Route 17	6.379 (1,944)	Pavement strengthening (two lanes). Route 5/17 intersection. Add right-turn lane on Route 17 approaching Route 5.
27	5	Route 17 to Naval Munitions Site	3,954 (1,205)	Pavement strengthening (two lanes).
52	12	Naval Munitions Site	—	MAP 16, proposed relocation of existing access point to Harmon Road for safety/operational improvements.
110	2	Route 2/12 Intersection	—	Intersection improvements to convert northbound right-turn lane to combine a through/right-turn lane.

Legend: AFB = Air Force Base; DoD = Department of Defense; ft = foot/feet; GRN = Guam Road Network; ITC = International Trade Center; m = meter(s); MAP = Military Access Point; NCTS = Naval Computer and Telecommunications Station.

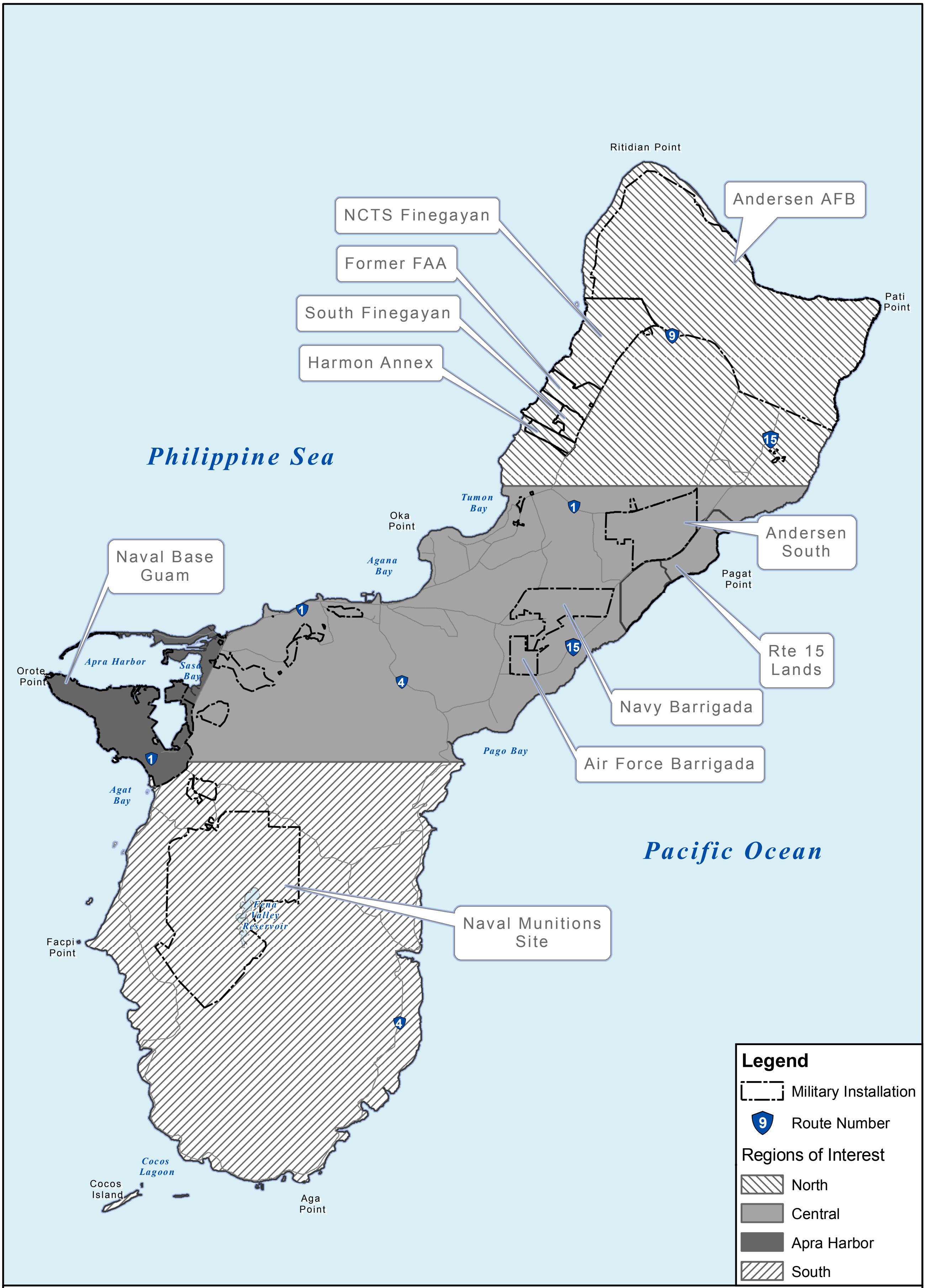

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Figure 2.5-7
Geographic Regions of Guam

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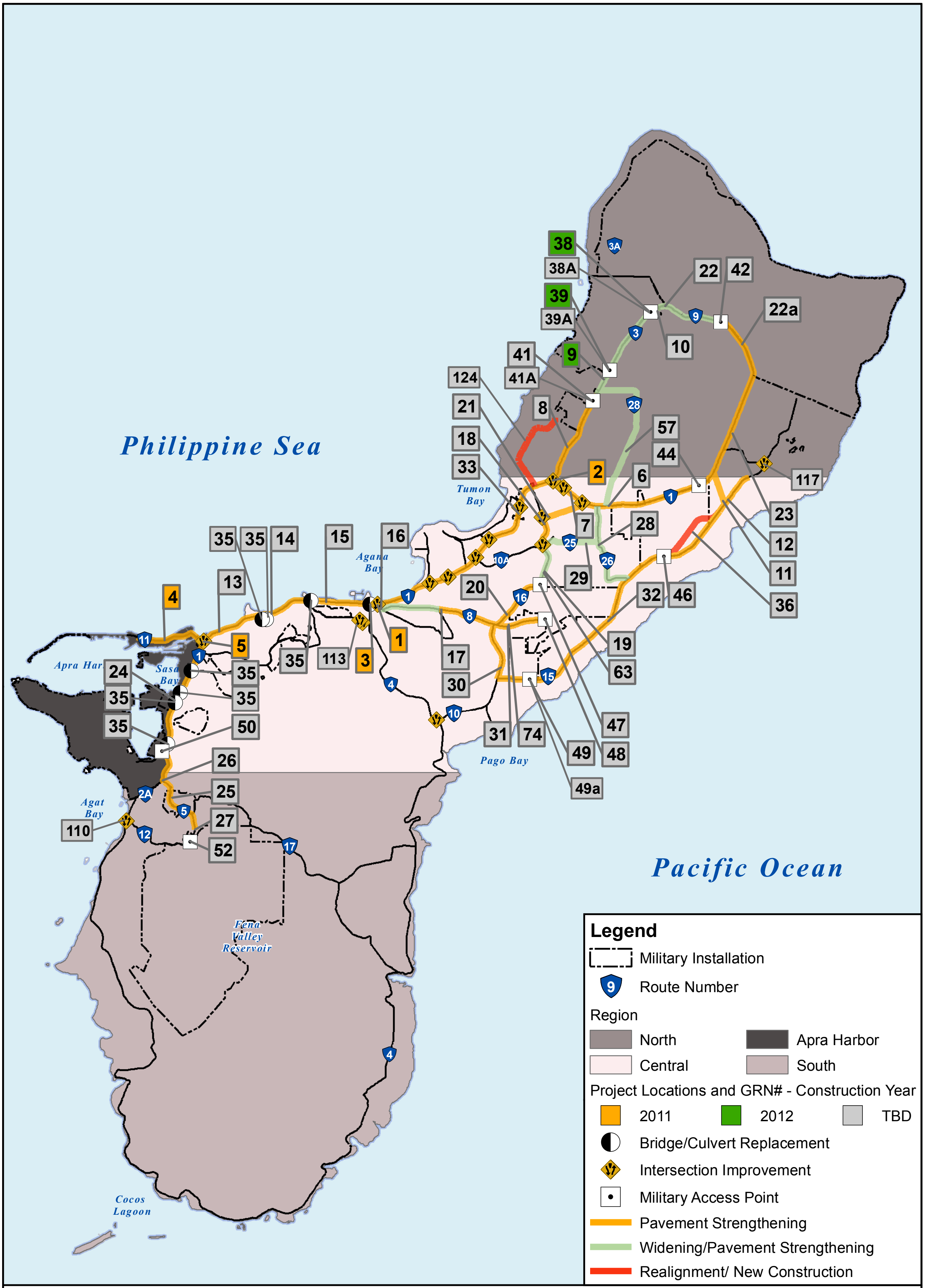


Figure 2.5-8
Guam Road Network Project Locations

Construction Schedule

To plan for construction of the GRN, islandwide traffic forecasts were prepared to define traffic associated with the increase in off-island construction workers and off-island indirect workers. Construction of the GRN may occur from 2011 to 2017 (a 7-year period pending identified funding). Table 2.5-4 identifies a preliminary schedule of the military-related GRN projects that would be initiated in the first two of seven construction years. This schedule is based on current funding of eight (8) of the total 58 GRN projects (refer to Volume 6, Chapter 1, Table 1.1-1).

Table 2.5-4 Guam Road Network Construction Projects to be Completed Each Year

Funding	*Construction Year*	*Projects to be Completed*
FY 2010	2011	1, 2, 3, 4 and 5[a]
FY 2011	2012	9, 38 and 39[b]
TBD	TBD	10, 11, 22, 35, 36, 44, 46, 52 [c]
TBD	TBD	TBD[d]

Note: Refer to Volume 6, Chapter 1, Section 1.1.4 regarding project funding, and Volume 6, Chapter 2, Figure 2.5-8 for GRN project locations.

[a] These five projects have been DAR-certified, authorized and appropriated.

[b] These three projects have been DAR-certified and are awaiting authorization and appropriation.

[c] These eight projects have been identified to be DAR-eligible. For GRN #35, replacement of box culverts at Aguda and Asan #1 will be funded by DPW.

[d] These remaining 42 GRN projects (GRN #s 6, 7, 8, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22A, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 38A, 39A, 41, 41A, 42, 47, 48, 49, 49A, 50, 57, 63, 74, 110, 113, 117, and 124) are in the process of being identified for DAR eligibility or identifying another funding source. Once funded, these projects will be scheduled into the corresponding construction year.

Legend: FY = Fiscal Year; TBD = To Be Determined.

2.5.1.8 Typical Construction Activities

Construction of the GRN would result in typical roadway and ancillary-facility construction activities at multiple locations. Typical roadway construction work is described in Table 2.5-5.

The types of construction activities might be combined in any particular project. In addition, projects would include matching existing access connections, pavement striping, and signing. As appropriate, intelligent traffic systems, modifications to comply with Americans with Disabilities Act requirements, and safety lighting may be included.

Depending on the road condition and loading, pavement strengthening may consist of one or more of the following methods:

- Full-depth reconstruction (removing the full depth of subbase, base, and asphalt pavement and replacing it with new high-quality crushed base and asphalt pavement to allow the existing and new roadway profile to remain the same).
- Full-depth reclamation and overlay (pulverizing the existing asphalt pavement and base to a depth of 8 in (20 cm) to 12 in (30 cm), followed by removal of the top 4 in (10 cm) to 6 in (15 cm) of pulverized material and stabilization of the remaining 4 in (10 cm) to 8 in (20 cm) of material by adding emulsion, cement, and other additives. A 4-in (10-cm) to 6-in (15-cm) layer of asphalt pavement is placed over the stabilized base.) This alternative provides pavement strengthening while minimizing both demand for natural resources and traffic impacts due to the fast process (roadway profile to remain the same).
- Mill and overlay (plus isolated surface preparation) could include the removal of the top inch of existing pavement and placing a 2-in (5-cm) to 6.5-in (16.5-cm) layer of asphalt. This

process is not valid for most of the routes because the pavement profile of existing curbs, gutters, or roadway approaches cannot be raised.

Table 2.5-5. Typical Construction Activities

Item	*Work Activity*	*Description*
1	Intersection Improvement (including Military Access Points)	Intersection improvements can include construction of additional turning lanes, construction of acceleration or deceleration lanes, construction of channelizing islands, installation of traffic signals and appurtenances, and/or installation of new traffic loop sensors.
2	Bridge Replacement Box Culvert Replacement	Bridge and box culvert replacements to correct structural deficiencies, increase load capacity, and comply with seismic/hydraulic requirements would be conducted in phases. The superstructure for a new bridge could consist of a cast-in-place concrete deck on precast prestressed box beams. The substructure would consist of concrete abutments founded on drilled shaft foundations. Box culverts would be replaced with new single cell or multi cell box culverts. The new structure would be lengthened to adequately accommodate the hydraulic flow of the river. The width of the new structure would accommodate more or wider lanes and a median, with sidewalks and barriers on each side, as required. A friction course would be applied to the bridge. The final step would be demolition of the existing bridge.
3	Pavement Strengthening	Existing asphalt pavement sections would be strengthened by rehabilitating the existing pavement materials in place and placing an asphalt overlay or by reconstructing with new materials. Pavement sections may be widened to include shoulders and would be constructed of residual material from the existing pavement rehabilitation, new material, or a combination thereof, and an asphalt overlay. Pavement strengthening may also include matching existing access connections, pavement striping, signing, intelligent traffic systems, and safety lighting. A project would match the existing horizontal and vertical alignment where practical with adjustments to roadway super elevation as required. Minor realignment of the road may be necessary to accommodate design elements.
4	Road Relocation (Route 15 only)	Route 15 would be realigned to accommodate the location of military firing ranges. New asphalt pavement would be constructed on the new alignment. The roadway cross section would consist of one lane in each direction, outside shoulders, and inside shoulders, with an unpaved median that would accommodate future widening. Bicycles would be accommodated in the outside shoulders of the shared roadway. Realignment would also include the construction of one or more new bridges to grade separate Route 15 and the range road(s), obliterating existing Route 15 pavement, building removal, connecting to existing roadways or other access roads, utility relocation, pavement striping, signing, property fence, and guardrail installation.
5	Road Widening	The widened pavement section would be constructed of residual material from the existing pavement rehabilitation, new material, or a combination thereof, and an asphalt overlay. Bicycles would be accommodated in the outside shoulders of the shared roadway.
6	New Road Construction (Finegayan Connection only)	New roadway would be constructed on a new alignment with new asphalt pavement constructed on compacted base or engineered fill.

2.5.2 Alternatives Development Process

The Navy evaluated alternatives as part of the siting process to identify suitable candidate locations for consideration of primary facility components. The alternatives siting process for the Marine Corps relocation is described in Volume 2 of this EIS. As described in this evaluation, the process resulted in the selection of four alternatives (or action alternatives) that are carried forward in the analysis.

The variation among alternatives is associated with the Main Cantonment and training facility components of the proposed action. The Main Cantonment would be the main base of operations for the Marine Corps, and under two alternatives, it would also be the main base of operations for the Army AMDTF (see Volume 5). The operational components of all four alternatives are as described in Volume 2, Sections 2.3 through 2.5 of this EIS.

2.5.3 Alternatives

Each of the four alternatives was evaluated for two scenarios described below with the assumption that all 58 roadway projects would be funded and constructed. In addition, the no-action alternative was analyzed, taking into consideration only expected natural growth.

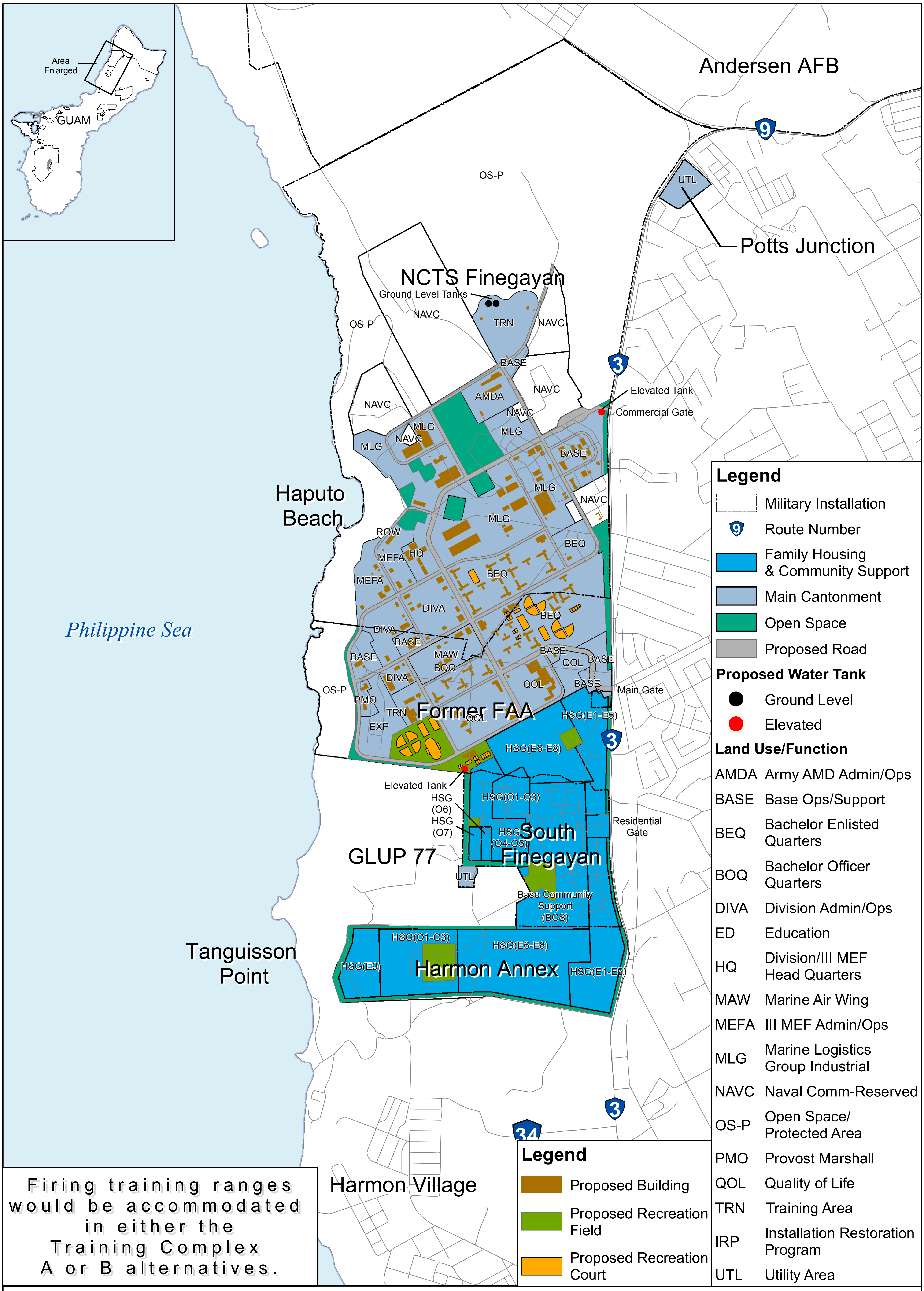
- *2014 (Peak Construction):* Each alternative was evaluated for environmental conditions in future year 2014, which represents peak construction associated with the military relocation. The end of year 2014 would represent full military relocation of active duty Marines Corps and their dependents. The year 2014 also represents the year with the highest estimated number of off-island construction workers for DoD projects.
- *2030:* Each alternative was evaluated for environmental conditions in future year 2030, consistent with the 2030 Guam Transportation Plan, assuming that military relocation has occurred.

2.5.3.1 Alternative 1

Alternative 1 involves utilizing NCTS Finegayan (1,181 ac [578 ha]), obtaining access to the Former FAA parcel (677 ac [274 ha]) south of NCTS Finegayan, and purchasing non-DoD land in the Harmon area (327 ac [132 ha]) south of South Finegayan, for a total of 2,113 ac (853 ha). A detailed view of the Main Cantonment configuration associated with this alternative is presented in Figure 2.5-9.

The Main Cantonment would include housing facilities, base operations and support facilities, various headquarters and administrative support facilities, quality-of-life facilities (e.g., shops, schools, and recreation), training areas, and open space. Military personnel, including the Army AMDTF, and their dependents would generally live, work, recreate, and shop in the north to northwest part of Guam. Most ground-training activities (i.e., nonfiring and firing) would occur on the east coast of Guam; the principal battalion-level training area would be on Tinian. Waterfront activities would be at Apra Harbor, but most Marine Corps vehicle traffic would be in the northern half of the island, except during embarkation. Amphibious Readiness Group embarkation and berthing would be at contiguous wharves, but the U.S. Coast Guard would need to be relocated to Oscar/Papa Wharves. Under this alternative, the new deep-draft aircraft carrier berth would be at the Former Ship Repair Facility. The water and wastewater proposals under this alternative would provide the greatest capacity and benefit to populations outside of the military relocation. The existing NDWWTP would be upgraded with secondary treatment capacity. Upgrades and improvements to the existing GPA system would be funded, but no new power generation capacity would be provided. Solid waste would be managed on DoD land.

The roadway projects that would be required for Alternative 1 are listed in Table 2.5-6. Individual projects that would not be included in this alternative are GRN #s 38, 39, 41, 47, 48, 49, 49A, 63, and 74.



Firing training ranges would be accommodated in either the Training Complex A or B alternatives.

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Figure 2.5-9
Alternative 1 Housing & Cantonment

Table 2.5-6. Alternative 1 GRN Projects

Item	*Off Base*						*Intersection Improvement at Military Access Point*	*TOTAL*
	Intersection Improvement	*Bridge Replacement*	*Pavement Strengthening*	*Road Relocation*	*Road Widening*	*New Road*		
GRN #(s)	1, 2, 5, 110, 113, 117	3, 35	4, 6, 7, 8, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22A, 23, 24, 25, 26, 27, 30, 31, 32, 33	36	9, 10, 16, 22, 28, 29, 57	124	38A, 39A, 41A, 42, 44, 46, 50, 52	
Subtotal	6	2	24	1	7	1	8	49

Legend: GRN = Guam Road Network.

2.5.3.2 Alternative 2

Alternative 2 involves using NCTS Finegayan (1,250 ac [578 ha]) and the Former FAA parcel (677 ac [274 ha]) for a total of 1,855 ac (751 ha). A detailed view of the Main Cantonment configuration associated with this alternative is presented in Figure 2.5-10.

The roadway projects that would be required for Alternative 2 are listed in Table 2.5-7. Individual projects that would not be included in this alternative are GRN #s 38A, 39A, 41A, 47, 48, 49, 49A, 63, and 74.

Table 2.5-7. Alternative 2 GRN Projects

Item	*Off Base*						*Intersection Improvement at Military Access Point*	*TOTAL*
	Intersection Improvement	*Bridge Replacement*	*Pavement Strengthening*	*Road Relocation*	*Road Widening*	*New Road*		
GRN #(s)	1, 2, 5, 110, 113, 117	3, 35	4, 6, 7, 8, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22A, 23, 24, 25, 26, 27, 30, 31, 32, 33	36	9, 10, 16, 22, 28, 29, 57	124	38, 39, 41, 42, 44, 46, 50, 52	
Subtotal	6	2	24	1	7	1	8	49

Legend: GRN = Guam Road Network.

2.5.3.3 Alternative 3

Alternative 3 involves utilizing NCTS Finegayan (1,250 ac [506 ha]), South Finegayan (283 ac [115 ha]), with portions of military housing and quality-of-life services at Navy and Air Force Barrigada (433 ac and 377 ac, respectively [175 ha and 153 ha, respectively]) for a total of 2,343 ac (848 ha). A detailed view of the Main Cantonment configuration associated with this alternative is presented in Figure 2.5-11.

The roadway projects that would be required for Alternative 3 are listed in Table 2.5-8. Individual projects that would not be included in this alternative are GRN #s 20, 31, 38A, 39A, 41, 41A, and 124.

Table 2.5-8. Alternative 3 GRN Projects

Item	*Off Base*						*Intersection Improvement at Military Access Point*	*TOTAL*
	Intersection Improvement	*Bridge Replacement*	*Pavement Strengthening*	*Road Relocation*	*Road Widening*	*New Road*		
GRN #(s)	1, 2, 5, 110, 113, 117	3, 35	4, 6, 7, 8, 11, 12, 13, 14, 15, 17, 18, 19, 21, 22A, 23, 24, 25, 26, 27, 30, 32, 33	36	9, 10, 16, 22, 28, 29, 57, 63, 74		38, 39, 42, 44, 46, 47, 48, 49, 49A, 50, 52	
Subtotal	6	2	22	1	9	0	11	51

Legend: GRN = Guam Road Network.

2.5.3.4 Alternative 8

Alternative 8 involves using the Former FAA parcel (677 ac [274 ha]), NCTS Finegayan (1,181 ac [578 ha]), South Finegayan (283 ac [115 ha]), with portions of military housing and quality-of-life services at Navy and Air Force Barrigada (433 ac [175 ha]), for a total of 2,574 ac (1,042 ha). A detailed view of the Main Cantonment configuration associated with this alternative is presented in Figure 2.5-12.

The roadway projects that would be required for Alternative 8 are listed in Table 2.5-9, Individual projects that would not be included in this alternative are GRN #s 38, 39, 41, 47, 48, 49, 63, and 74.

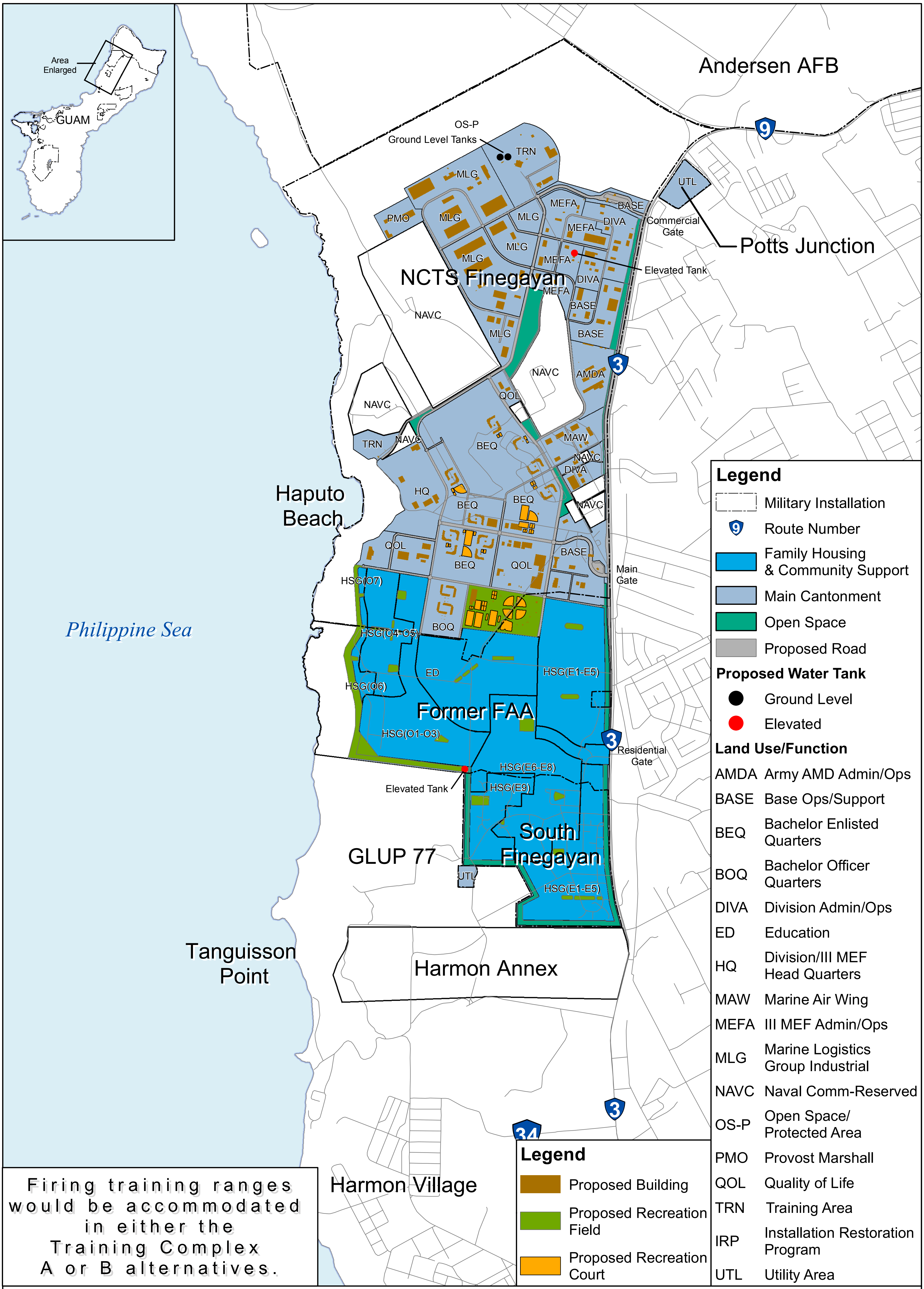
Table 2.5-9. Alternative 8 GRN Projects

Item	*Off Base*						*Intersection Improvement at Military Access Point*	*TOTAL*
	Intersection Improvement	*Bridge Replacement*	*Pavement Strengthening*	*Road Relocation*	*Road Widening*	*New Road*		
GRN #(s)	1, 2, 5, 110, 113, 117	3, 35	4, 6, 7, 8, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22A, 23, 24, 25, 26, 27, 30, 31, 32, 33	36	9, 10, 16, 22, 28, 29, 57	124	38A, 39A, 41A, 42, 44, 46, 49A, 50, 52	
Subtotal	6	2	24	1	7	1	9	50

Legend: GRN = Guam Road Network.

2.5.3.5 Firing Range Options

Depending on the selection of the firing range option, the alternatives described for the relocation include the Main Cantonment action alternatives with either a Firing Range Option A or Option B. Option A would require the realignment of Route 15 (GRN #36), while Option B would not require the realignment of Route 15.



Firing training ranges would be accommodated in either the Training Complex A or B alternatives.

Figure 2.5-10
Alternative 2 Housing & Cantonment

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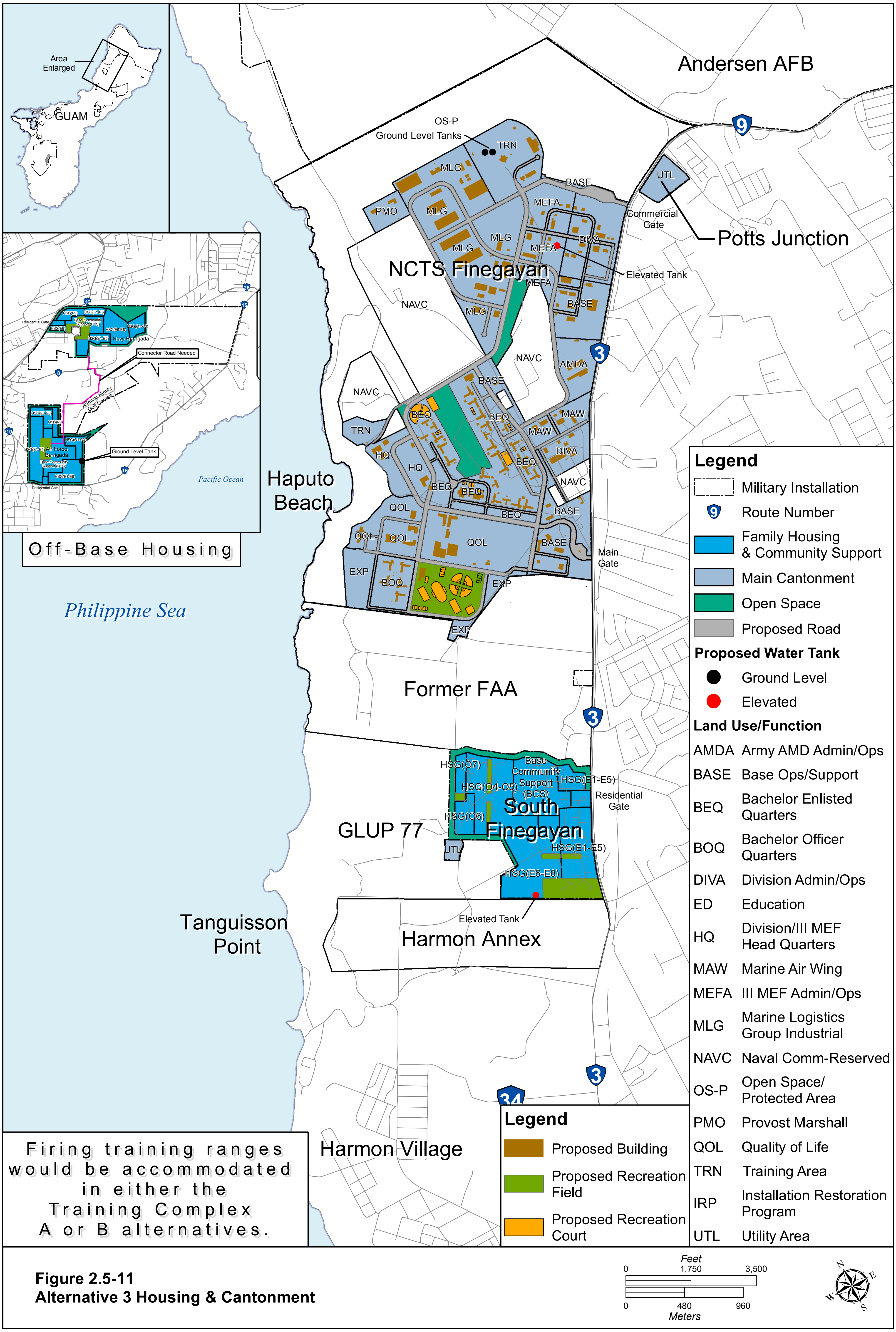

Firing training ranges would be accommodated in either the Training Complex A or B alternatives.

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Figure 2.5-11
Alternative 3 Housing & Cantonment

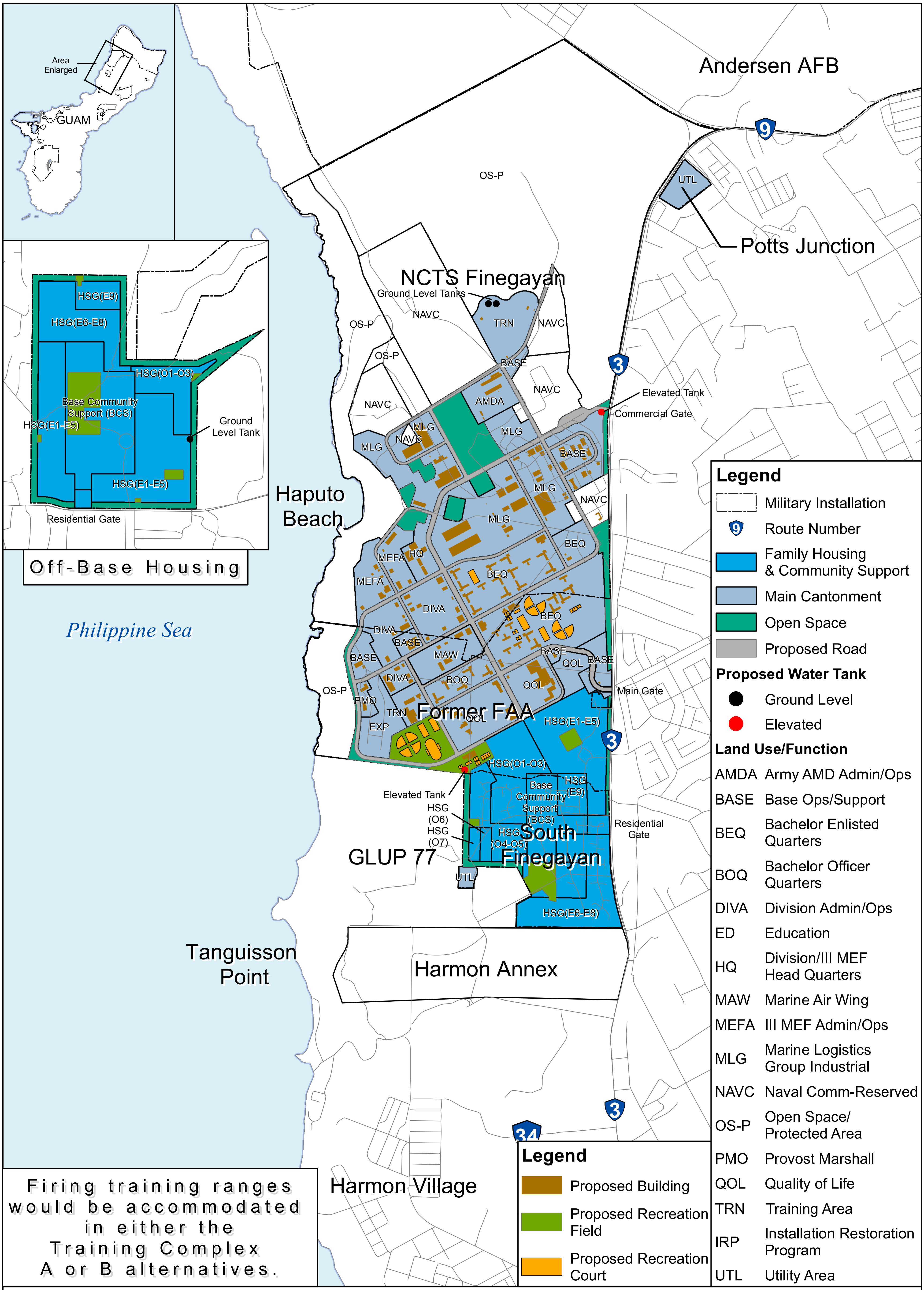

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Figure 2.5-12
Alternative 8 Housing & Cantonment

2.5.3.6 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Okinawa and not relocate to Guam, the visiting aircraft carrier would berth at Kilo Wharf, improvements to Apra Harbor would occur, and an Army AMDTF would not be positioned on Guam. No additional training capabilities (beyond what is proposed in the Mariana Islands Range Complex EIS and the Intelligence, Surveillance, and Reconnaissance/Strike EIS would be implemented for the Commonwealth of the Northern Mariana Islands or Guam. The project objectives and the U.S. Government/GoJ treaty and associated agreements would not be met. There would be no land acquisition, dredging, new construction, or infrastructure upgrades associated with Marine Corps or Army forces stationed on Guam. There would be no construction costs associated with this alternative. The Air Force military population would grow as projected for Intelligence, Surveillance, and Reconnaissance/Strike (see "Cumulative Projects," Volume 7). The Navy and Army do not project population increases. The no-action alternative does not meet the purpose and need of the proposed action. Although this alternative serves as a baseline, roadway capacity improvement projects would be conducted by the GovGuam to accommodate organic growth on Guam.

Existing (2009) (Preproject)

The no-action alternative evaluates existing environmental conditions for the baseline year of 2009, assuming that no military relocation would occur.

2014 (Peak Construction)

The no-action alternative evaluates environmental conditions for future year 2014, assuming that construction associated with military relocation would not occur. Seven GovGuam roadway capacity improvement projects would occur, as identified in Table 2.5-10 and Figure 2.5-13.

2030

The no-action alternative evaluates environmental conditions for future year 2030, assuming that military relocation would not occur. Twenty GovGuam roadway capacity improvement projects would occur, as identified in Table 2.5-5 and Figure 2.5-13.

2.5.3.7 Summary of Guam Road Network Projects Required for Each Alternative

All GRN projects identified in Table 2.5-3 would be required for each of the four alternatives, with the following exceptions:

- Alternative 1 would not require GRN #38, 39, 41, 47, 48, 49, 49A, 63, or 74. This alternative would consist of 49 projects.
- Alternative 2 would not require GRN #38A, 39A, 41A, 47, 48, 49, 49A, 63, or 74. This alternative would consist of 49 projects.
- Alternative 3 would not require GRN # 20, 31, 38A, 39A, 41, 41A, or 124. This alternative would consist of 51 projects.
- Alternative 8 would not require GRN #38, 39, 41, 47, 48, 49, 63, or 74. This alternative would consist of 50 projects.

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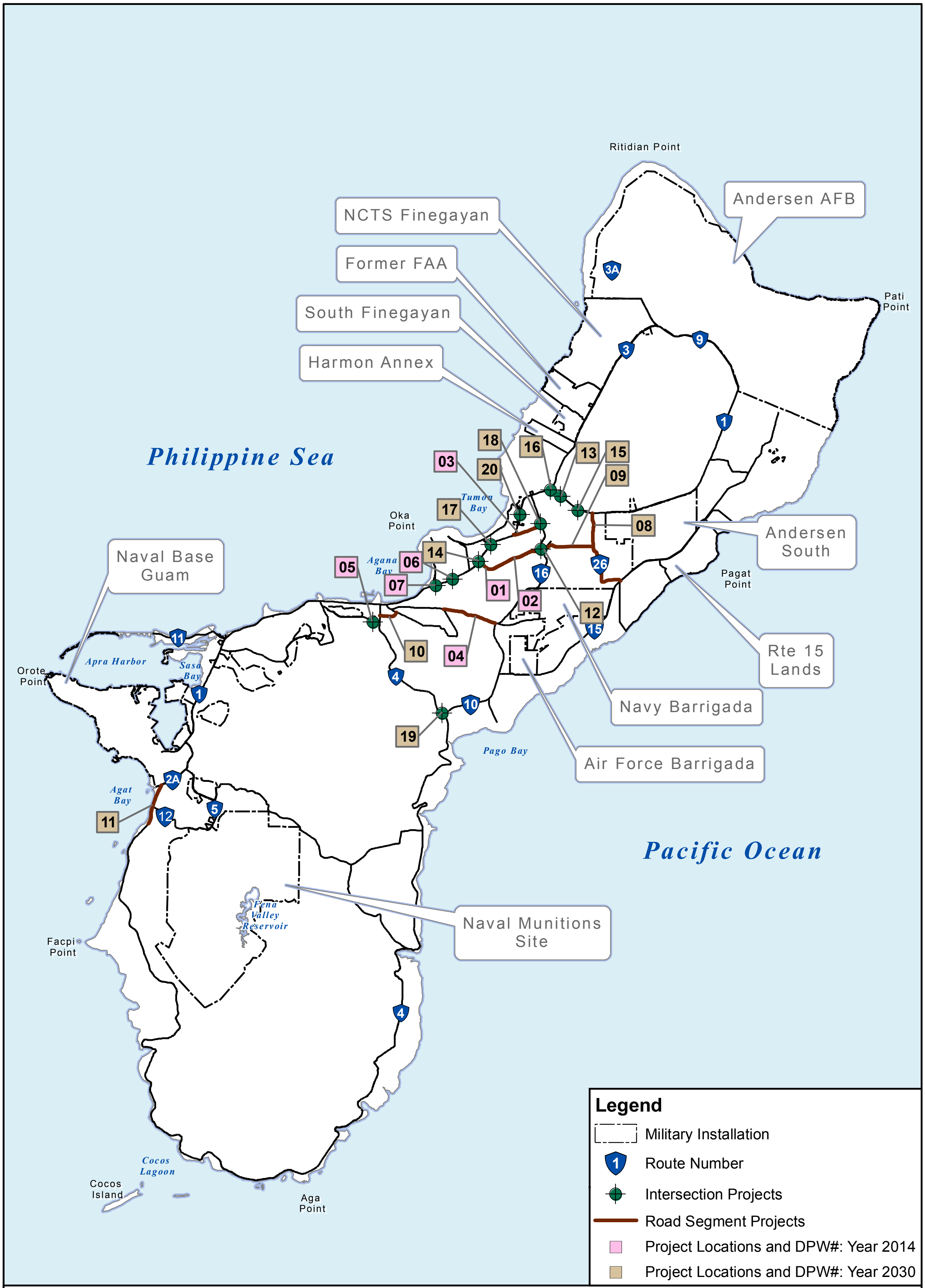

Figure 2.5-13
Government of Guam Organic Growth Project Locations

Table 2.5-10. Government of Guam Roadway Capacity Improvement Projects

Year	*Project No.*	*Route*	*Segment Limits*	*Requirements*
2014				
Road Segment Projects	01	10A	Route 1 to Airport	Widen two/four lanes to four lanes
	02	10A	Airport to Route 16	Widen two lanes to six lanes
	03	27 Ext.	Route 16 to Route 1	Widen two to four lanes
	04	Tiyan Parkway	Route 10A to Route 8	Widen two to four lanes
Intersection Projects	05	7	Route 7/Route 7A, Route 24	Reconfigure Y-intersection
	06	1	Route 1/Route 14 (ITC)	Add southbound right-turn lane, improve adjacent development access near intersection
	07	1	Route 1/Route 30	Additional turn lanes pending further study
2030				
Road Segment Projects	08	26	Route 1 to Route 15	Widen two to four lanes
	09	25	Route 16 to Route 26	Widen two to four lanes
	10	7A	Route 8 to Route 4	Widen three lanes to four lanes
	11	2	Route 2A to Erskin	Widen two lanes to three lanes (add center left-turn lane)
Intersection Projects	12	16	Route 16/Route 10A	Restripe/sign existing lanes
	13	1	Route 1/Route 27A	Add eastbound right-turn lane
	14	1	Route 1/Route 10A	Add northbound right-turn lane
	15	1	Route 1/Route 27	Add southbound left-turn lane
	16	1	Route 1/Route 3	Add northbound left-turn lane
	17	1	Route 16/Route 14A	Add northbound/southbound right-turn lane
	18	16	Route 16/Route 27	Add turn lanes pending further study
	19	4	Route 4/Route 10	Add southbound through lane
	20	1	Route 1/Route 14 (NSV)	Add northbound left-turn lane

Legend: ITC = International Trade Center; NSV = North Sans Vitores.

2.5.4 Preferred Alternative

The Navy has identified Alternative 2 as the Preferred Alternative. This alternative involves use of NCTS Finegayan and the Former FAA parcel, and includes 49 roadway improvement projects as shown in Table 2.5-7.

At this time, 8 of the 49 roadway improvement projects associated with Alternative 2 are Defense Access Road (DAR)-certified. Of the 8 DAR-certified projects, 5 are funded in Fiscal Year 2010 and would start construction in 2011; the remaining 3 projects are awaiting authorization and appropriation in Fiscal Year 2011 (potentially constructed in 2012). The remaining 41 projects required for Alternative 2 are in the process of being identified for DAR eligibility or identifying another funding source. Once funded, these projects will be scheduled into the corresponding construction years from 2013 through 2017.

As the DoD, FHWA, and GovGuam continue to work cooperatively to develop a funding plan for the off base roadway and intersection capacity projects, the select number of off base roadway projects with funding or reasonable expectation of being funded were further evaluated. A limited traffic analysis was conducted to determine the impact of the housing and additional military base traffic on Guam roadways with only the select number of roadway improvement projects. This separate traffic analysis was completed for the 17 roadways and 42 intersections included in Alternative 2, assuming that only the DAR-certified and DAR-eligible projects were implemented.

As a result of the military relocation, Routes 3 and 9 would receive the majority of the new traffic because most of the relocated military population would reside in the Finegayan area. The evaluation of the limited Alternative 2 scenario included only the eight off base roadway and intersection projects that would involve limited widening of Routes 3 and 9, intersection improvements along Routes 1 and 3 and MAPs to NCTS Finegayan along Route 3.

In the event that funding of the remaining projects is not obtained, severe consequences to the roadway network on Guam would occur. The analysis for Alternative 2 with limited roadway improvements showed that:

- There would be substantial, unmitigated congestion in the North and Central regions (no mitigation available) resulting from traffic associated with the additional housing and base activities without the full recommended off base roadway improvements.
- There would be a reduction in level of service compared to conditions with completion of all roadway improvements. For most of the intersections, the predicted level of service in both 2014 and 2030 would be below the minimum acceptable level. Roadway and intersection capacities in the North and Central regions would be considered severely congested.
- In the year 2030, there would be an increase from 22 to 31 intersections with an unacceptable level of service in at least one peak hour. There would be an increase from 13 to 19 intersections with an unacceptable level of service both peak hours.
- There would be a substantially greater delay at intersections during the morning and afternoon peak hours (even when the level of service is already considered unacceptable).

The limited roadway improvements would be similar for Alternatives 1, 3, and 8, with similar unmitigated traffic impacts. Further impacts to roadways connecting Navy Barrigada and Air Force Barrigada, such as Route 16, would occur if Alternative 3 or 8 were carried forward.

2.5.5 Permits and Regulatory Requirements

Environmental permits and approvals that would be required for the GRN are summarized as follows:

- Endangered Species Act Section 7 consultation with U.S. Fish and Wildlife Service would be required for impacts on habitat for threatened and endangered species. Roadway projects are included in the Section 7 consultation for the entire proposed action.
- Clean Water Act Section 404 permits from the U.S. Army Corps of Engineers would be required for construction activities at bridges and culverts that cross any jurisdictional waters or wetlands. As part of this permit process, the U.S. Fish and Wildlife Service and USEPA would be reviewing any impacts on wetlands and associated mitigation measures.
- Water Quality Certification from GEPA for activities that require a Clean Water Act Section 404 permit.
- Section 106 consultation with the State Historic Preservation Officer would be required for effects on cultural and historic resources that would occur as a result of the proposed action. A separate Section 106 consultation, with a corresponding Programmatic Agreement, would be conducted for the roadway projects.
- A coastal consistency determination from the Guam Bureau of Statistics and Plans would be required to evaluate the effect of the proposed action on coastal resources. Except for federal lands, the entire island of Guam is considered a coastal zone.

Additional permits from GEPA may be required for temporary emissions sources and wastewater discharges. A stormwater pollution prevention plan may be required to address stormwater contamination from storage of hazardous materials, potential for erosion from uncontrolled stormwater, and other stormwater management issues in accordance with the USEPA Technical Guidance on Implementing Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act. FHWA would be responsible for obtaining all permits required for construction of off base roadway projects.

CHAPTER 3.
UTILITIES

3.1 AFFECTED ENVIRONMENT

This section includes information related to existing electrical utilities, potable water supplies, wastewater systems, solid waste, and roadways on Guam that could be directly or indirectly affected by the proposed military relocation. The region of influence (ROI) for this resource includes the Department of Defense (DoD) lands and lands that support public utilities servicing DoD that would be directly affected by the proposed military relocation. It also includes the public utilities that may be indirectly affected by the projected increase in the construction workforce and other induced growth.

3.1.1 Power

The ROI for power includes the generation units and Transmission and Distribution (T&D) system supporting the existing Island-Wide Power System (IWPS). DoD, Guam Power Authority (GPA), and Independent Power Producers (IPPs) also operate backup diesel generators dedicated to mission critical and emergency functions, but these generators are reserved for those functions; therefore, they are not considered in this analysis.

The existing IWPS consists of generation units owned by GPA, generation contracted to GPA, and DoD-owned generation units whose output is available to GPA based on a customer service agreement between GPA and the DoD. The list of generation units is included in the GPA generation status report that is prepared daily and submitted to the Navy's Utility Group. The names of power-generating facilities and an example of the information presented in the generation status report are provided in Table 3.1-1, with an additional column showing the type of unit. At the time of the below report, GPA had an installed capacity of 552.8 megawatts (MW). GPA's generation units available for use had a capacity of 429.8 MW. Figure 3.1-1 shows the power facility locations on Guam. GPA's demand forecast has indicated that the reserve capacity (or excess capacity to ensure reliability) would be exceeded in 2017, based on GPA's load projections for the IWPS for a high growth rate for tourism and infrastructure (GPA 2008).

Table 3.1-1. Example of the Information Presented in the Guam Power Authority Generation Status Report

Plant	*Rated Capacity (MW)*	*Actual Capacity (MW)*	*Capacity Used (MW)*	*Unit Type*
GPA Steam				
Cabras #1	66	66	52	Base load
Cabras #2	66	66	47	Base load
Cabras #3	39.3	39	37	Base load
Cabras #4	39.3	39	37	Base load
Tanguisson #1	26.5	26.5	15	Base load
Tanguisson #2	26.5	26.5	15	Base load
Marianas Energy Co, LLC #8	44.2	.20	0	Base load
Marianas Energy Co, LLC #9	44	44	42	Base load
GPA Steam Total	**352.0**	**307.0**	**245.0**	
GPA Diesels				
Manengon	10.6	8.8	0	Peaking, Reserve
Dededo CT #1	23	21	0	Peaking, Reserve
Dededo CT #2	22	0	0	Peaking, Reserve
Dededo	10	5	0	Peaking, Reserve
Macheche	22	20	0	Peaking, Reserve
Temes (Piti)	40	40	0	Peaking, Reserve
Yigo CT	22	0	0	Peaking, Reserve
Talofofo	8.8	4	0	Peaking, Reserve
Mount Tenjo	26.4	24	0	Peaking, Reserve
Marbo CT	16	0	0	Peaking, Reserve
GPA Diesel Total	**200.8**	**122.8**	**0**	
GPA Total	**552.8**	**429.8**	**245.0**	
DoD Diesels				
NCTS Finegayan	7.5	7.5	0	Backup, dedicated
Radio Barrigada	4	4	0	Backup, dedicated
Orote	19.8	19.8	0	Backup, dedicated
Naval Hospital	2	2	0	Backup, dedicated
DoD Total	**33.3**	**33.3**	**0**	
System Total	**586.1**	**463.1**		
Peak Load Total			245	

Legend: CT = Combustion Turbine; DoD = Department of Defense; GPA = Guam Power Authority; NCTS = Naval Computer and Telecommunications Station.

A summary of Navy service outages for all DoD facilities currently on Guam from October 2005 to July 2006 indicates the following:

- During this period, 214 outages occurred.
- GPA system failures accounted for 39 of those outages. Of the 39 outages, 10 were generation outages and 29 were T&D system outages.
- The internal distribution system for DoD facilities accounts for 175 of the outages.

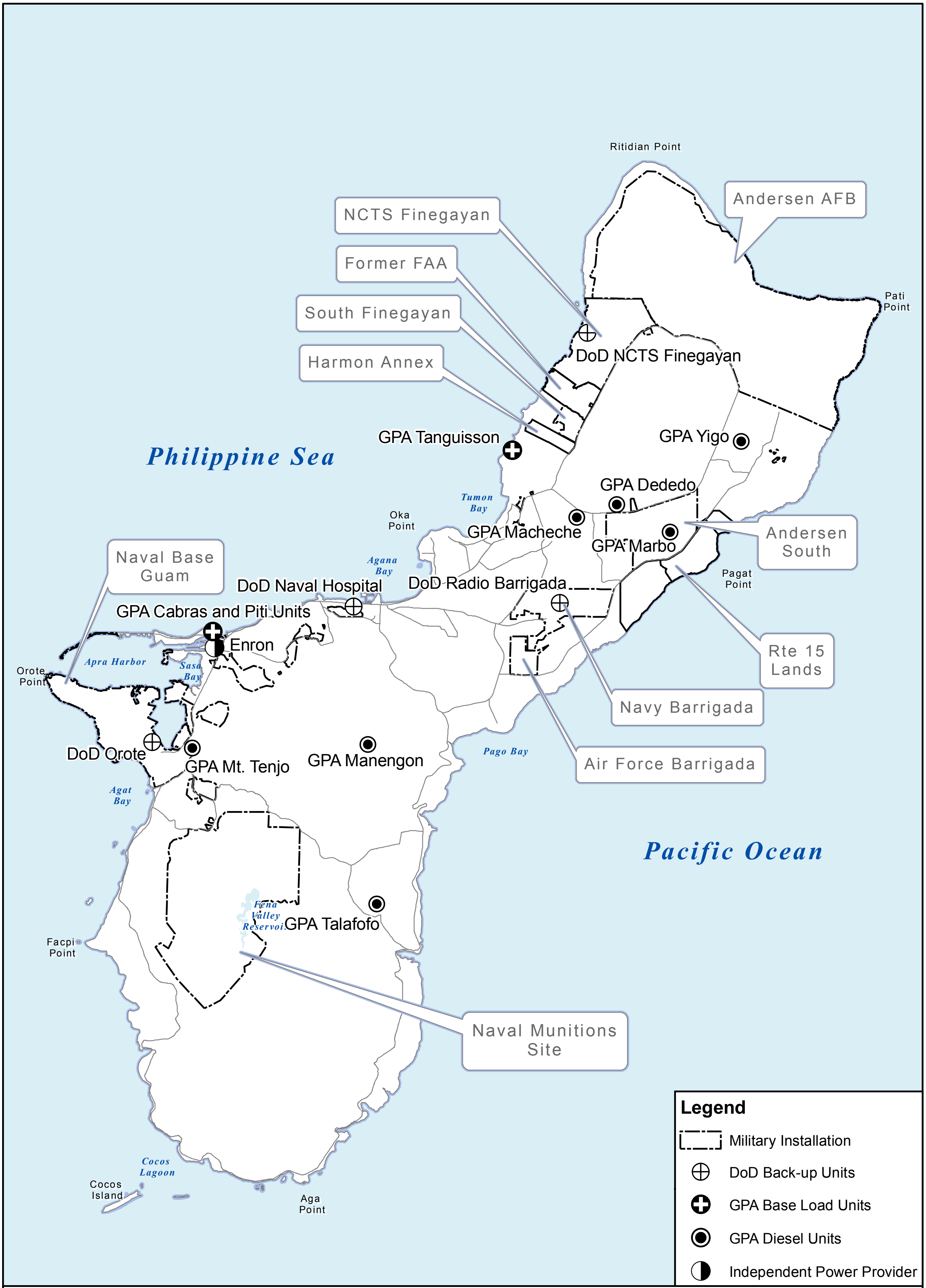

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Figure 3.1-1
Power Facility Locations, Guam

This summary covers a relatively short period and is not intended to provide a comprehensive evaluation of IWPS performance or to detail outages down to specific circuits or devices. The summary does show that nearly 85 percent (%) of the outages in the 9-month period were external to the GPA system. A more detailed evaluation of the outage data would identify specific system components (lines, breakers, switchgear, transformers, or similar components) that represent a larger portion of the outages and would reveal the upgrades that would have the greatest effect on system performance. The age of the generation units within the IWPS varies from less than 10 years to more than 30 years old.

Figure 3.1-2 summarizes the base-load generation units that provide most of the energy consumed on Guam and their "thermal efficiency." This information was calculated based on power generation information analyzed between August 2007 and January 2008. Thermal efficiency is sometimes called "energy efficiency"; when expressed as a percentage, the thermal efficiency must be between 0% and 100%. Thermal efficiencies are typically between 30% and 50% because of inherent inefficiencies in the combustion and generation process, such as friction and heat loss, in converting energy sources into electric power. Cabras #3 and #4, and Marianas Energy Company (Piti) #8 and #9 are slow speed diesel units and considered high efficiency generation units. Cabras #1 and #2 are steam powered units. Thermal efficiencies would vary through the maintenance cycle for each unit. The slow speed diesel units are at the most efficient point at about 80% through the maintenance cycle. DoD diesel plants are not part of GPA's regular dispatch for the power grid in Guam. They are strictly DoD backup generation.

Table 3.1-2. Guam Power Authority Base-Load Generation Units

Power Plant	*Generation (MWh)*	*% of Total*	*Thermal Efficiency (%)*
Cabras #1	156,953	16	34.35
Cabras #2	138,191	15	34.13
Cabras #3	131,124	14	42.18
Cabras #4	137,732	14	40.84
Tanguisson #1	47,140	5	26.46
Tanguisson #2	39,123	4	25.29
Enron IPP Piti #8	160,932	17	42.91
Enron IPP Piti #9	144,994	15	42.78
Total	**956,189**	**100**	

Legend: IPP = Independent Power Producers; MWh = megawatt-hours.

The existing power generation units and T&D systems within the north, central, Naval Base Guam, and south regions of Guam are described in Sections 3.1.1.1 through 3.1.1.3.

According to Fitch Ratings, GPA has shown an ongoing process of improvement. Recent bond rating upgrade shows the impact of that commitment. Fitch Ratings affirms the rating on GPA's $375 million (M) of outstanding electric system revenue bonds at 'BB+'. The Rating Outlook remains *Positive*. The rating is supported by the continued solid track record of GPA's governance structure, a more stable financial profile, and improved system reliability and operating performance. The Positive Rating Outlook reflects the improved relationship with the Public Utilities Commission's (PUC) approval of a base rate increase and other charges, and the PUC's willingness to respond to the fuel cost volatility in 2008 and provide GPA with a third fuel cost recovery using the levelized energy adjustment clause.

Fitch believes that a rating upgrade is dependent on continued improvements in debt service coverage for full obligations (including the capitalized lease), increased liquidity to a level sufficient to protect against volatile fuel prices and adverse economic impacts, and natural disasters (typhoons and earthquakes).

Additionally, the Rating Outlook reflects the continued progress on the pay down of government past account receivables. Other rating considerations include:

- Absence of competition
- Key load center transmission lines being placed underground, providing protection from outages due to typhoons
- Ongoing exposure to natural disasters
- Tourism-based economy (mitigated by current military presence and future expansion)
- Dependence on oil for generation and the need for the PUC to approve timely recovery of fuel costs throughout the levelized energy adjustment clause

GPA, the only retail provider of energy on Guam, serves 45,751 customer accounts and a population of approximately 175,000. Fitch's rating definitions and the terms of use of such ratings are available on the agency's public site, www.fitchratings.com. Published ratings, criteria, and methodologies are available from this site, at all times.

GPA's 2010 budget was approved in August 2009 during a meeting of the Consolidated Commission on Utilities. Commissioners approved the Authority's Fiscal Year 2010 Budget with an anticipated $386 M estimated revenue ($139M non-fuel and $247M in fuel revenues). Despite lower projected electricity sales due primarily to the economic slowdown on the island, the Authority's budget reflects a more conservative forecast that maintains key funding for projects aimed at improving service.

3.1.1.1 North

Andersen Air Force Base (AFB)

The T&D system at Andersen AFB is currently operating near capacity and would need to be expanded to meet increases in future DoD loads. The T&D system is primarily underground with some overhead power lines. The Navy would continue to install new lines underground to provide enhanced resistance to damage from typhoons.

No DoD power generation facilities exist on Andersen AFB other than small local emergency backup generators for specific buildings. GPA has the ability to serve Andersen AFB from nearby generation through an underground circuit to the base. Generation units in the area include Dededo Combustion Turbines (CTs) (No. 1 and No. 2) and Marbo to the south.

Finegayan

The Finegayan area currently has limited development and is a potential site for major facilities associated with the DoD relocation. DoD has a facility on standby to generate 7.5 MW (three 2.5 MW engine generators) for a communication facility at the Naval Computer and Telecommunications Station (NCTS). The IWPS does not have access to this power generation unit because the unit is fully dedicated to mission-critical functions at NCTS. This NCTS generator facility is permitted as a standby generation unit and as a unit to meet special power requirements.

The GPA Macheche CT is located on non-DoD land and is currently permitted for 4,280 hours per year of operation. It has a rated capacity of 22 MW and actual capacity of 20 MW. It was constructed in 1993.

3.1.1.2 Central

Andersen South

GPA facilities at Marbo and Yigo provide generation capacity in the Andersen South area. The use of the term “area” refers to the fact that all GPA power generation units provide energy to a grid and that grid is interconnected throughout Guam. That interconnection allows power from a generator to be carried to a wide geographical area and is not specifically limited to Andersen South. Neither of these units is presently used for any substantial source of generation, and neither has been used for approximately 2 years. These units would need some rehabilitation to operate reliably as intermediate generation (generation that is not used continuously but is used for more than peak loads). These units are listed as having system capacity but are not operating at this time. Marbo is rated at 16-MW capacity and Yigo at 22-MW capacity. Marbo is permitted to operate 2,640 hours per year and Yigo for 4,280 hours per year. The construction date for Marbo is unknown and Yigo was constructed in 1993.

Barrigada

The Dededo generation facilities and Radio Barrigada facility are in the central area of Guam but physically separated. Radio Barrigada is a DoD asset and not available to the GPA system because its use is dedicated to a specific mission. At the time the power study was done, the Dededo facilities, except Dededo CT #2 as shown in Table 3.1-1 are available to provide generation capacity as needed by the generation system. The Dededo generation facility comprises two CTs and four diesel units. The diesel generators have 10-MW rated capacity (four 2.5-MW units). Dededo CT #1 was constructed in 1992 with a capacity of 23-MW, CT #2 in 1994 with a capacity of 22-MW, and the diesel units were installed in 1972.

Piti/Nimitz Hill

The Cabras and Piti generation units provide the majority of energy produced by the IWPS. These facilities have been upgraded and are some of the most reliable facilities for efficiently generating power for the system. The Cabras and Piti units are used primarily as base-load generation units except when out of service for maintenance or failures. The majority of the fuel storage for the IWPS is also located in the harbor area because of its proximity to generation units and the supply ship unloading facilities. These units are permitted as base-load generation units and can operate continuously, year round. Table 3.1-3 shows their ratings and status.

Table 3.1-3. Cabras and Piti Generation Units

GPA Steam	*Rated Capacity (MW)*	*Actual Capacity (MW)*	*Year Constructed*
Cabras #1	66	66	1974
Cabras #2	66	66	1975
Cabras #3	39.3	39	1996
Cabras #4	39.3	39	1996
Enron #8 (Piti)	44.2	44	1999
Enron #9 (Piti)	44.2	44	1999

Legend: GPA = Guam Power Authority; MW = megawatts.

Manengon is a diesel unit located in the hills toward the eastern side of Guam. It is permitted for only 4,640 hours per year. It is rated at 10.6-MW capacity with an actual capacity of 8.8-MW.

Naval Base Guam

The Orote Power Plant, a DoD asset, is operational and can connect to the IWPS and generate power to the system. The facility has not generated substantial power to the IWPS for years and is not currently suitable to provide extended operation support to the IWPS. The site would need system upgrades to provide the necessary reliability to the system and consideration for expanded fuel storage and would need modification to the existing air permit for the site. The Orote facility is not permitted for extended operation and must notify the GEPA before scheduled operation. These permit restrictions would need to change to allow more flexibility and more hours of operation should the Orote facility be used to provide substantial generation capacity to the IWPS. The Orote Power Plant has a rated and actual capacity of 19.8-MW. The date of construction was not determined.

The Naval Hospital facility is dedicated to the hospital and would not provide capacity/supply to the IWPS.

3.1.1.3 South

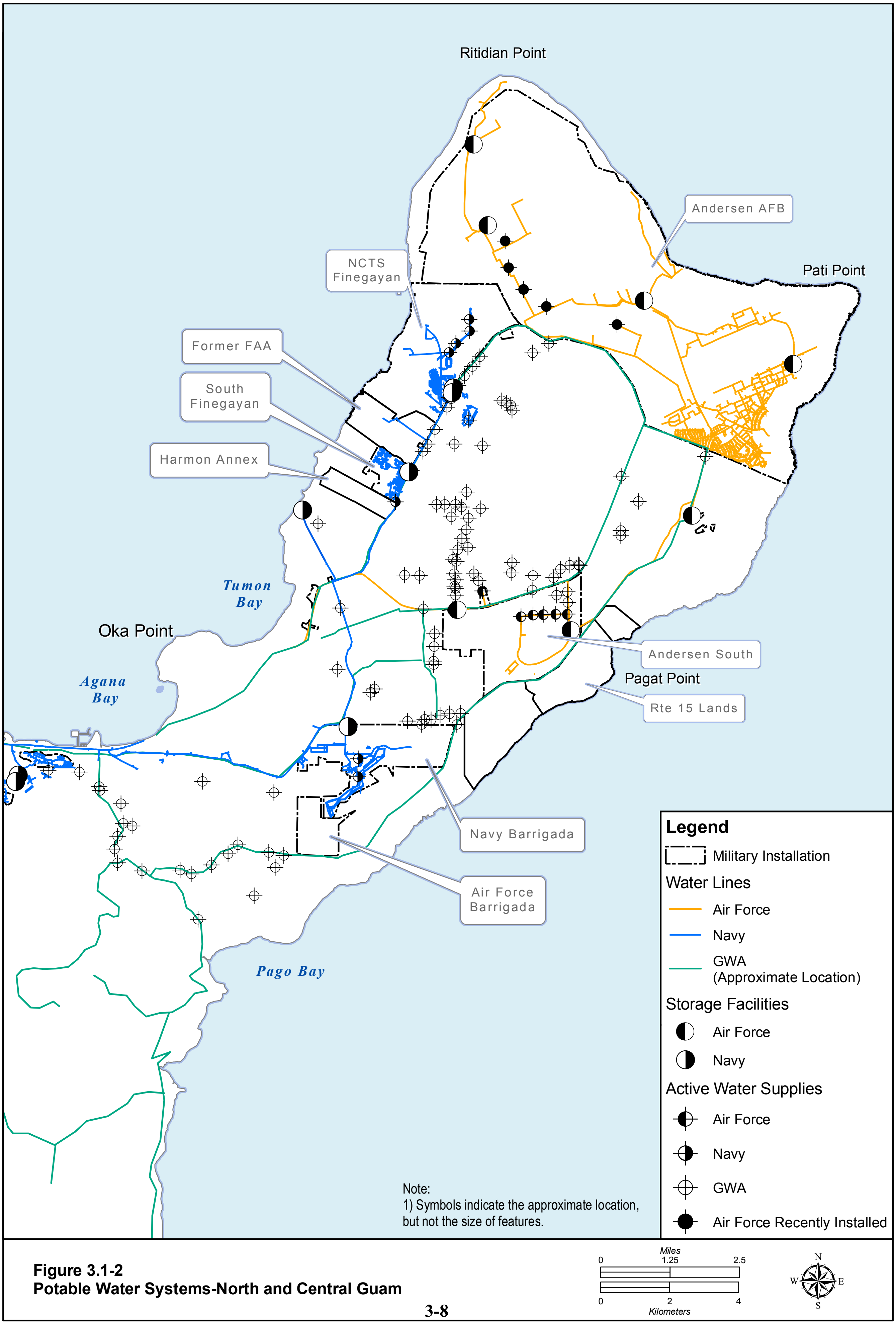
At the Naval Munitions Site, generation capacity at Talofofo (2 – 5 MW units) and Mount Tenjo (6 – 4.88 MW units) are GPA assets and can provide power generation support to the IWPS. Talofofo units are permitted for operation at 2320 hours per year for each unit or 4640 hours per year for one unit. Talofofo has a rated capacity of 8.8-MW and an actual capacity of 4-MW. The Mount Tenjo facility has a rated capacity of 26.4-MW and an actual capacity of 24-MW. Both units were constructed in 1994.

3.1.2 Potable Water

The ROI for potable water includes the Andersen AFB and Navy water systems, which would be directly affected by the proposed military relocation and the GWA water system. It could also be indirectly affected by increased water demands associated with the construction workforce and induced population growth. Locations of the components of the primary water system that are associated with each of these water systems (i.e., active and planned water supplies, storage facilities, and water distribution lines) are presented in Figure 3.1-2 and Figure 3.1-3. The three water systems are described in detail in Section 3.1.2.2.

3.1.2.1 GWA Data and Information Used to Assess Impacts

Since repairs and upgrades to the GWA owned and operated water system are not part of DoD’s proposed action, DoD relied on readily available data about the GWA water system from GWA’s public website, from communications with GWA, and from comments received during the public comment period, particularly those from GWA, GEPA and USEPA Region 9. In accordance with CEQ regulations (i.e. 40 CFR §1502.22), incomplete or unavailable information exists for the GWA water system that hinders a comprehensive understanding and assessment of the functionality, capacity, and condition of these off-base water systems. As such, it is not possible to fully assess or determine the full significance of the indirect and cumulative impacts of the proposed action associated with induced civilian population growth and workforce housing and logistics. Because these off-base systems are owned and operated by GWA and regulated by USEPA and GEPA, DoD has no authority to conduct required surveys and assessments. Therefore, the DoD must rely on the data provided by these entities outlining the current conditions of these systems. Further, efforts to accurately survey, map, and assess the conditions of these systems would involve exorbitant costs and necessitate extensive excavation of neighborhoods and key roadways. Based on the best available information, which is presented in the following sections, DoD has identified, to the extent possible, the indirect and cumulative impacts of the proposed action associated with induced civilian population growth and workforce housing and logistics and their significance. In making these assessments, DoD employed industry and regulatory standards to make its determinations of impacts and significance.



Note:
1) Symbols indicate the approximate location, but not the size of features.

Figure 3.1-2
Potable Water Systems-North and Central Guam

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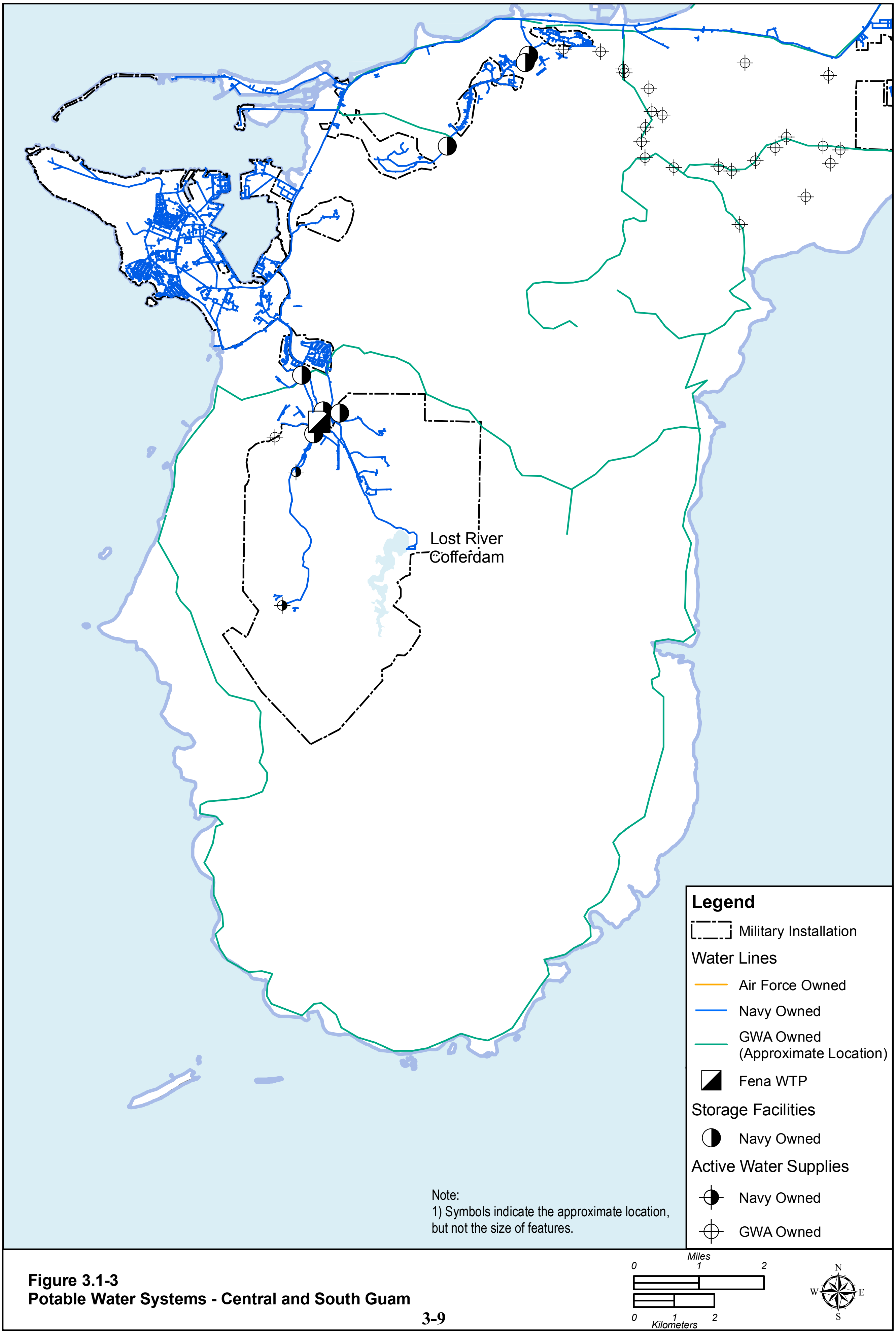

Note:
1) Symbols indicate the approximate location, but not the size of features.

Figure 3.1-3
Potable Water Systems - Central and South Guam

3.1.2.2 Water Systems

Andersen AFB Water System

Andersen AFB gets its water from Andersen Northwest Field and Andersen South. It includes an off-base water supply; disinfection, storage, and transmission system; and an on-base water distribution system. The off-base water supply and transmission system includes nine water production wells, two booster pump stations, three storage tanks, chlorination facilities, one fluoridation facility, and approximately 80,000 feet (ft) (24,400 meters [m]) of water lines. The existing on-base water distribution system includes a pump station, three storage tanks, and approximately 700,000 ft (213,350 m) of water lines.

Water is currently supplied to Andersen AFB from seven of the nine off -base water production wells. The remaining two wells are inactive. An additional five wells were constructed on the Andersen Northwest Field. Water supplied from the off-base production wells is stored, disinfected, fluoridated, and then pumped to the main base. The off-base production wells draw water from the Northern Guam Lens Aquifer (NGLA). Unaccounted for Water (UFW) for the system is estimated at 50%, compared to a recognized acceptable rate of 15% or less.

Navy Water System

The Navy water system services NCTS Finegayan, South Finegayan, Navy Barrigada, Nimitz Hill, the Naval Hospital, the Naval Munitions Site, and the Naval Base Guam. The existing Navy water system is an islandwide system extending from the Navy Reservoir in southern Guam to NCTS Finegayan near the northern tip of Guam. Water for the system is supplied primarily from the Fena Water Treatment Plant (WTP). Water from the treatment plant is transmitted to storage tanks designed to serve different service zones and transfer water to other DoD lands across Guam. Most of the transmission lines from the storage tanks to the distribution systems are 24-inch (in) (61-centimeter [cm]) pipelines. The Navy water transmission system is interconnected with the GWA water distribution system at numerous locations throughout the island, allowing the transfer of water between the two systems. This interconnection allows the Navy system to supply water to GWA and it provides emergency service capability. Under a 1991 Memorandum of Understanding (MOU) with the Government of Guam (GovGuam), the Navy system provides up to 4 million gallons per day (MGd) (15 million liters per day [57 MLd]) to the GWA water system. Transmission lines connecting the Navy water system and the Andersen AFB system also exist, but they are presently out of service. UFW for the system is estimated at 25%, compared to a recognized acceptable rate of 15% or less.

Primary water supply sources for the Navy's islandwide water system are located in the southern region of Guam and include Almagosa Springs, Bona Springs, and the Fena Reservoir surface water impoundment. Water from these three sources is treated at the Fena WTP and is transmitted through a network of storage tanks, transmission lines, and booster pump stations. Groundwater wells are the primary source of potable water at Finegayan and Navy Barrigada. A brief description of the water supply sources in each of the Navy service areas is provided below.

- At NCTS Finegayan and South Finegayan, water is supplied primarily by on-site groundwater wells. If necessary, water can also be supplied by interconnections with the GWA system or the Navy's islandwide system.
- At Navy Barrigada, water is supplied primarily by groundwater wells. As a backup, the water storage system is connected to the Navy's islandwide system.

- At the Naval Hospital, water can be provided from either the Navy islandwide water system or from on-site groundwater wells. Currently, one well is operational.
- At the Naval Base Guam and other Navy areas south of the Piti Power Plant, potable water is supplied entirely by the Fena WTP.

GWA Water System

The baseline condition of the GWA water system is described in GWA's Water Resources Master Plan (WRMP) (GWA 2007b). The overall condition of the water system's equipment is identified as poor in the WRMP with substantial corrosion in the entire infrastructure. According to the WRMP, the water system has a 50% UFW rate compared to a recognized acceptable rate of 15% or less. Problems with the GWA infrastructure result from the effects of natural disasters, poor maintenance, and vandalism. According to the WRMP, the water system infrastructure does not meet the basic flow and pressure requirements for all customers and does not consistently comply with regulatory requirements. The unreliable drinking-water distribution system has historically resulted in frequent bacterial contamination from sewage spills, causing "boil water" notices to be sent to residents. Maintenance to improve the system has been conducted since the water system was assessed in 2005. GWA planned improvements to the distribution system are principally to improve the continuity of the water supply. Improvements include a corrosion control program, pipe and equipment replacement, distribution system improvements, improvements to the GWA Northern Public Water System's raw-water transmission line, and filtration compliance for groundwater under the direct influence of surface water.

Transmission lines are used to make bulk water transfers. Distribution lines are used to deliver water from the transmission lines to customers. It is assumed that the primary challenge in delivering water to GWA customers while maintaining adequate supplies and pressures throughout the system is difficult because the existing transmission lines are incapable of serving current requirements. According to the 2007 WRMP, there are deficiencies in the transmission system:

> "GWA's water system network does not have a separate water transmission system that conveys water from supply to storage and then from storage through the distribution system. Transmission and distribution are combined into a common network for GWA's system. Water supply sources feed the same pipes to which service connections are made. The installed system provides severe challenges to GWA in attempting to meet the SDWA disinfection requirements because some of the customer connections are adjacent to the wells, or the inception point for disinfection. This shortcoming is one of the high priority CIP projects that must be pursued by GWA to enhance the integrity and reliability of its potable water system."

The GWA water system consists of three public water systems known as the Northern, Central, and Southern Public Water Systems, serving the respective areas of Guam with some overlaps.

The GWA Northern Public Water System is the largest system serving all public areas in the north and central parts of the island south of Andersen AFB and serves a population of about 146,050. This system consists of 119 groundwater wells, 14 storage facilities (11 in use), and 10 booster pump stations (nine in use). The GWA Northern Public Water System is important to the Marine Corps relocation because of its proximity to the relocation areas and because the system is supplied primarily by the same aquifer that serves the DoD systems.

The GWA Central Public Water System consists of one spring, eight storage facilities (five in use), and nine booster stations (six in use). The main source of water for this system is the Navy water system. Water is purchased through 54 metered interconnections, of which 15 are reported to be inactive. Water from the Northern Public Water System can also be fed via water mains to the Central Public Water System.

The GWA Southern Public Water System supplies the southern and southeastern parts of Guam. It consists of two groundwater wells, four springs, 14 storage facilities, 16 booster stations (14 in use), and the Guam WTP.

GWA Compliance Background

Between 1997 and 2002, GWA had financial losses of nearly $80M (GWA 2003) partly because of bad debt write-offs and the lack of rate increases. In 2001, a $9M judgment was made against GWA for failure to pay for water delivery from the Navy. Also at this time, GWA carried $12M debt to GPA and $3.5M to a private vendor (Business Wire 2009).

The United States Department of Justice (DOJ) filed a civil suit against GWA and GovGuam in December 2002 for failure to comply with the Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA) (U.S. versus Guam Waterworks Authority, Civil No. 02-00035 (D. Guam)). A Stipulated Order (SO) for Preliminary Relief was entered in June 2003. Subsequently, the parties agreed to two modifications of the SO. The second amended SO was entered by the court in October 2006. The parties viewed the SO as the most appropriate way to require GWA to immediately implement short-term projects to address GWA's compliance with the CWA and SDWA. The SO indicates that the parties contemplate entering into a further stipulation to address additional compliance issues after GWA's completion of the initial planning measures set out in the SO. The SO requires the following actions:

- Ensure USEPA oversight of plans and other submittals relating to the SO.
- Reorganize staff and hire qualified personnel as general manager, financial officers, engineers, etc.
- Develop a WRMP.
- Develop a plan to ensure that optimal chlorine levels are maintained at chlorination points and throughout the distribution system.
- Ensure that there are adequate chlorine supplies on Guam.
- Implement a project to upgrade the groundwater chlorination system.
- Develop and implement a potable-water leak detection and response program.
- Develop and implement a water-meter improvement program.
- Develop an inventory of operation and maintenance parts and ensure that parts are available.
- Develop and implement an emergency response plan.
- Develop and implement a preventive maintenance program.
- Comply with specific financial and reporting requirements.

As described in the 2003 independent audit of GWA finances, compliance with the SO was estimated to cost $225M. GWA intended to meet this obligation initially by borrowing approximately $160M. Between 2003 and 2005, GWA sold bonds, settled litigation related to the authority's debt, and received rate relief. Improvements have reduced labor and operating costs by more than 20% (Business Wire 2009).

As part of compliance with the SO, GWA submitted the Guam WRMP in 2007. The GWA WRMP lists the following goals:

- Institute sound asset management and capital planning.
- Develop foundation for sound management, operations and maintenance, and financial planning.
- Engage the customer and achieve the appropriate level of service.
- Achieve long-term resource sustainability.
- Establish a road map for full regulatory compliance.

The plan includes descriptions of the components of the water system, the water budget, a water-loss control program, a water conservation program, development of and results from hydraulic modeling of the water system, an assessment of facility conditions, a comprehensive Capital Improvements Program (CIP) for the water system.

The WRMP states that substantial improvements to the distribution system are of primary concern. The improvements were developed to enhance service levels; satisfy storage, flow, and pressure requirements to meet fire protection criteria; and reduce the high level of water loss from the system. The full cost of the CIP for water through 2025 was estimated by GWA to be $550M. GWA developed the following projects to support the needed improvements:

- Convert Ugum WTP to a 4.0-MGd (15.1-MLd) membrane filtration facility.
- Modify the Ugum WTP intake at the diversion in the Ugum River.
- Construct transmission lines.
- Supervise control and data acquisition improvements.
- Develop a corrosion control program.
- Acquire raw-water storage land and construct storage tank at Ugum WTP.

Progress has been made in implementing the WRMP projects. Many major capital projects have been completed. GWA has invested more than $80M in capital improvements since 2003 (Business Wire 2009). As documented in the Quarterly SO Compliance Progress Report No. 20, some of the important improvements to the GWA water system are as follows:

- Leak detection plan — GWA has a crew dedicated to leak detection. In Fiscal Year 2007 alone, more than 11,000 leaks were repaired.
- Residual disinfection — Implementation of an Interim Disinfection Residual Level Monitoring Program is in progress with biweekly sampling at 93 selected locations, daily sampling at disinfected wells, and twice-daily sampling at high-risk wells.
- Chlorine supply — GWA has contracted with a vendor to always have an adequate supply of chlorine on the island.
- Water meter improvement program — GWA has replaced more than 97% of the industrial meters and 68% of the residential meters.
- Emergency response plan — The plan has been prepared and partially integrated into the Guam Emergency Response Plan.
- Preventative maintenance program — A plan has been prepared. GWA has implemented a computerized maintenance management system.
- Transmission line projects — Construction of the Sinajana Transmission Line project is under way.

The progress made by GWA in providing a reliable water system has been recognized by USEPA. As stated in the USEPA Progress Report 2006: Pacific Southwest Region (USEPA 2006):

> "Last year, however, improvements to the island's drinking water and wastewater treatment systems, along with EPA oversight of the GWA, resulted in the safest drinking water Guam has experienced in decades. The GWA improved its management by hiring a new chief engineer on loan from EPA, and increasing the number of certified operators at its wastewater treatment plant. Better generators, pumps, and motors were installed; the disinfection system was improved."

However, the existing off-base GWA water system infrastructure is still today considered by USEPA Region 9 to be substandard in terms of water quantity, water quality, and overall condition and reliability of the supply and distribution system. In its comments on the Draft Environmental Impact Statement (EIS), USEPA Region 9 stated that Guam's environmental and public health problems exceed those of most U.S. communities, with its population experiencing boil water notices, sewage spills, exposures to waterborne disease, and illegal dumping that can result in public health problems associated with its water supply. Over the last seven years, USEPA has demanded stipulated penalties for violations of the SO.

There have been some improvements to the potable water system as a result of the SO. In recent years, boil water notices have declined and water quality has improved. Still, the GWA potable water system continues to suffer from decades of deferred maintenance and minimal capital improvements due to a severe lack of funding, and from limits set by the Guam Consolidated Commission for Utilities (CCU) on the amount of user fees that can be charged to GWA customers. Not all of GWA's water supply wells and surface water reservoirs are fully operational, resulting in a shortage of available water. Water shortage, coupled with the use of the distribution system as the primary means of transferring water around the island (and a lack of a distinct transmission system) results in an inability to meet basic flow and pressure standards required of public water suppliers. These conditions can result in intermittent loss of water or water pressure to some customers, and microbiological and other contaminants entering the distribution system, potentially resulting in illness. In addition to basic flow and pressure problems, GWA's water distribution system (i.e., water storage tanks, treatment systems, and distribution piping and pumps) are not fully functional due to corrosion, leakage, age, and vandalism. These conditions can potentially lead to unreliable water supply, poor water quality, and ultimately to illness.

As a condition of the SO, GWA also prepared a 5-year plan for fiscal years 2009 to 2013 for financing the continued operation, maintenance, and repair of GWA's systems. The CIP estimates that the cost for expanding the system to accommodate the induced population from the military relocation would total \$200M for 16 wells plus storage facilities and transmission lines. Absent of other funding sources, the CIP would need to be financed through surplus system revenues, grants, and loans (GWA 2008b, Business Wire 2009). Additionally, substantial rate increase relief would be expected to recoup GWA expenditures.

A recent USEPA Region 9 draft report assessed GWA's management and financial capability to operate, maintain, and improve its systems as outlined in its Master Plan, CIP, and other management tools. USEPA Region 9 looked at not only GWA's ability to obtain funding through bonds and user fees, but also looked at GWA's ability to execute its CIP in the event that funding is obtained. USEPA also looked at GWA's ability to operate and maintain these new systems in the future. The draft USEPA report recommended the following:

- Changes in planning, prioritization, and costing of capital improvement projects
- Changes to address staffing shortages
- Changes in construction management
- New strategies for financing operations and capital improvement projects
- Improvements in funding preventative maintenance programs

The report concluded that the projects that are identified in the GWA CIP could not be validated, either in terms of project scope or cost. The report also concluded that GWA is not equipped with the staff or adequate resources to effectively execute the construction projects even if funding becomes available.

A follow-on draft report was prepared by USEPA Region 9 which reassessed the cost basis for the GWA CIP and provided a conceptual cost estimate that included a list of revised projects and adjusted cost estimates. This conceptual cost estimate concluded that the costs identified in the GWA CIP fall short of what is actually needed in terms of funding both projects to address current non-compliance with the SDWA and the CWA, and projects to meet off-base indirect demands related to the military relocation.

DoD, USEPA Region 9, GEPA, GovGuam, and other federal agencies acknowledge that GWA cannot fund all of the needed repairs and upgrades identified in the CIP through GWA financing and rate increases alone. Additionally, as discussed in Chapter 1, Section 1.2.2.3, GovGuam and GWA's limited ability to assume more debt is problematic. The USEPA Region 9 conceptual cost estimate identified the need for $1.3 billion (B) in funding to implement necessary water and wastewater infrastructure improvements that must be accomplished in the first five years to accommodate the military relocation. DoD also acknowledges the desire by many for DoD to fund improvements to these systems. DoD is working to secure funding for utilities systems that support the Marine Corps relocation from the Government of Japan (GoJ). The Realignment Roadmap Agreement between the U.S. Government and the GoJ states that Japan would provide funding to develop facilities and infrastructure on Guam to enable the Marine Corps relocation. Currently, the GoJ is considering financing water and wastewater improvement projects. This potential financing is described in the Executive Summary of Volume 1.

Additionally, the Council on Environmental Quality (CEQ) is facilitating interagency discussions with DoD and appropriate federal agencies to identify specific utilities projects, the level of funding, and source of funding for necessary water and wastewater infrastructure improvements that must be accomplished in the first five years of the military relocation effort to bridge the gap between GoJ funding and remaining Guam utilities infrastructure needs. Lastly, the Economic Adjustment Committee (EAC) is evaluating overall Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD relocation for water and wastewater improvements that may not be provided by GoJ financing. The USEPA Region 9 conceptual cost estimate is being used as a planning tool by all parties to frame the scope of funding that may be necessary to execute the CIP and assist in identifying funding sources and strategies on Guam's behalf.

3.1.2.3 DoD Water Storage Facilities

The capacity of the existing DoD storage facilities is listed in Table 3.1-4. The storage capacity by area is shown in Table 3.1-5.

Table 3.1-4. DoD Water Storage Facilities

Tank	*Capacity (Gallons)*	*Capacity (MGd)*	*Owner*	*Location*	*Type*
Water Storage Tank	150,000	0.15	Andersen AFB	Andersen AFB, Northwest Field	At-grade, steel
Water Storage Tank	150,000	0.15	Andersen AFB	Andersen AFB, Northwest Field	Steel
Storage Tank No. 2	250,000	0.25	Andersen AFB	Andersen South	Partially buried concrete
Storage Tank No. 4	480,000	0.48	Andersen AFB	Andersen South	Partially buried concrete
Santa Rosa Storage Tank	2,000,000	2.00	Andersen AFB	Andersen South	Buried concrete
Facility 19008	250,000	0.25	Andersen AFB	Andersen AFB	Ground level concrete
NCTS South, Finegayan South	250,000	0.25	Navy	South Finegayan	Elevated
NCTS Elevated	250,000	0.25	Navy	North Finegayan	Elevated
NCTS Ground (inoperative in 2005)	200,000	0.20	Navy	North Finegayan	Ground
Barrigada	3,000,000	3.00	Navy	NCTMS Barrigada	Reinforced concrete covered by earth
Naval Hospital	1,000,000	1.00	Navy	Naval Hospital	Reinforced concrete covered by earth
Nimitz Hill	1,000,000	1.00	Navy	Nimitz Hill	Reinforced concrete covered by earth
Adelup	3,000,000	3.00	Navy	Naval Hospital/ Nimitz Hill	Reinforced concrete covered by earth
Maanot	500,000	0.50	Navy	Apra Harbor/ Naval Munitions	Reinforced concrete at grade
Tupo	5,000,000	5.00	Navy	Apra Harbor/ Naval Munitions	Reinforced concrete covered by earth
Naval Magazine	700,000	0.70	Navy	Apra Harbor/ Naval Munitions	Reinforced concrete covered by earth
Apra Heights Tank	5,000,000	5.00	Navy	Apra Harbor/ Naval Munitions	Reinforced concrete covered by earth

Legend: AFB = Air Force Base; MGd = million gallons per day; NCTMS = Naval Computer and Telecommunications Main Station; NCTS = Naval Computer and Telecommunications Station.
Source: NAVFAC Pacific 2010e.

Table 3.1-5. Department of Defense Water Storage Capacity by Area

Area	*Total Existing Capacity (MG)*
South Finegayan	0.25
North Finegayan	0.25
Andersen Northwest Field	0.30
Andersen Main Base	0.25
Andersen South	2.73
Apra Harbor/Naval Munitions	11.2
Barrigada	3.00
Navy Hospital/Nimitz Hill	5.00
Total	**23**

Legend: MG = million gallons.
Source: NAVFAC Pacific 2010e.

3.1.3 Wastewater

The ROI for wastewater includes wastewater systems on Guam that would be directly or indirectly affected by the proposed military relocation. Wastewater generated from newly constructed DoD facilities and from visiting ships could result in direct impacts to GWA-owned and Navy-owned wastewater treatment plants (WWTPs). The potential direct impacts are discussed in this section. Wastewater generated from construction workforce housing and from the induced civilian population that is expected to come to Guam in response to the military relocation could also result in indirect impacts to GWA- and Navy-owned WWTPs, and are also discussed in this section.

As discussed in Chapter 2, Section 2.3, wastewater flows from existing DoD facilities are presently treated at the GWA Northern District WWTP (NDWWTP), the GWA Hagatna WWTP, and the Navy Apra Harbor WWTP. Figure 3.1-4 shows the locations of these WWTPs.

For new wastewater flows resulting from the military relocation, the NDWWTP would receive the new wastewater treatment demand from the direct DoD populations that are associated with the military relocation from all facilities, with the exception of wastewater from visiting ships at Naval Station Apra Harbor. Therefore, these DoD sources of wastewater would result in direct impacts to the NDWWTP and the Navy Apra Harbor WWTP.

As discussed in Chapter 2, Section 2.3.3, it was assumed that two-thirds of the construction workforce would reside in northern Guam and one-third in central Guam. Plus, per the socioeconomic analysis, the induced civilian population growth was assumed to be 38% in northern Guam, 43% in central Guam, and 19% in southern Guam. Based on these assumptions, it is expected that the NDWWTP and Hagatna WWTP would treat the vast majority of the increased wastewater flows that would be generated by the temporary construction workforce and the induced civilian population. There are other GWA wastewater treatment facilities on Guam that are not in the proposed military relocation area, but would be indirectly affected by the relocation-induced civilian population growth. These facilities are located among scattered communities in south Guam and include Agat–Santa Rita WWTP, Baza Gardens WWTP, Umatac Merizo WWTP, and Inarajan WWTP.

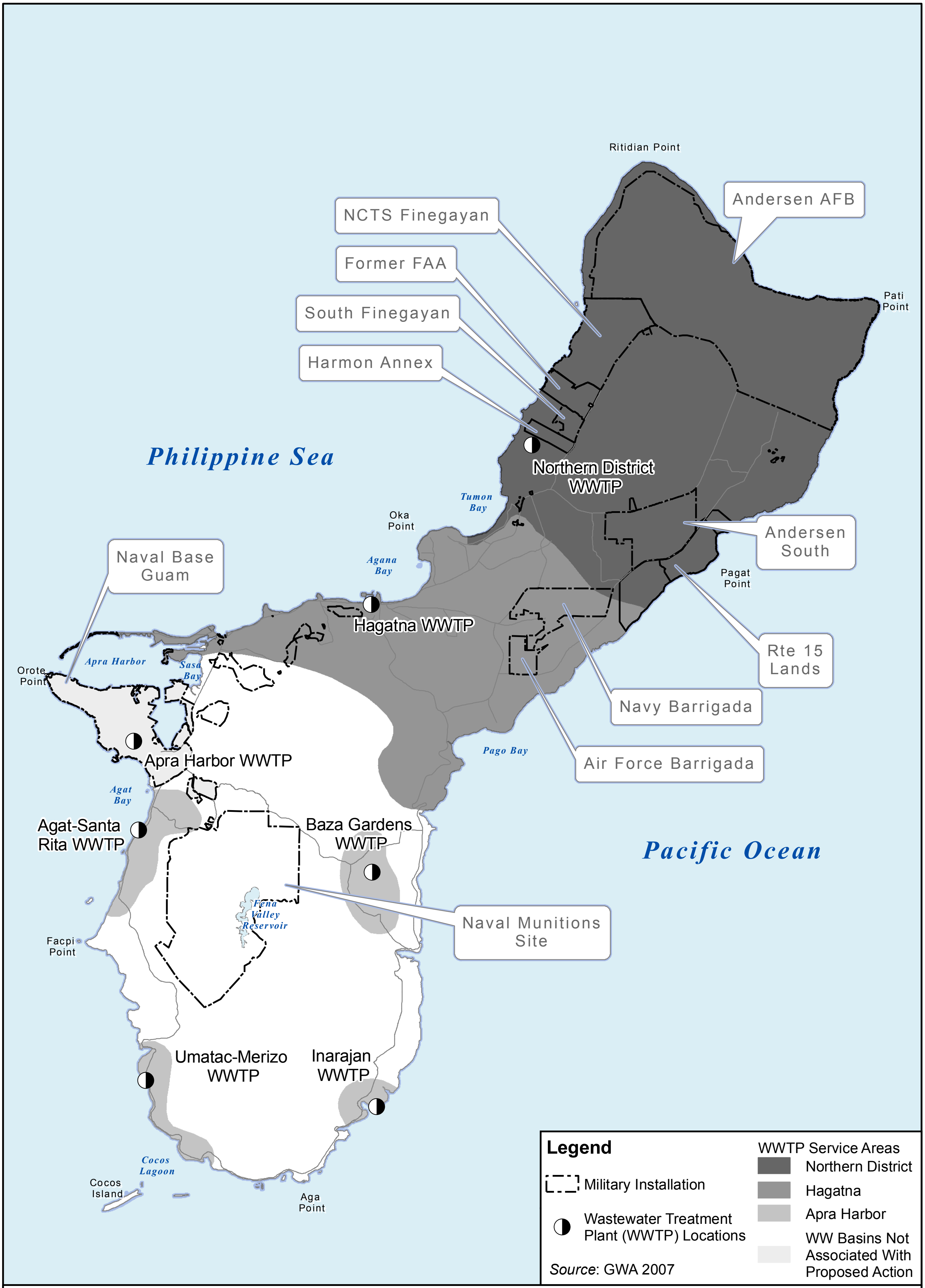

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Figure 3.1-4
Wastewater Treatment Plant Locations and Service Areas, Guam

3.1.3.1 GWA Data and Information Used to Assess Impacts

Since repairs and upgrades to the NDWWTP are part of DoD's proposed action, DoD obtained information about the GWA owned and operated NDWWTP and its collection system from GWA and USEPA Region 9, and funded and conducted several studies to determine the condition of the NDWWTP, what repairs and upgrades would be necessary to bring the plant into compliance and accommodate the increased wastewater demand from the military relocation, and what direct effects the effluent from the plant would have on the environment. These studies are described in this section and in Section 3.2.4.

For all other GWA wastewater treatment plants and their collection systems that are not part of the proposed action, DoD relied on readily available information from GWA's public website, from communications with GWA, and from comments received during the public comment period, particularly those from GWA, GEPA and USEPA Region 9. In accordance with CEQ regulations (i.e. 40 CFR §1502.22), incomplete or unavailable information exists for these other wastewater treatment plants and collection systems that hinders a comprehensive understanding and assessment of their functionality, capacity, and condition. As such, it is not possible to fully assess or determine the full significance of the indirect and cumulative impacts of the proposed action associated with induced civilian population growth and workforce housing and logistics. Because these off-base systems are owned and operated by GWA and regulated by USEPA and GEPA, DoD has no authority to conduct required surveys and assessments. Therefore, the DoD must rely on the information provided by these entities outlining the current conditions of these systems. Further, efforts to accurately survey, map, and assess the conditions of these systems would involve exorbitant costs and necessitate extensive excavation of neighborhoods and key roadways. Based on the best available information, which is presented in the following sections, DoD has identified, to the extent possible, the indirect and cumulative impacts of the proposed action associated with induced civilian population growth and workforce housing and logistics and their significance. In making these assessments, DoD employed industry and regulatory standards to make its determinations of impacts and significance.

3.1.3.2 GWA Compliance Background

GWAs wastewater infrastructure (treatment plants, collection piping, and pump stations) have a legacy of deferred maintenance and minimal capital improvements that have caused the systems to slowly deteriorate over the years. This deterioration, coupled with natural disasters, such as typhoons and flooding, has resulted in frequent sewage spills at pump stations and collection piping, collapse of collection piping, and failure of treatment plant equipment. Severe lack of funding, particularly due to limits set by the Guam Consolidated Commission for Utilities (CCU) on the amount of user fees that can be charged to GWA, have severely limited GWA's ability to adequately maintain and update their wastewater treatment system. As a result, GWA has experienced frequent violations of its National Pollutant Discharge Elimination System (NPDES) permit conditions, including inability to adequately treat wastewater and exceedances of the allowed pollutant levels in plant discharges. GWA now must replace much of its infrastructure to meet current demands and address its CWA violations. Concurrently, GWA must plan for, fund, and execute upgrades to meet new demands that are indirectly brought about by the proposed military relocation.

On April 4, 1997, USEPA Region 9 issued a tentative decision to deny the reissuance of the CWA Section 301(h) secondary treatment variance to GWA for the NDWWTP and the Hagatna WWTP because, in USEPA Region 9's view, GWA failed to provide sufficient information that both plants meet 301(h) secondary treatment variance criteria. Central to this tentative denial was USEPA's assessment that the Hagatna WWTP and NDWWTP had failed to meet minimum standards for primary treatment, including adequate removal of pollutants, violations of pollutant discharge permit limits, and inability to demonstrate that plant discharges are not impacting water quality or the environment.

GWA provided additional information to USEPA Region 9 in an attempt to address the inadequacies cited in the USEPA Region 9 tentative secondary treatment variance denial. However, lack of maintenance on GWAs aging plants due to resource shortfalls continued to limit GWA's progress in improving their wastewater treatment program and bringing the plants into permit compliance.

The United States Department of Justice (DOJ) filed a civil suit against GWA and GovGuam in December 2002 for failure to comply with the Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA) (U.S. versus Guam Waterworks Authority, Civil No. 02-00035 (D. Guam)). A Stipulated Order (SO) for Preliminary Relief was entered in June 2003. Subsequently, the parties agreed to two modifications of the SO. The second amended SO was entered by the court in October 2006. The parties viewed the SO as the most appropriate way to require GWA to immediately implement short-term projects to address GWA's compliance with the CWA and SDWA. The SO indicates that the parties contemplate entering into a further stipulation to address additional compliance issues after GWA's completion of the initial planning measures set out in the SO. The SO requires the following steps:

- Construct a new ocean outfall at the Hagatna WWTP by January 1, 2008.
- Construct a new ocean outfall at the NDWWTP by January 1, 2009.
- Implement corrective actions to restore primary treatment to the original design operational capacity at the Hagatna WWTP and the NDWWTP by March 2, 2007.
- Implement corrective actions to restore operational capacity at the Hagatna Main Sewage Pump Station (SPS) by March 2, 2007.
- Implement corrective actions to stop overflows of raw sewage from the Hagatna Main SPS, including development of an implementation schedule.
- Assess the Chaot Wastewater Pump Station, sewer collection, and conveyance system, including development of an implementation schedule.
- Renovate and/or expand Agat, Baza Gardens, and Umatac-Merizo WWTPs.

In 2003, an independent audit of GWA finances was conducted, which estimated the cost for GWA to comply with the SO at $225M. GWA intended to meet this obligation initially by borrowing approximately $160M. Between 2003 and 2005, GWA sold bonds, settled litigation related to the authority's debt, and received rate relief. Improvements have reduced labor and operating costs by over 20% (Business Wire 2009).

As part of compliance with the SO, GWA submitted the WRMP in 2007. The WRMP lists the following goals:

- Institute sound asset management and capital planning.
- Develop a foundation for sound management, operations, and maintenance and financial planning.
- Engage the customer and achieve the appropriate level of service.
- Achieve long-term resource sustainability.
- Establish a road map for full regulatory compliance.

The plan includes descriptions of the components of the wastewater treatment facilities, wastewater collection system, an estimation of current and future wastewater flows, wastewater collection system hydraulic modeling development and results, sewer hook-up program for unsewered properties (e.g., septic tanks), a facility conditions assessment, and a comprehensive wastewater system CIP. The Guam WRMP did not consider future wastewater flow increases that could result from the military relocation on Guam. However, the flow estimates for the NDWWTP were overestimated by roughly double due to installed faulty flow measuring devices at GWA's treatment plants.

The primary objectives of the CIP are to improve the operations of the system and to meet the requirements of SO. The total capital needs through 2025 are substantial at an estimated $900M in 2007 dollars. The full cost of the CIP for wastewater identified by the Guam WRMP is estimated at $335M. The GWA developed the following projects to support the needed improvements on Guam:

- Improve the Hagatna WWTP by adding another primary clarifier for redundancy, new solids screens, improved grit removal, and an effluent pump station.
- Construct a new primary clarifier for future flows and system reliability at the NDWWTP.
- Repair existing sludge handling facilities and construct a new sludge digester and new sludge dewatering facilities for centralized sludge treatment and system reliability at the NDWWTP.
- Upgrade sewer capacities at the Hagatna WWTP and the NDWWTP.
- Provide sewer hook-ups for the Hagatna WWTP and the NDWWTP unsewered properties (e.g., septic tanks). This project has been identified as a high priority effort because septic systems have the potential to impact Guam's sole source aquifer used for drinking water (the NGLA).
- Upgrade Agat-Santa Rita and Baza Gardens WWTPs.
- Upgrade and expand Inarajan WWTP.
- Improve Umatac Merizo WWTP.
- Implement a wastewater collection system recurring inspection program.
- Implement a wastewater collection system replacement and rehabilitation program.
- Install system control and data acquisition improvements. These systems collect data at the treatment plants and at pump stations and transmit the data to a central control facility.

Some progress has been made on the projects outlined in the WRMP. Many major capital projects have been completed. GWA has invested over $80M in capital improvements since 2003 (Business Wire 2009). As documented in the Quarterly SO Compliance Progress Report No. 20, some of the significant improvements to the GWA wastewater system include:

- Sewer hook-up revolving fund – This program provides financial assistance to low-income owners of septic systems that are slated for hookup to the GWA sewer collection system. GWA developed a program and the funds are now available for public use.
- Hagatna WWTP ocean outfall – The outfall was put into service on January 23, 2009.
- NDWWTP ocean outfall – The outfall was put into service on December 15, 2008.
- Assessment of the Chaot Wastewater Pump Station and sewer collection and conveyance system – GWA submitted an Engineering Assessment, and constructed a new pump station and new sewer lines that are currently in service.
- Agana Main SPS renovation – GWA completed repairs and the pump station was put back online and worked as the headworks for the Hagatna WWTP.
- Hagatna WWTP renovation – GWA completed plant refurbishment and put it into full service on March 29, 2007.
- NDWWTP renovation – GWA has completed portions of the treatment plant refurbishment.

In 2007, GWA established a private/public partnership with Veolia LLC to operate all six GWA WWTPs and implement a preventative maintenance program for the treatment plants and conveyance systems. The Veolia LLC preventative maintenance program was to provide a stop-gap measure to target maximum potential adverse effect equipment in the wastewater system, but according to a recent draft USEPA Region 9 report, this program has been severely limited due to lack of funding on the part of GWA.

In July 2008, citing an overburdened wastewater system, GWA imposed a development moratorium for areas in central Guam, and issued a request for proposals in order to use a private partner for upgrading the wastewater collection system in central Guam. The project was estimated to cost from $30M to $40M, and expected to bid in September 2009 and complete in two years. It would increase the capacity of central Guam sewer collection system and help improve treatment efficiency at the Hagatna WWTP. The moratorium was lifted in April 2009, prior to the repairs being made to the system. In March 2009, GWA began accepting bid packages from contractors to make the necessary repairs, but this work has yet to begin. GWA is currently seeking bond funds to pay for the moratorium improvements.

NPDES Discharge Monitoring Reports for the Hagatna WWTP and the NDWWTP from January to June 2009 indicate that despite progress made by GWA to bring their facilities into compliance, the plants continue to violate their permit conditions. Discharges from the Hagatna WWTP and the NDWWTP do not consistently meet the minimum primary treatment standards for removal of organic matter and suspended solids. Both plants also experience routine violations of their effluent discharge pollutant limits, including exceedance of the NDWWTP maximum flow (6 MGd) and exceedances of their suspended solids and biological oxygen demand (BOD) limits.

Between 1998 and 2001, GWA revised their permit renewal application and submitted additional information to USEPA Region 9 to request a continuance of their 301(h) secondary treatment variance. These submittals included information related to installing new extended ocean outfalls for the Hagatna WWTP and the NDWWTP. The new outfalls were put into service in December 2008 and the Hagatna WWTP was refurbished to restore its original designed capacity in 2007.

In January 2009, USEPA Region 9, upon review of this new information from GWA, again issued a tentative decision to deny the 301 (h) secondary treatment variance, followed by a final decision to deny the variance on September 30, 2009. This final variance denial decision by USEPA Region 9 effectively requires GWA to install full secondary treatment at both the Hagatna WWTP and the NDWWTP. In its final decision, USEPA Region 9 stated that they denied the variance because the treatment plants did not meet several CWA 301(h) criteria, including the following:

- The discharge does not meet the mandatory minimum standard of primary treatment.
- GWA has not demonstrated that the discharge would attain or maintain water quality to allow recreational activities in and on the water.
- GWA has not demonstrated that the discharge would attain or maintain water quality to allow protection and propagation of a balanced indigenous population of shellfish, fish, and wildlife.
- The applicant's monitoring data are insufficient to demonstrate compliance with Guam's water quality standards.
- The applicant has not developed a program to control toxic pollutants from nonindustrial sources.

GWA anticipates major system refurbishment (e.g., primary clarification, grit chamber, chlorine contact tank, drying beds, etc.) that is currently underway at the NDWWTP would improve the plant performance to meet its existing compliance requirements at current flows. GWA has also suggested that completion of the on-going development moratorium project that limits development and new sewer connection, and mitigation of septage discharge at the Hagatna WWTP, would improve plant performance and lead to permit compliance.

As a condition of the SO, GWA prepared a 5-year plan for financing the continued operation, maintenance, and repair of GWA's systems for fiscal years 2009 to 2013. GWA estimated the cost for expanding its system to accommodate the military relocation induced population to cost a total of $200M, including $66M for wastewater infrastructure improvements. Absent of other funding sources, the CIP would be financed through surplus system revenues, grants, and loans (GWA 2008b, Business Wire 2009).

A recent USEPA Region 9 draft report assessed GWA's management and financial capability to operate, maintain, and improve its systems as outlined in its WRMP, CIP, and other management tools. USEPA Region 9 looked at not only GWA's ability to obtain funding through bonds and user fees, but also looked at GWA's ability to execute its CIP if funding is obtained. USEPA also looked at GWA's ability to operate and maintain these new systems in the future. The draft USEPA report recommended the following:

- Changes in planning, prioritization, and costing of capital improvement projects
- Changes to address staffing shortages
- Changes in construction management
- New strategies for financing operations and capital improvement projects
- Improvements in funding preventative maintenance programs

The report concluded that the projects that are identified in the GWA CIP could not be validated, either in terms of project scope or cost. The report also concluded that GWA is not equipped with the staff or adequate resources to effectively execute the construction projects even if funding were available.

A follow-on draft report was prepared by USEPA Region 9 which reassessed the cost basis for the GWA CIP and provided a conceptual cost estimate that included a list of revised projects and adjusted cost estimates. This conceptual cost estimate concluded that the costs identified in the GWA CIP fall short of what is actually needed in terms of funding both projects to address current non-compliance with the CWA and SDWA, and projects to meet off base indirect demands related to the military relocation.

Comments submitted by USEPA Region 9, GWA and GEPA on the Draft EIS reiterate the substandard condition of GWA WWTPs and collection systems, ongoing non-compliance with environmental regulations and permits, chronic shortfalls in funding repairs and capital improvement projects, and increased demands that would be placed on the GWA wastewater system as a result of the indirect population growth on Guam. DoD, USEPA Region 9, GEPA, GovGuam, and other federal agencies acknowledge that GWA cannot fund all of the needed repairs and upgrades identified in the CIP through GWA financing and rate increases alone. Additionally, as discussed in Chapter 1, Section 1.2.2.3, GovGuam and GWA's limited ability to assume more debt is problematic. The USEPA Region 9 conceptual cost estimate identified the need for $1.3B in funding to implement necessary water and wastewater infrastructure improvements that must be accomplished in the first five years to accommodate the military relocation. DoD also acknowledges the desire by many for DoD to fund improvements to these systems. DoD is working to secure funding for utilities systems that support the Marine Corps relocation from the GoJ. The Realignment Roadmap Agreement between the U.S. Government and the GoJ states that Japan would provide funding to develop facilities and infrastructure on Guam to enable the

Marine Corps relocation. Currently, the GoJ is considering financing water and wastewater improvement projects. This potential funding is described in the Executive Summary of Volume 1.

Additionally, the CEQ is facilitating interagency discussions with DoD and appropriate federal agencies to identify specific utilities projects, the level of funding, and source of funding for necessary water and wastewater infrastructure improvements that must be accomplished in the first five years of the military relocation effort to bridge the gap between GoJ funding and remaining Guam utilities infrastructure needs. Lastly, the EAC is evaluating overall Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD relocation for water and wastewater improvements that may not be provided by GoJ financing. The conceptual cost estimate would be used as a planning tool by all parties to frame the scope of funding that may be necessary to execute the CIP, and assist in identifying funding sources and strategies on behalf of Guam.

For wastewater, DoD is engaged in ongoing consultation with GWA, USEPA Region 9, and GEPA concerning wastewater requirements from the Guam military relocation. The purpose of this consultation is to achieve a common understanding of the requirements for treatment plant upgrades that address not only the military relocation on Guam, but also those associated with the recent 301(h) secondary treatment variance denial. All parties are committed to working collaboratively to develop solutions that meet everyone’s needs. While these discussions may ultimately lead to specific timeframes for treatment plant upgrades, they are not expected to result in significantly different facilities than those represented in the wastewater alternatives in this Final EIS.

The wastewater flows presented in Section 2.3.3 include expected wastewater flows that are part of normal civilian population growth during the military relocation years between 2010 and 2019. After 2019, normal civilian population growth on Guam would continue, thereby generating additional wastewater flows from the population in the out years. As part of DoD’s ongoing consultation with GWA, GEPA and USEPA Region 9, GWA has indicated that if DoD selects an alternative in this Final EIS that involves using the NDWWTP, long-range wastewater flows at the NDWWTP beyond the military relocation (e.g., beyond the year 2019) would quickly exceed the 12 MGd (45.4 MLd) design capacity of the plant. DoD would work with GWA to establish the required future capacity need at the NDWWTP, which would be in excess of the current design capacity of 12 MGd (45.4 MLd). As mentioned previously in Section 2.3.2, USEPA Region 9 recently issued a decision to deny GWA’s secondary treatment 301(h) variance, effectively requiring GWA to upgrade its NDWWTP and Hagatna WWTP to secondary treatment. Therefore, the treatment plant upgrades needed to meet this new requirement should be planned to ultimately provide the capacity needed at the NDWWTP to meet long-term considerations.

The analysis of wastewater presented in this Final EIS centers on the impacts related to the proposed action that are the responsibility of the DoD to assess; namely the military relocation on Guam during the years 2010 to 2019. Thus, the Final EIS presents a detailed analysis of potential environmental impacts as they relate to the military relocation and total projected wastewater flow of 12 MGd (45.4 MLd) that could be treated at the NDWWTP during this timeframe. This Final EIS also includes an analysis of potential environmental impacts that may be associated with upgrades to the NDWWTP, but only as they relate to expected changes in water quality that could result from increased pollutant loads in the plant discharge from a larger demand (see Section 3.2.4.2 for this analysis). Nevertheless, treatment plant upgrades to expand the NDWWTP would not result in different treatment processes than those represented in the wastewater alternatives in this Final EIS, but would simply be sized larger. It is expected that GWA would conduct additional engineering analysis to properly size the NDWWTP to accommodate the projected future required capacity.

3.1.3.3 Northern District Wastewater Treatment Plant

The NDWWTP is a primary treatment plant that is owned by GWA and operated by Veolia under contract with GWA. The treatment plant treats wastewater flows from civilian populations and DoD installations that are located in northern Guam. Andersen AFB, NCTS Finegayan, and South Finegayan contribute wastewater flows to the NDWWTP.

The existing wastewater collection system on DoD property in northern Guam has been maintained by Andersen AFB and is being transferred to Naval Facilities Engineering Command (NAVFAC) Marianas. It consists of a network of gravity sewers, four major pump stations, and force mains located on the south side of the airfield. Two small SPSs collect wastewater generated from facilities located on the north side of the airfield and convey the wastewater via force main to the gravity collection system on the south side of the airfield. The system also collects wastewater generated by the industrial and residential areas on the base. The average daily wastewater flow generated by Andersen AFB in 2008 was approximately 0.36 MGd (1.36 MLd). Wastewater generated by Andersen AFB is discharged off base into the GWA sewage collection system at a sewer manhole located near the Andersen AFB main gate. The wastewater is then conveyed to the NDWWTP for treatment.

The existing wastewater collection system at NCTS Finegayan is primarily gravity sewer system consisting of two main trunk lines. The wastewater is conveyed to the NDWWTP via a GWA wastewater collection system. At South Finegayan, the wastewater collection system is a gravity sewer system connected to the GWA wastewater collection system. The wastewater is conveyed to the NDWWTP. The current average wastewater flow generated by NCTS Finegayan is approximately 0.14 MGd (0.53 MLd).

Existing facilities and infrastructure at Andersen South in northern Guam have been abandoned and are not being maintained. The original sewers in the area flowed to a sewer pumping station located along the northern edge of the site. Sewage from the pump station discharged to a GWA sewer collection system and was subsequently conveyed to the NDWWTP for treatment. Neither the sewer lines nor the sewer pumping station are in operating condition and Andersen South contributes no wastewater flows to the NDWWTP.

The NDWWTP is a primary treatment plant designed for an average daily flow of 12.0 MGd (45.4 MLd) and a peak capacity of 27 MGd (102 MLd). Communication with GWA has indicated that the current average daily flow to the NDWWTP from civilian and military sources is approximately 5.7 MGd (22 MLd) (GWA 2008c).

The NDWWTP discharges treated effluent through a newly constructed 34-in (86-cm) outfall into the Philippine Sea approximately 2,100 ft (640 m) offshore at a depth of approximately 150 ft (45 m) near Tanguisson Point. Section 301(h) of the CWA allows the USEPA administrator to waive secondary treatment requirements for publicly owned treatment works that discharge into marine waters under a modified NPDES permit. The NDWWTP had received a 301(h) modified permit (NPDES Permit No. GU0020141) that expired on June 30, 1991. This permit authorized the NDWWTP to discharge a maximum daily flow of 6 MGd (23 MLd). Because GWA failed to provide sufficient information for USEPA to conclude that the GWA permit renewal application met the 301(h) criteria, USEPA issued a tentative decision on April 4, 1997, denying the reissuance of a 301(h) variance to GWA. GWA revised the permit renewal applications by installing a new extended outfall and planned CIP for restoring the treatment capacity of the plant. The new outfall was put into service in December 2008. Based on plant operation performance and data provided by GWA on the actual discharged wastewater qualities, USEPA denied GWA's application for a renewed variance from full secondary treatment in September 30, 2009, and concluded that the CWA 301(h) criteria have not been met at the NDWWTP.

3.1.3.4 Hagatna Wastewater Treatment Plant

The Hagatna WWTP is a primary treatment plant that is owned and operated by GWA. The treatment plant treats wastewater flows from civilian populations and DoD lands that are located in central Guam. Navy and Air Force Barrigada, the Naval Hospital, and DoD lands located in the Nimitz Hill area contribute wastewater flows to the Hagatna WWTP.

The existing Navy Barrigada sewer system consists of approximately 13,000 ft (3,962 m) of gravity sewer lines ranging from 6 to 8 in (15 to 20 cm) in diameter. The existing Naval Hospital sewer system consists of approximately 14,800 ft (4,511 m) of gravity sewer lines ranging from 6 to 10 in (15 to 25 cm) in diameter. The Nimitz Hill sewer system consists of gravity sewer lines ranging from 6 to 15 in (15 to 38 cm) in diameter. There is one lift station for the Naval Hospital sewer system and one lift station for the Nimitz Hill sewer system. Sanitary sewer systems servicing Barrigada, the Naval Hospital, and Nimitz Hill are connected to GWA interceptor sewers. Wastewater generated at these DoD lands is conveyed to GWA's Hagatna WWTP for treatment. The current average wastewater flow generated by Navy Barrigada is approximately 0.34 MGd (1.28 MLd).

The central Guam sewer collection system that conveys sewage to the Hagatna WWTP has several capacity limitations, which create periodic overflows during high flow conditions. To alleviate the problem, in 2008 GWA issued a moratorium that limits development and new sewer connection, which was lifted in early 2009 based on planned improvements to the collection system to address sewer line capacity issues.

The Hagatna WWTP is designed to treat an average daily flow of 12.0 MGd (45.4 MLd) and a peak flow of 21 MGd (79 MLd). Communication with GWA has indicated that the current average daily flow to the Hagatna WWTP from civilian and military sources is approximately 4.4 MGd (16.6 MLd) (GWA 2008d). Treated effluent is discharged from the WWTP through a newly constructed 42-in (107-cm) outfall into Agana Bay approximately 2,178 ft (664 m) offshore at a depth of approximately 275 ft (84 m) under a USEPA-administrated permit (NPDES Permit No. GU0020087) that expired on June 30, 1991. The permit contained a 301(h) variance allowing for less than secondary treatment and authorized the Hagatna WWTP to discharge a maximum daily flow of 12 MGd (45.4 MLd). GWA failed to provide sufficient information for USEPA to conclude that the GWA permit renewal applications for both plants met the 301(h) criteria. As a result, USEPA issued a tentative decision on April 4, 1997, denying the reissuance of a 301(h) variance to GWA. GWA revised the permit renewal applications by installing a new extended outfall for each of these two plants. The new outfall for the Hagatna WWTP was put into service in December 2008 and the Hagatna WWTP was refurbished to restore its original designed capacity in 2007. Based on plant operation performance and data provided by GWA on the actual discharged wastewater qualities, USEPA denied GWA's application for a renewed variance from full secondary treatment on September 30, 2009 and concluded that the CWA 301(h) criteria have not been met at the Hagatna WWTP.

3.1.3.5 Apra Harbor WWTP

The Apra Harbor wastewater collection and treatment system is Navy owned and operated. It is a secondary treatment plant that services Naval facilities at the Naval Base Guam, Apra Heights, and Naval Munitions Site. The Apra Harbor wastewater system also collects and treats discharged sludge flow from the Navy's Fena WTP. The existing wastewater collection system includes nine major sewer trunk or subtrunk lines consisting of about 35 miles (56 kilometers) of sewer lines ranging from 6 in to 36 in (15 to 91 cm) in diameter, and 24 sewer pumping/lift stations.

The Apra Harbor WWTP is designed to treat an average daily flow of 4.3 MGd (16 MLd) and a peak flow of 9 MGd (34 MLd). The treatment plant currently receives an average daily flow of approximately 2.9 MGd (11 MLd). Treated effluent is discharged through an ocean outfall into Tipalao Bay under NPDES Permit No. GU0110019. This permit authorizes the Apra Harbor WWTP to discharge an average monthly flow of 4.3 MGd (16.3 MLd). The Navy-owned outfall also discharges effluent from the GWA Agat-Santa Rita WWTP (NPDES Permit No. GU0020222).

The Apra Harbor WWTP experiences violations of its permit effluent limits for aluminum, copper, nickel, total residual chlorine, BOD, and total suspended solids (TSS). Compliance problems have been attributed to poor treatment efficiencies, infiltration/inflow (I/I), which results in an increase of stormwater to the plant that reduces removal efficiencies, metals sources originating from Fena WTP sludge supernatent, and metals from shipboard wastewater. The Navy conducted a study to investigate compliance strategies for the Apra Harbor WWTP (DoD 2010). Concurrently, there are three military construction projects that will address many of the compliance issues associated with the plant. A military construction project at the Fena WTP will eliminate all of the aluminum and some of the copper sources to the Apra Harbor WWTP by rerouting this supernatent to the headworks of the Fena WTP. BOD and TSS removal efficiencies will be improved as part of two other military construction projects that will make repairs/upgrades to the sewage collection system and reduce I/I, and a project to restore the Apra Harbor WWTP.

The Navy's compliance strategy study addresses copper and nickel sources in shipboard wastewater treated at the Apra Harbor WWTP. Ship sewer piping is composed primarily of copper and nickel, and the salt water used for shipboard toilet flushing is highly corrosive to these pipes. This condition results in higher levels of these metals than would typically be found in land-based domestic sewage. The report does not recommend upgrades to the Apra Harbor WWTP because in order to meet the copper limits in the current discharge permit, the wastewater would have to be treated to below drinking water standards using a tertiary treatment process. This upgrade would be too costly and may still not attain the levels required by the permit. Pretreatment of ship sewage was also considered but ruled out because it is not feasible. The primary plan to address the metals non-compliance is to apply for a mixing zone, which has been suggested by both GEPA and USEPA Region 9 federal facilities inspectors. Having a mixing zone calculated into the permit limits would eliminate the non-compliance and the issue of metals in visiting ships sewage. A Federal Facilities Compliance Agreement (FFCA) is being negotiated by the Navy and USEPA Region 9 to globally address all NPDES wastewater compliance issues. The FFCA is expected to address the metals non-compliance through, (1) expansion of the internal base instructions into a certificate of discharge control program applied to all copper and nickel sources, and (2) a site-specific receiving water monitoring program to support the application for a mixing zone. The significant copper and nickel sources are not limited to the ships sanitary wastewaters but include the treated oily waters from the Bilge and Oily Wastewater Treatment System (BOWTS) units and fuel tank farm. There are numerous other smaller sources as well.

The Apra Harbor WWTP is a Navy-Owned Treatment Works as defined by USEPA regulations. Navy-Owned Treatment Works are not required by regulation to have pretreatment programs, which control industrial discharges to sewage plants, and may require pretreatment of these waste streams. However, Navy and Marine Corp facilities typically institute base-wide pretreatment programs to control industrial wastes sources. For the Apra Harbor WWTP, an internal Navy pretreatment program is in place under Instruction 5090.3A "Joint Region Marianas Wastewater Pollutant Minimization and Pretreatment Program" dated January 14, 2003. This instruction covers basic pretreatment requirements, such as a requirement for grease traps for base galley and restaurants wastewater, oil/water separators for industrial wastewaters containing petroleum products, and Navy Bilge and Oily Water Treatment Systems for shipboard bilge and oily wastes that employ advance oil/water separation and air flotation for oil removal.

Sewage sludge from the Apra Harbor WWTP is disposed of in the Apra Harbor landfill and does not have a history of elevated metals. Sewage from visiting ships associated with the military relocation is not expected to contribute significant quantities of metals in this sludge to impact the ultimate disposal of the sludge.

Plant and collection system capacities at the Apra Harbor treatment plant are sufficient to treat the new wastewater flows from the transient ship population. Military construction projects that are underway will further improve collection system and plant treatment performance. There are no significant impacts anticipated to collection or treatment plant capacities or efficiencies from the sewage resulting from visiting ships associated with the military relocation. Additionally, these new sewage flows are not expected to contribute significant quantities of metals in sludge at the plant that would impact the ultimate disposal of the sludge. Therefore, there would be no significant impact related to handling and disposal of sludge at the Apra Harbor WWTP.

3.1.3.6 Agat-Santa Rita Wastewater Treatment Plant

The Agat – Santa Rita WWTP was built in 1972 and is a secondary treatment plant. The plant was designed to treat 0.75 MGd (2.8 MLd) with a peak flow of 2.2 MGd (8.3 MLd). The plant effluent is discharged through a combined ocean outfall shared with the Navy's Apra Harbor WWTP, which discharges to Tipalao Bay in the Philippines Sea.

According to the GWA WRMP (GWA 2007b) and two reports issued by the GWA operations and maintenance contractor, Veolia Water Guam, LLC (GWA 2007a, 2008a), the Agat-Santa Rita WWTP is out of compliance with its NPDES permit requirements 100% of the time. This non-compliance is because the majority of the treatment processes and equipment are non-functioning, bypassed, or are not operating within their design parameters due to lack of maintenance or deterioration. Another major factor in the plant's non-compliance is that the average wastewater flow to the plant is well in excess of the plant design. Unless the plant capacity is upgraded significantly or flow to this plant diverted, permit violations will continue. There is a possibility that a new plant at Tupaleo will be constructed; however, this possibility depends on the result of an investigative study, which is currently underway by GWA.

The excess flow results in insufficient hydraulic retention time for this type of process. Unless the plant capacity is upgraded significantly by GWA as recommended in the WRMP, or flow to this plant diverted, these parameters will continue to fail the full suite of NPDES requirements. Furthermore, chemical dosing may be required to meet the BOD and TSS requirements as well as precipitate out the heavy metals. Disinfection would be required to meet the Fecal Coliform and Enterococci requirements. There is a possibility that a new plant at Tupaleo will be constructed by GWA; however, this possibility depends on the result of an investigative study, which is currently underway.

The plant would likely receive wastewater from the indirect induced population resulting from the military relocation, but is not expected to receive wastewater from the indirect construction workforce. The small increase of wastewater flows to the Agat-Santa Rita WWTP from the induced population would not contribute significantly impacts to the plant in terms of plant performance and capacity.

3.1.3.7 Baza Gardens Wastewater Treatment Plant

The Baza Gardens WWTP was commissioned in 1975 and is a secondary treatment plant. The plant is designed to treat 0.60 MGd (2.3 MLd). The plant effluent is discharged through a rock infiltrator to the Togcha River, which in turn flows into the Pacific Ocean. Because the treated effluent flows indirectly to a water body (river), the NPDES permit requirements are extremely strict.

Several effluent discharge parameters of the plant are not in compliance with the NPDES permit. This plant has strict compliance requirements, particularly for phosphorus and nitrogen due to its indirect discharge into the Togcha River. These requirements are based on federal secondary discharge standards and Guam Water Quality Standards. The water quality standards for stream discharge, primarily nutrient (phosphorous and nitrogen) limits, could not be achieved with the existing treatment plant design.

According to the GWA WRMP (GWA 2007b) and two reports issued by the GWA operations and maintenance contractor, Veolia Water Guam, LLC (GWA 2007a, 2008a), the plant is in a state of disrepair, with much of its treatment processes bypassed. Pollutant removal is reduced due to the state of disrepair resulting in poor effluent quality.

The plant would likely receive wastewater from the indirect induced population resulting from the military relocation, but is not expected to receive wastewater from the indirect construction workforce. The small increase of wastewater flows to the Baza Gardens WWTP from the induced population would not contribute significantly impacts to the plant in terms of plant performance and capacity.

3.1.3.8 Umatac-Merizo Wastewater Treatment Plant

The Umatac – Merizo WWTP was commissioned in 1981 and is a secondary treatment plant designed to treat 0.39 MGd (1.5 MLd). This plant is an aerated facultative lagoon with effluent discharging into a percolation field. A recirculation pond is used to store excess effluent when the percolation fields are saturated allowing recirculation of the effluent back into the percolation fields. According to USEPA Region 9, only the excess wastewater that does not percolate or evaporate is directed to the recirculation pond. If the percolation fields are too saturated, the treated wastewater would discharge from the recirculation pond to the Toguan River. Failure of the effluent pump station is the primary reason for a bypass of the percolation fields. Although this is an emergency bypass of the percolation fields, wastewater has received a level of treatment from the aerated lagoon. However, any wastewater discharged from the aerated lagoon directly to the Toguan River has received minimal treatment and is not authorized.

According to the GWA WRMP (GWA 2007b) and two reports issued by the GWA operations and maintenance contractor, Veolia Water Guam, LLC (GWA 2007a, 2008a), the plant is in a state of disrepair, with its headworks, one aerator of the lagoon, effluent pump station, recirculation pump station and recirculation pond is non-functioning or bypassed. Pollutant removal and effluent quality is typically poor.

The plant would likely receive wastewater from the indirect induced population resulting from the military relocation, but is not expected to receive wastewater from the indirect construction workforce. The small increase of wastewater flows to the plant from the induced population would not contribute significantly impacts to the plant in terms of plant performance and capacity.

3.1.3.9 Inarajan Wastewater Treatment Plant

The Inarajan WWTP was commissioned in 1989 and the plant is designed to treat 0.19 MGd (0.72 MLd). It is a secondary WWTP employing an aerobic lagoon system with effluent percolation basins. Major unit processes include four aerated lagoons, three percolation basins, and six sludge drying beds. As effluent disposal occurs through percolation and not to surface water, there is no NPDES permit required at this site. According to USEPA Region 9, this plant would receive leachate from the future Layon Landfill.

According to the GWA WRMP (GWA 2007b) and two reports issued by the GWA operations and maintenance contractor, Veolia Water Guam, LLC (GWA 2007a, 2008a), the plant is in a state of disrepair, with its decant well, sludge drying beds, effluent weir box, and dosing chamber non-functioning or bypassed. Pollutant removal and effluent quality is typically poor.

The plant would likely receive wastewater from the indirect induced population resulting from the military relocation, but is not expected to receive wastewater from the indirect construction workforce. The small increase of wastewater flows to the plant from the induced population would not contribute significantly impacts to the plant in terms of plant performance and capacity.

3.1.3.10 GWA Wastewater Collection System

The GWA wastewater collection system is divided into six major service areas named by the wastewater treatment system to which the wastewater is conveyed. The largest service areas are located in the northern and central parts of the island and bring wastewater to the NDWWTP, the Hagatna WWTP, and the Agat-Santa Rita WWTP. This collection system consists of approximately:

- 1,420,000 ft (432,800 m) of gravity sewer pipes
- 73 force mains that total 240,000 ft (73,100 m)
- 6 siphons that total 650 ft (200 m)
- 3 ocean outfalls that currently total 6,000 ft (1,800 m)
- 6,480 manholes

The largest component of the collection system is the gravity sewer system. These pipes vary in size from 4- to 48-in (10- to 120-cm) diameter with the majority of pipes being 8-in (20-cm). A diverse range of pipe material exists for the current system including concrete, asbestos cement, iron, plastic, and clay.

There are currently 73 operational lift stations under the direct control of GWA. These lift stations distribute the sewage from the collection system to the WWTPs via a force main network. Most lift stations have a capacity between 30 gallons per minute (gpm) (114 lpm) to 10,000 gpm (37,850 lpm), while the three largest stations' capacities range from 21,200 gpm (80,242 lpm) to 32,000 gpm (121,120 lpm).

The islandwide sewage collection system has undergone some inspections to identify where there are pipe breaks, leaks, or blockages. These have been primarily focused in the northern and central sections of Guam where these collection systems convey wastewater to the larger GWA WWTPs (i.e., to the NDWWTP and the Hagatna WWTP). Limited camera and visual inspections of manholes and pipe inverts, and records indicating where there are routine sewage overflows, are primarily used to identify problem areas in the system. Although some problem areas have undergone hydraulic modeling, there is no comprehensive hydraulic modeling of the system that could be used to indicate where system limitations and failures are located, and where maintenance and/or replacement of piping and pump stations should be targeted.

GWA and their operations and maintenance contractor, Veolia Guam LLC, have both indicated that comprehensive visual inspections of the collection systems and a hydraulic model is a critical first step in assessing the condition of the collection system. Undertaking these first steps would allow critical prioritization of maintenance and upgrades to the system, and necessary validation of the GWA CIP for the collection systems. Until this is done, DoD can only assess indirect impacts qualitatively at a macro level.

The sewage collection system to the Hagatna WWTP experiences problems with reduced capacity, leaks, line breaks, and pump station outages, all resulting in sewage overflows onto the ground and into storm drains. In response, GWA issued a sewer connection moratorium in July 2008 to limit development in this portion of Guam to allow for time to address limitations in sewers. The proposed moratorium improvements included:

- Mamajanao Pump Station Upgrades — Upgrade the Mamajanao SPS and extend the force main down the hill to a new terminating manhole. This change would control the flows from the pumping station, increase efficiency, and eliminate the overflow at the terminating manhole.
- Route 16 Pump Station Operational Measures — Increase risk management measures at the Route 16 SPS and eliminate the flow split to the south.
- Route 4 Wastewater Piping — Pipe the flow from the New Chaot SPS directly to the Agana WWTP, saving pumping costs at Agana Main SPS. This change would remove the flow from the Marine Corps drive interceptor, which would help reduce surcharging and flooding of the sewers downstream of the diversion and increase the available capacity of the Agana Main SPS.
- Tamuning Pump Station — Build a new SPS in Tamuning that would collect all of the flow from Marine Corps drive to the northeast of the intersection with Gov Carlos Camacho Road and from Tamuning (Oka Point) and pump it directly to the Agana WWTP.
- Agana Main Pump Station — Upgrade the Agana Main SPS by installing new pumps that are more efficient and better suited to the revised flow conditions.

The moratorium was lifted in April 2009, prior to the repairs being made to the system. In March 2009, GWA began accepting bid packages from contractors to make the necessary repairs, but this work has yet to begin as of the writing of this Final EIS. GWA is currently seeking bond funds to pay for the moratorium improvements.

The condition of the GWA's collection systems are assumed to be relatively poor based on information contained in the GWA WRMP and two Veolia Water Guam reports (GWA 2007a, 2008a). Therefore, additional wastewater flows from the induced population may result in more frequent overflows from the collection system. If improvements are not made to the collection systems, then sewage overflows would continue to occur and may become more frequent as increased flows from the indirect civilian population growth overwhelm the already inadequate system. These indirect impacts would likely cause further degradation to water resources with increased potential for sewage spills. Depending on the location of overflows, a sewage spill has the potential to impact surface water, groundwater (including the NGLA), nearshore water, and wetlands. Therefore, indirect impacts from construction workforce and induced population wastewater would result in significant impacts to water resources due to increased potential for sewage overflows from the collection systems.

3.1.4 Solid Waste

The ROI for solid waste includes solid waste facilities on Guam that would be directly or indirectly affected by the proposed military relocation. Solid waste from DoD lands is presently disposed of at the Navy Sanitary Landfill or the Air Force landfill at Andersen AFB. Solid waste from non-DoD sources is disposed of at GovGuam facilities. Descriptions of the existing Navy, Air Force, and GovGuam solid waste facilities are provided in the following sections.

3.1.4.1 Navy Sanitary Landfill

The Navy owns and operates one landfill facility on Guam. The Navy Sanitary Landfill is located in the southeastern portion of the Apra Harbor Navy Base. The landfill is bounded to the northeast, east, and south by wetlands; to the northwest by Perimeter Road; and to the west by Shoreline Drive (Figure 3.1-5). A natural vegetative barrier blocks views of the landfill from the nearby Navy Exchange and Commissary.

The landfill has been in use since 1965 and is currently operated by the Base Operations Support contractor, DZSP-21, under the terms of the Solid Waste Management Permit, No. 95-1009, dated December 26, 1995. This permit allows for the disposal of MSW. The Navy has applied for a permit renewal from GEPA. The landfill also operates a hardfill for Construction and Demolition (C&D) disposal in accordance with a permit application that has been approved based on Rules and Regulations for GEPA Solid Waste Disposal.

The Navy Sanitary Landfill serves all DoD lands and their tenants, including the following:

- Apra Harbor Navy Base
- Naval Munitions Site
- Nimitz Hill
- Naval Hospital
- NCTS Barrigada
- South Finegayan
- NCTS Finegayan

The landfill also receives solid waste from Navy ships berthed in Apra Harbor. Naval activities on Guam generate approximately 21 tons (19 metric tons) of solid waste daily that is placed into the landfill. The Navy Sanitary Landfill currently accepts waste from housing, commercial, and industrial activities; hardfill from on base construction projects; sterilized waste from ships; asbestos waste; and wastewater treatment sludge that has passed the paint filter test.

The Navy Sanitary Landfill is unlined and occupies an area of approximately 60 acres (ac) (24 hectare [ha]). An active waste placement area is in the southeast corner of the landfill site. Other designated and segregated areas of the landfill site include areas for asbestos, hardfill (e.g., concrete), wood waste, and sewage sludge. Soils and backfill are used for daily cover. Concrete debris is often used for berming and landfill road maintenance.

Foreign refuse from ships is collected in special containers strategically located along the ship’s berthing. Containers are picked up and transported to a specifically designed facility using steam for the decontamination and sterilization of ship waste. After the sterilization process, a compactor truck transports the waste to the Navy Sanitary Landfill for disposal.

Asbestos-containing material is accepted at the landfill on a case-by-case basis. The landfill is notified at least 24 hours before the receipt of incoming asbestos waste. After receiving approval for disposal, certified asbestos contractors arrive with the asbestos waste prebagged and sealed in compliance with GEPA and Navy regulations. The landfill operator inspects the seals of the asbestos bags for their integrity and accompanies the asbestos contractor to the designated area for disposing of asbestos. The landfill operator places the waste and covers it with at least 6 in (15 cm) of soil cover in compliance with its permit. Sludge from the Navy’s WWTP is accepted at the Navy Sanitary Landfill if the sludge passes a paint-filter test, demonstrating that the sludge meets landfill requirements of no free liquid.

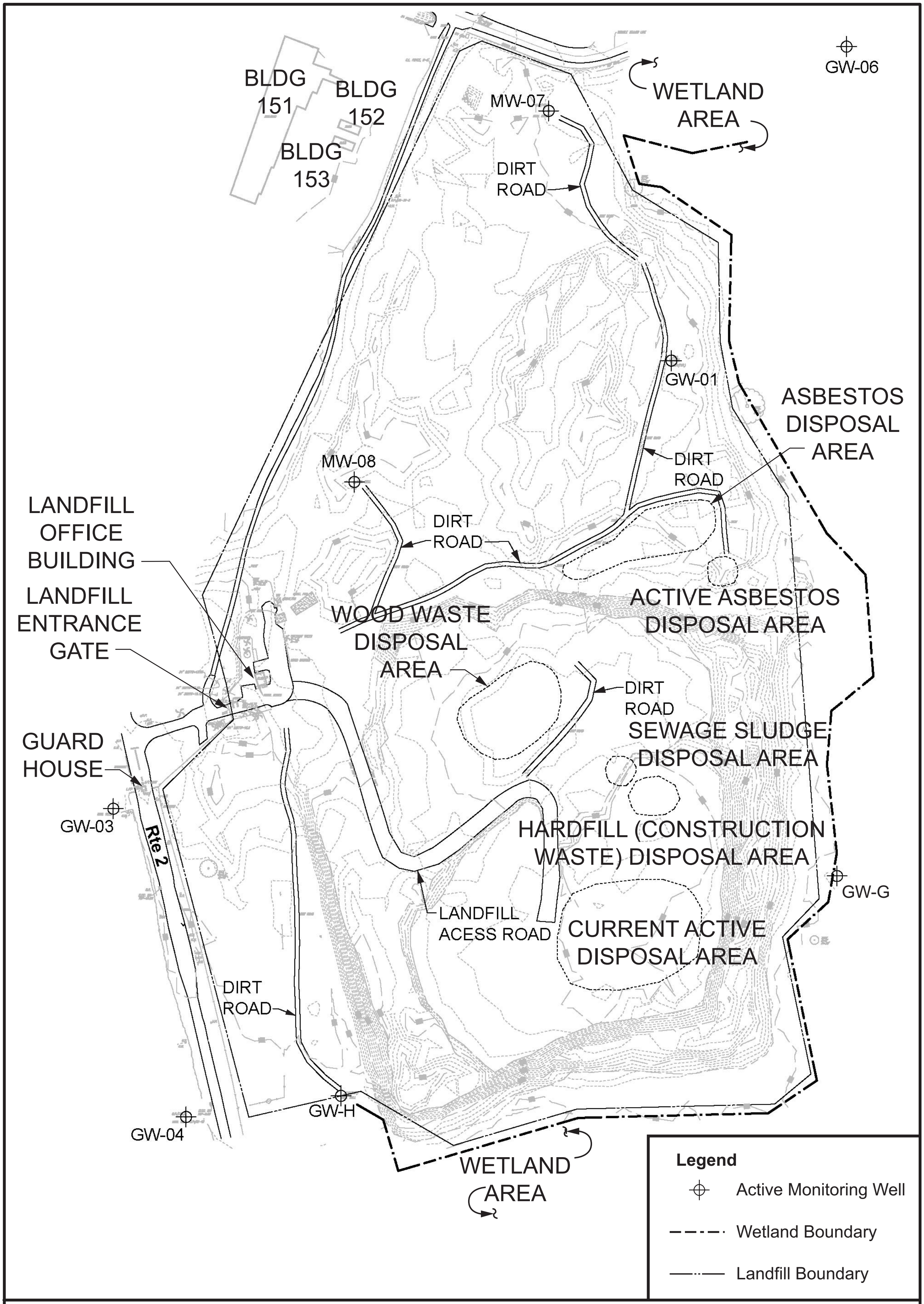

Figure 3.1-5
Existing Navy Sanitary Landfill, Guam

Categories of solid waste prohibited from being disposed of in the landfill include the following:

- Hazardous waste
- Liquids
- Oily wastes, oil-based paints, and petroleum products
- Metal and appliances
- Whole or partially whole vehicles, vehicle parts, and tires
- Batteries
- Wet sewage sludge
- Flammables

Collection truck operators visually inspect waste loads in each container for prohibited wastes. If prohibited wastes are found, the load would not be collected until the material has been removed for proper disposal.

An office located at the landfill entrance is the only on site structure. A scale with a maximum capacity of 270,000 pounds (122,500 kilograms) was recently installed at the landfill and became fully operational in November 2009. A weight of incoming solid waste is determined by weighing the collection vehicle before and after it unloads at the landfill. Weights are recorded electronically on a digital recorder. Waste disposal at the landfill is also tracked through daily trip tickets, daily disposal logs, weekly metric reports, and semiannual and annual reports submitted to GEPA and NAVFAC Marianas.

Groundwater at the landfill facility is monitored at two upgradient wells, two downgradient wells, and four wells located within the landfill boundary. Groundwater is currently monitored on a quarterly basis. Landfill gas (methane) is also monitored on a quarterly basis. Groundwater and gas monitoring data are reported to GEPA in semiannual solid waste reports. Results from the groundwater monitoring program indicate that low level concentrations of volatile organic compounds were detected in the downgradient wells in 2006. However, subsequent assessment monitoring events resulted in no detections of these compounds. Chlordane has also been detected in one of the wells during a single monitoring event in 2006. Since that time, chlordane has not been detected.

Recycling Facilities

The Navy currently recycles plastics, glass, aluminum cans, and cardboard. DoD housing areas have recycling bins that are picked up every other week by a contractor. Three recycle collection points are available for all residents or anyone with base access to drop off recyclables (cardboard, plastics, glass, and aluminum cans). Various Morale, Welfare, and Recreation facilities and food establishments provide recycling bins and accept plastic, glass, and aluminum cans. Cardboard is collected and recycled from the Naval Exchange and Commissary. DoD maintenance contractors mulch all palm fronds and generated green waste on site. Some green waste from northern facilities is provided to the Department of Agriculture as mulch for farmers. Recycling containers are provided to visiting ships upon request. NAVFAC Marianas has initiated an effort to “partner” with Andersen AFB in its recycling efforts. By collecting and transferring recyclable waste from Navy facilities to the Andersen AFB recycling center, the Navy hopes to reduce the flow of waste into the Navy Sanitary Landfill and increase the profitability of the Air Force’s investment into its recycling equipment by adding volumes of recyclable waste.

3.1.4.2 Air Force Solid Waste Facilities

Landfill Facilities

The Air Force owns and operates a single landfill on Guam, located at Andersen AFB near Route 1 and the entrance road to Andersen AFB. The current landfill is a vertical expansion constructed over an unlined landfill area and began operation in late 1998. The landfill expansion has a design capacity of 172,000 cubic yards (CY) (131,503 cubic meters [m^3]) and had an expected life of 10 years. The current landfill footprint occupies an area of approximately 79 ac (32 ha). Base operations support personnel operate and maintain the facility under current GEPA Rules and Regulation for Solid Waste Disposal. The landfill was constructed over the NGLA, a designated sole source aquifer.

The landfill expansion is constructed with a double liner system that provides an added measure of protection should one of the liners fail. This site is also equipped with fire hydrants at the corners of the property and a base landfill wash rack.

The landfill is made up of two major sections: a solid waste disposal area and a hardfill disposal area. Waste delivered to the landfill facility is first identified and segregated. Wastes consisting of cardboard, paper, glass, plastic, scrap metal, and aluminum are taken to Andersen AFB's Arc Light Recycling Center (discussed below). Typical municipal waste, such as food waste and other types of biodegradable trash is placed in the solid waste disposal area and then compacted and covered with roughly 6 in (15 cm) of soil daily. Wood (e.g., crates) and green waste are segregated into separate piles and shredded by a large wood chipper. The resulting wood chips are provided to local residents and base operators for mulching and landscaping purposes. Construction debris such as concrete, asphalt, and rock are piled together and processed through a rock crusher. The crushed debris is then mixed with dirt and used as daily cover for the landfill. C&D debris that cannot be crushed is disposed of in the hardfill section of the landfill.

For several years, the Air Force and Navy have structured their long-term solid waste collection and disposal plans based on the expectation that GovGuam would open a new, fully compliant landfill by September 2007 per the terms of a federal consent decree. At this time, the Air Force and possibly the Navy would become GovGuam customers, using the GovGuam landfill and other solid waste management facilities.

Because GovGuam had not established a new landfill by September 2007, the Air Force was left with few options to meet its solid waste disposal needs in the near future. The Air Force landfill reached its original design capacity in September 2007. Therefore, it constructed a 2-ac (0.81-ha) expansion to meet its disposal needs through 2009. Because the GovGuam landfill would not be available until July 2011, the DoD has awarded a project to design and construct an expansion to the Air Force landfill to accommodate receiving waste for an additional 18 months. This expansion would be used for Air Force municipal and industrial waste streams. The Air Force landfill would only receive waste generated from daily operations of Andersen AFB and no C&D waste. The Air Force is currently awaiting permit approval from GEPA.

Recycling Facilities

Andersen AFB has taken the lead in recycling efforts on Guam. Beginning in 1997, the base constructed the Arc Light Recycling Center (Facility 2408) to support its voluntary recycling program. This center is operated by a private contractor and currently receives and processes cardboard, wastepaper, aluminum cans, glass, and plastic bottles. The glass is ground to fill sandbags and provide backfill at construction sites. The other items are separated, stacked, and compressed into large bales that are sold off-island a few times a year through a broker. In addition, palm fronds and other green waste are ground at the base landfill, producing mulch that is available to installation residents through a "Self-Help Store."

The operating cost of the recycling center is approximately $300,000 annually, far greater than the $30,000 in revenues that the center generates through sales of recyclable materials. However, the recycling program saves the Air Force an estimated $1.7M in costs each year by diverting 45% to 52% of the base's trash (i.e., 8,650 tons [7,847 metric tons]) from being disposed of at the Andersen AFB landfill, thus prolonging the life of this landfill.

A list of recycling equipment that the base owns and operates is provided in Table 3.1-6.

Table 3.1-6. Recycling Equipment at Andersen AFB

Equipment	*Model/Make*	*Quantity*
Baler	Model EX602 Horizontal	2
Weight scale	Series 9711-326	1
Recycling trailer, 17 feet × 8 feet (6-foot B/L wheels), with pintel hook attachment		1
Andela glass pulverizer	Model GP-07	1
Toter containers, 96 gallons (for family housing units)		1,500
Dumpsters, 8 cubic yards (for industrial/commercial facilities)		40

Source: Air Force Solicitation 2007

Andersen AFB has an educational program that influences installation activities and informs residents about the importance of waste recycling, the base's voluntary recycling program, and Air Force facilities and services available to enable them to participate in recycling efforts on base.

3.1.4.3 GovGuam Solid Waste Facilities

The current solid waste management system on Guam consists of the disposal site Ordot Dump and three waste transfer stations (Dededo, Ayat, and Malojloj). The GovGuam hardfill in Malojloj is no longer operational. These facilities and other permitted private hardfills (Northern Hardfill and Eddie Cruz Hardfill) serve the entire civilian community of Guam. Trash collection is provided by Guam Department of Public Works (GDPW) and several private trash haulers.

Currently, the Ordot Dump is the only facility available on Guam for the disposal of municipal, commercial, and industrial waste. The first use of the site as a dump is not documented. However, the site was used for waste disposal by the Japanese during their occupation of Guam in the early 1940s (World War II). After the liberation of Guam, the Navy continued to use the site as a disposal area. Ownership of the Ordot Dump was transferred from the Navy to GovGuam in 1950 under the Organic Act. The GDPW is primarily responsible for the collection of solid waste on Guam and operation of the Ordot Dump.

The Ordot Dump receives approximately 526 tons (477 metric tons) of waste per day or 191,990 tons (174,089 metric tons) per year. The dump has grown to full capacity, covering an estimated 54 ac (22 ha) to date. The dump is unlined and in the past was improperly operated, maintained, and monitored.

The Ordot Dump was created in a natural flowing ravine before regulatory standards for siting a landfill were established. Although the dump has been filled in the ravine, the general area slope remains southward, approximately 500 ft (152 m) from the Lonfit River. Leachate emanates from the dump and flows to the river, a violation of the federal CWA. In February 2004, USEPA, DOJ, and GovGuam entered into a consent decree to resolve issues related to this unauthorized discharge of pollutants to the Lonfit River. Subsequently, GovGuam's solid waste program was placed into federal receivership.

The consent decree outlines specific tasks and time requirements that the GovGuam has agreed to complete to correct the violation. These tasks included the closure of the Ordot Dump by October 2007, and the siting, design, and construction of a new municipal solid waste landfill facility that is fully compliant with federal RCRA Subtitle D. The opening of the new landfill, which began construction on February 25, 2009, would coincide with the mandated regulated closure of Ordot Dump.

The Ordot Dump is still in operation; however, it is at full capacity and it is unknown how much longer it can continue to receive waste. The receivership has recently incorporated improvements to the Ordot Dump operations including installation of a weigh scale, placement of cover soil over the solid waste on a daily basis, and has begun implementing recycling and diversion programs. Following its eventual closure, the Consent Decree mandates a 30-year post-closure maintenance plan that would include monitoring the gas, stormwater, leachate, cover system, and monitoring wells.

The new landfill site, Layon Landfill, selected by GovGuam is located near the village of Inarajan. The selection of this site was based on landfill siting criteria set forth in RCRA Subtitle D, the Guam Solid Waste Disposal Rules and Regulations (Guam Code Annotated Title 22, Division 4, Chapter 23), and other guidelines. These criteria are used to evaluate the potential site impacts of the landfill on surface and groundwater quality, wetlands, floodplains, nearby communities, traffic, air quality, biological resources, archaeological and historic resources, land use, airport safety, aesthetics, noise levels, property values, and utilities. The proposed landfill site is approximately 317 ac (128 ha), with a landfill footprint of 127.4 ac (51.6 ha), and with a design capacity of 15.8M CY (12.1 million m^3) that would provide at least 30 years of service life (NAVFAC Pacific 2008).

Gershman, Brickner, and Bratton, Inc. (GBB), the receivership firm managing GovGuam's solid waste program, awarded a construction contract for the initial phase of the landfill and construction that began on February 25, 2009. The current phase consists of constructing the landfill operations road and performing mass grading for landfill Cells 1 and 2. Invitations to bid on the construction of the Layon Municipal Sanitary Landfill Entrance Area Facilities and Cells 1 and 2 were released on August 17, 2009. Cells 1 and 2 are approximately 11.0 ac (4.5 ha) each, with planned waste filling depths of approximately 100 ft (30 m). The Layon Landfill is currently projected to be ready to accept solid waste by July 2011. The landfill would be designed and operated in compliance with the federal RCRA Subtitle D Municipal Solid Waste Landfill Facility regulations and Guam's solid waste disposal regulations (Guam Code Annotated Title 22, Division 4, Chapter 23). These regulations serve to minimize and mitigate any potential adverse affects on human health and the environment from the landfill.

Integrated Solid Waste Program

In 1983, GEPA adopted a solid waste management plan for Guam and regulations for solid waste collection and disposal. In 2000, GovGuam began upgrading and modernizing its solid waste facilities with the adoption of the Integrated Solid Waste Management Plan (ISWMP) through Public Law 25-175 (December 12, 2000). In addition, the Guam legislature enacted more than 40 laws related to solid waste management and disposal from October 1983 to September 2006. Unfortunately, these legislative attempts have largely failed to improve the effectiveness and efficiencies of Guam's solid waste management program. The program has been plagued by funding inefficiencies; poor permit, tipping, and user fee collection rates; poor waste collection records; delays in meeting mandated and planned performance criteria (such as privatization of waste collection and disposal activities); and a consent decree requiring the closure of the Ordot Dump and the construction of a new landfill. To address these deficiencies and the consent decree, GEPA prepared an update to the ISWMP in September 2006 (GEPA 2006). The ISWMP was adopted via the administrative adjudication act (rule-making) in January 2007. The goal of the updated plan is to develop a truly "integrated" solid waste management system that provides waste management through diversion, recycling, composting, and processing. The integration would also consolidate all current solid waste management efforts on Guam (civilian and military) into one system to the extent possible. GovGuam has been consulting with the military for several years about potentially consolidating their individual solid waste programs or components of these programs (e.g., recycling facilities).

The 2006 ISWMP identifies the objectives, performance criteria, and key elements of the integrated solid waste management system going forward. The plan provides recommendations for the following:

- Closing the Ordot Dump.
- Transferring GDPW's solid waste duties to a newly formed public utility corporation (to be known as the Guam Solid Waste Authority) under the oversight of the Consolidated Commission on Utilities.
- Privatizing all solid waste operations.
- Conducting a waste source and characterization study.
- Implementing source reductions, recycling, composting, resource recovery, and waste reduction.
- Developing a new landfill and regulated landfill disposal.
- Developing solid waste transfer stations around the island to accept, segregate, and consolidate waste streams for recycling or landfill disposal.
- Defining program funding requirements and potential funding sources (including the collection of permit and user/tipping fees).
- Implementing special handling requirements and facilities for construction/demolition waste, household hazardous wastes, bulky metallic waste and white goods (e.g., washers, refrigerators), and green waste.
- Developing a public education program.

The plan revises Guam's solid waste load projections to the year 2037 (which approximates the conservative lifespan of the new landfill) and includes waste generated from future military relocation.

The goals and key components of this plan would not be realized without future legislation that makes the plan's recommendations mandatory and provides the funding mechanisms needed to implement the plan. To date, this legislation has not been forthcoming. In mid-December 2007, the federal courts appointed federal receivership of Guam's solid waste management program to ensure the prompt closure of Ordot Dump, the construction of a new compliant landfill, and implementation of the 2006 ISWMP.

3.1.5 Roadway Projects

Because of potential impacts on public and military utilities and infrastructure from associated roadway improvements, the existing infrastructure located within the Guam Road Network (GRN) are described. Public utilities in the GRN study area include electricity, water and wastewater facilities, telecommunications, fuel pipelines, and solid waste disposal. In addition, separate military-operated water and wastewater systems are either originating or terminating in the Apra Harbor and Andersen AFB areas, where roadway improvements are also considered.

3.1.5.1 North

Table 3.1-7 indicates the presence of each particular utility along the major roadway routes within the study area in the north region. The major roadway routes within northern Guam include Routes 1, 3, 9, 15, and 28.

Table 3.1-7. Existing Utilities within Guam Road Network Routes

Region	*Route*	*GPA Power*	*Navy Power*	*Power Plant*	*GPA Fuel*	*Telephone*	*Cable TV*	*Fiber Optic*	*GWA Sanitary Sewer*	*Navy Sanitary Sewer*	*Wastewater Treatment Plant*	*GWA Water*	*Navy Water*
North	1	X		X		OH	OH	X				X	
	3	X	X			OH and UG	OH	X	X	X		X	X
	9	X				OH	OH and UG	X		X		X	
	15	X				OH	OH	X				X	
	28					OH			X			X	
Central	1	X	X	X	X	OH and UG	OH and UG	X	X	X	X	X	X
	7	X				OH			X			X	
	8	X				OH and UG	OH and UG	X	X			X	X
	8A	X				OH and UG	OH		X	X		X	
	10	X				OH and UG	OH	X	X			X	
	15	X				OH and UG	OH		X			X	
	16	X			X	OH and UG	OH	X	X			X	X
	25*												
	26*												
	27	X		X		OH and UG	OH	X	X			X	X
Apra Harbor	1	X	X	X		OH and UG	OH and UG	X		X			X
	2A	X	X			OH and UG	OH						X
	11	X	X	X			OH and UG	X	X	X		X	X
South	2	X				OH and UG			X			X	
	5	X	X	X		OH and UG	OH		X	X		X	X
	12	X				OH			X			X	

Legend: GPA = Guam Power Authority; GWA = Guam Waterworks Authority; OH = overhead; TV = television; UG = underground.
Note: * Utility data are not currently available for Routes 25 and 26.

Power

GPA and IPPs generate power for the north region's study area. In addition, Navy-produced power is transmitted through northern Guam to Andersen AFB. GPA provides full electric utility services generated from power plants to individual users. Power is generated through the combustion of crude oil. Power generation in northern Guam comprises a GPA power plant located in Yigo and a joint power plant operated by GPA and Pruvient Energy Guam, Inc., located in Tanguisson.

Transmission of GPA and Navy power throughout northern Guam is through overhead power transmission lines. In northern Guam, 34.5-kilovolt (kV) overhead power lines are present along Routes 1, 3, 9, and 15. Overhead conductors with wooden cross arms on concrete poles are used at most locations, although a few wooden poles are still in use. The predominant service voltage is supplied through pole-mounted transformers that are provided with lightning surge arresters to protect downstream equipment.

Potable Water

GWA, the Navy, and the Air Force operate and maintain water source facilities in the north region's study area. GWA's Northern Public Water System serves the population in northern Guam through an extensive network of wells. GWA's water distribution system is a collection of legacy pipe systems built principally by the Navy and then turned over to GovGuam to operate for the civilian population. GWA's water system combines T&D pipes into a common network, with isolation and pressure-reducing valves used to ensure that water reaches customers throughout northern Guam. The main water T&D pipe network in northern Guam is aligned along the existing major road network, either directly under the roads or adjacent to the roads in the existing roadway right-of-way (ROW). Parallel lines run the length of most of Routes 1, 3, 9, 15, and 28 to serve the most populated areas in the northern system.

The existing Navy water system is an islandwide system extending from the Navy Reservoir in southern Guam to NCTS Finegayan near the northern tip of Guam. Water for the system is supplied primarily from the Fena WTP. Water is distributed from the treatment plant through a network of reservoirs, transmission mains, and booster pump stations. Water is also supplied to the Naval facilities from on-site groundwater wells.

In northern Guam, the Navy services NCTS Finegayan and South Finegayan primarily by on-site groundwater wells. If necessary, water can also be supplied by interconnections with the Navy water system along Route 3.

Andersen AFB gets its water from Andersen Northwest Field and Andersen South. It includes an off-base water supply; disinfection, storage, and transmission system; and an on-base water distribution system. The off-base water supply and transmission system includes nine water production wells, two booster pump stations, three storage tanks, chlorination facilities, one fluoridation facility, and approximately 80,000 feet (ft) (24,400 meters [m]) of water lines. The existing on-base water distribution system includes a pump station, three storage tanks, and approximately 700,000 ft (213,350 m) of water lines.

Water is currently supplied to Andersen AFB from seven of the nine off -base water production wells; the remaining two wells are inactive. An additional five wells were constructed on the Andersen Northwest Field. Water supplied from the off-base production wells is stored, disinfected, fluoridated, and then pumped to the main base. The off-base production wells draw water from the Northern Guam Lens Aquifer (NGLA). UFW for the system is estimated at 50%, compared to an acceptable rate of 15% or less.

Wastewater

GWA provides wastewater services for the population in the north region, Andersen AFB, NCTS Finegayan, and South Finegayan. The system is made up of gravity sewer pipes and force mains, SPSs, siphons, a WWTP, and an ocean outfall. Similar to the water T&D network, the wastewater network is aligned along the existing road network, either directly under the roads or adjacent to the roads in the existing roadway ROW. The NDWWTP is a Class III, primary treatment plant. This plant is located on the northwestern coast of Guam and provides wastewater treatment for northern Guam.

In addition to areas served by the GWA collection systems, approximately 41% of the island residents live in the areas of the north region that are not served by collection systems. High concentrations of properties in northern Guam use septic systems to collect and dispose of wastewater in areas that are not sewered.

Solid Waste

GBB has assumed all of the responsibilities, functions, duties, powers, and authority of the Solid Waste Management Division (SWMD) of the GDPW. The SWMD provides collection of residential solid waste materials in the north region's study area. The SWMD also manages disposal of residential and commercial solid waste.

The Air Force owns and operates a landfill at Andersen AFB in the north region. The landfill is located near Route 1 and the entrance to Andersen AFB. The landfill handles disposal of solid waste and hardfill. The Air Force also constructed the Arc Light Recycling Center near the main entrance. The recycling center is run by a private contractor and handles mixed recyclables for residents on and off the base.

Telecommunications

The two main providers of telecommunication services (i.e., telephone, television, and fiber optics) for Guam are GTA Teleguam and MCV Broadband. Most of the transmission of telephone and television lines throughout northern Guam is through overhead transmission lines. Portions of the telephone and television lines and all of the fiber optic lines are buried underground. Main T&D lines are aligned along all of the existing major roadways in northern Guam.

3.1.5.2 Central

Table 3.1-7 indicates the presence of each particular utility along the major roadway routes within the central region. The major roadway routes within central Guam are Routes 1, 8, 8A, 10, 15, 16, 25, 26, and 27, and the Chalan Lujuna roadway.

Power

GPA and IPPs generate power for the central region. In addition, the Navy transmits power through the central region for DoD facilities on the island. GPA provides full electric utility services generated from power plants to individual users. Power is generated through the combustion of crude oil. Three power plants are in the northern portion of central Guam: GPA power plants in Macheche and Dededo and a joint power plant operated by GPA and supplied by Shell Guam, Inc., located in Marbo. A GPA power plant at Manengon Hills is located in the southern portion of the central region.

Transmission of GPA and Navy power throughout central Guam is through overhead power transmission lines. Both 34.5-kV and 115-kV overhead power lines are present throughout many of the major roads in central Guam. The transmission network in the central region runs along Routes 1, 8, 10, 15, 16, 26, 27, and the Chalan Lujuna roadway. Overhead conductors with wooden cross arms on concrete poles are used at most locations, although a few wooden poles are still in use. The predominant service voltage is supplied through pole-mounted transformers that are provided with lightning surge arresters to protect downstream equipment.

Fuel lines for GPA, the Navy, the Air Force, and Shell Guam, Inc. are located along Route 16 between the Tiyan Guam Airport and the Tanguisson Power Plant in central Guam.

Water

The GWA and the Navy operate and maintain water source facilities in the central region. The Navy system is interconnected to supply water to GWA and for emergency service capability. The Central Public Water System serves the east side of central Guam through the U.S. Navy Fena WTP. The west side of central Guam is served through an extensive network of wells. GWA's water distribution system is a collection of legacy pipe systems built principally by the Navy and then turned over to GovGuam to operate for the civilian population. The GWA water system combines T&D pipes into a common network, with isolation and pressure-reducing valves used to ensure that water reaches customers throughout central Guam. The main water T&D pipe network in central Guam is aligned along the existing major road network, either directly under the roads or adjacent to the roads in the existing roadway ROW.

The existing Navy water system is an islandwide system extending from the Navy Reservoir in southern Guam to NCTS Finegayan near the northern tip of Guam. Water for the system is supplied primarily from the Fena WTP. Water is distributed from the treatment plant through a network of reservoirs, transmission mains, and booster pump stations. Water is also supplied to the Naval facilities from on-site groundwater wells.

In central Guam, the Navy services Navy Barrigada and the Naval Hospital primarily by on-site groundwater wells. As a backup, water can also be supplied by interconnections with the Navy water system along Routes 1, 8, and 16.

Wastewater

GWA provides wastewater services for the population of central Guam. The system is made up of gravity sewer pipes and force mains, SPSs, siphons, WWTPs, and ocean outfalls. Similar to the water T&D network, the wastewater network is aligned along the existing road network, either directly under the roads or adjacent to the roads in the existing roadway ROW. The Hagatna WWTP is a Class III, primary treatment plant located adjacent to Agana Bay in central Guam. One other WWTP is in central Guam (Pago Socio WWTP); however, it is not located adjacent to the GRN.

In addition to areas served by the GWA collection systems, approximately 41% of the island residents live in areas not served by collection systems. High concentrations of properties in central Guam use septic systems for wastewater collection and disposal in areas that are not sewered.

Solid Waste

GBB has assumed all of the responsibilities, functions, duties, powers, and authority of the SWMD of the GDPW. The SWMD provides collection of residential solid waste materials in central Guam. The SWMD also manages disposal of residential and commercial solid waste. In central Guam, the SWMD operates the Ordot Dump and a transfer facility at Dededo. The Ordot Dump is scheduled to close in mid-2011. Residents within the central region can recycle, for free, cardboard and glass at the Dededo Transfer Station and Ordot Dump.

Telecommunications

The two main providers of telecommunication services (i.e., telephone, television, and fiber optics) for central Guam are GTA Teleguam and MCV Broadband. Most of the transmission of telephone and television lines throughout central Guam is through overhead transmission lines. Portions of the telephone and television lines and all of the fiber optic lines are buried underground. The main T&D network is aligned along nearly all of the existing major roadways within central Guam.

3.1.5.3 Apra Harbor

Table 3.1-7 indicates the presence of each particular utility along the major roadway routes within the Apra Harbor region. The major roadway routes in the Apra Harbor region include Routes 1, 2A, and 11.

Power

GPA and many IPPs generate power for the Apra Harbor region. In addition, the Navy produces power for DoD facilities. GPA provides full electric utility services generated from power plants to individual users. Power is generated through the combustion of crude oil. One GPA power plant is located in Cabras and three IPP power plants are located at Temes, Mec, and Orote Point.

Transmission of GPA and Navy power throughout the Apra Harbor region is through overhead power transmission lines. The Apra Harbor region contains overhead 34.5-kV lines along Route 1. Overhead conductors with wooden cross arms on concrete poles are used at most locations, although a few wooden poles still are in use. The predominant service voltage is supplied through pole-mounted transformers that are provided with lightning surge arresters to protect downstream equipment.

Water

GWA and the Navy operate and maintain water source facilities in the Apra Harbor region. The Navy system is interconnected to supply water to GWA and for emergency service capability. The Central Public Water System serves the Apra Harbor region through the U.S. Navy Fena WTP. The GWA water distribution system is a collection of legacy pipe systems built principally by the Navy and then turned over to GovGuam to operate for the civilian population. GWA's water system combines T&D pipes into a common network, with isolation and pressure-reducing valves used to ensure that water reaches customers throughout the Apra Harbor region. The main water T&D pipe network in the Apra Harbor region is aligned along Routes 1 and 11, either directly under the roads or adjacent to the roads in the existing roadway ROW.

The existing Navy water system is an islandwide system extending from the Navy Reservoir in southern Guam to NCTS Finegayan near the northern tip of Guam. Water for the system is supplied primarily from the Fena WTP. Water is distributed from the treatment plant through a network of reservoirs, transmission mains, and booster pump stations. Water is also supplied to the Naval facilities from on-site groundwater wells.

In the Apra Harbor region, the Navy water system services the Naval Base Guam through the Fena WTP. Transmission lines for the Navy water system run along Routes 1, 2A, and 11.

Wastewater

GWA and the Navy provide wastewater services for the Apra Harbor region's population. The system is made up of gravity sewer pipes and force mains, SPSs, siphons, a WWTP, and an ocean outfall. Similar to the water T&D network, the wastewater network is aligned along the existing road network, either directly under the roads or adjacent to the roads in the existing roadway ROW. The Navy operates a WWTP located in the Apra Harbor region.

Solid Waste

GBB has assumed all of the responsibilities, functions, duties, powers, and authority of the SWMD of the GDPW. The SWMD provides collection of residential solid waste materials in the Apra Harbor region's study area. The SWMD also manages disposal of residential and commercial solid waste.

The Navy-owned and operated landfill is located at the southeastern area of Naval Base Guam. The landfill currently accepts all solid waste and hardfill generated by all DoD lands on Guam. The Navy landfill also accepts solid waste from Navy ships, as well as asbestos and wastewater treatment sludge. The Navy does not currently have an official recycling program.

Telecommunications

The two main providers of telecommunication services (i.e., telephone, television, and fiber optics) for the Apra Harbor region's study area are GTA Teleguam and MCV Broadband. Most of the transmission of telephone and television lines throughout the Apra Harbor region's study area is through overhead transmission lines. Portions of the telephone and television lines and all of the fiber optic lines are buried underground. The main T&D network is aligned along the existing major roadways within the Apra Harbor region's study area.

3.1.5.4 South

Table 3.1-7 indicates the presence of each particular utility along the major roadway routes within southern Guam. The major roadway routes in southern Guam include Routes 2, 5, and 12.

Power

GPA generates power for the south region. GPA provides full electric utility services generated from power plants to individual users. Power is generated through the combustion of crude oil. A power plant is located in Tenjo within southern Guam.

Transmission of GPA power throughout the study area in southern Guam is through overhead power transmission lines. Along Routes 2A and 2 in the southwest portion of the island are 34.5-kV overhead lines. Along Route 5, 34.5-kV overhead lines also cross southern Guam. Overhead conductors with wooden cross arms on concrete poles are used at most locations, although a few wooden poles are still in use. The predominant service voltage is supplied through pole-mounted transformers that are provided with lightning surge arresters to protect downstream equipment.

Water

GWA and the Navy operate and maintain water source facilities in southern Guam. The Navy system is interconnected to supply water to GWA and for emergency service capability. Southern Guam is served by the U.S. Navy Fena WTP. GWA's water distribution system is a collection of legacy pipe systems built principally by the Navy and then turned over to GovGuam to operate for the civilian population. GWA's water system combines T&D pipes into a common network, with isolation and pressure-reducing valves used to ensure that water reaches customers throughout southern Guam. The main water T&D pipe network in southern Guam is aligned along the major roadways, either directly under the roads or adjacent to the roads in the existing roadway ROW.

The existing Navy water system is an islandwide system extending from the Navy Reservoir in southern Guam to NCTS Finegayan near the northern tip of Guam. Primary water supply sources for the Navy's islandwide water system are located in the southern region of Guam and include Almagosa Springs, Bona Springs, and the Fena Reservoir surface water impoundment. Water for the system is primarily supplied from the Fena WTP. Water is distributed from the treatment plant through a network of reservoirs, transmission mains, and booster pump stations. Water is also supplied to the Naval facilities from on-site groundwater wells.

In southern Guam, the Navy's water system services the Navy Munitions Site through the Fena WTP. Transmission lines for the Navy water system run along Route 5.

Wastewater

GWA provides wastewater services for the population of southern Guam. The system is made up of gravity sewer pipes and force mains, SPSs, siphons, WWTPs, and ocean outfalls. Similar to the water T&D network, the wastewater network is aligned along the existing road network, either directly under the roads or adjacent to the roads in the existing roadway ROW. The Agat-Santa Rita WWTP, a Class II treatment plant, is located on the west coast of Guam. The Agat-Santa Rita WWTP serves the area bounded to the north by the intersection of Routes 2 and 2A, to about the midpoint of Route 12 to the east, and to Taelayag Beach on the south (near where Route 2 heads inland to the east as opposed to directly on the coast). Three other WWTPs (i.e., Baza Gardens WWTP, Inarajan WWTP, and Umatac-Merizo WWTP) are in southern Guam; however, they do not serve areas adjacent to the GRN.

Solid Waste

GBB has assumed all of the responsibilities, functions, duties, powers, and authority of the SWMD of the GDPW. The SWMD provides collection of residential solid waste materials in southern Guam. The SWMD also manages disposal of residential and commercial solid waste. Within southern Guam, the SWMD operates the Agat Transfer Station, where residents can recycle, for free, cardboard and glass.

Telecommunications

The two main providers of telecommunication services (i.e., telephone, television, and fiber optics) for the south region's study area are GTA Teleguam and MCV Broadband. Most of the transmission of telephone and television lines throughout southern Guam is through overhead transmission lines. Portions of the telephone and television lines, as well as all of the fiber optic lines are buried underground. The main T&D network is aligned along nearly all of the existing major roadways within southern Guam.

3.2 ENVIRONMENTAL CONSEQUENCES

3.2.1 Approach to Analysis

3.2.1.1 Methodology

The impact analysis for utilities compares the existing capacity and demand on a utility to the projected capacity and demand. This analysis is done for each of the utility alternatives. Military and civilian populations on Guam are projected to increase as a result of the proposed military relocation. Projected population changes are used to forecast future demand for a utility, based on average per capita usage, except for power, which utilizes proposed facilities as well as population in some cases. Changes in facility usage or new facility construction may also contribute to the total projected demand. Demand projections are then compared to the planned capacity under each utility alternative.

It must be understood that utility and roadway alternatives are tied to the alternatives for the main NEPA actions: the Marine Corps Relocation, the Marine Corps Relocation CNMI, the Aircraft Carrier Berthing, and the Army Air & Missile Defense Task Force. The utility and roadway alternatives are evaluated as options for the best approach considering their impacts to the various resource categories, but are not independent alternatives themselves. Since the utilities are related actions, the "no action" alternative is not really pertinent to their analyses and presentation. Thus, in Volume 6, "no action" is not evaluated for utilities. However, Volume 6, Chapters 3 and Chapter 4 characterize the existing utility and roadway conditions that would likely continue in the absence of the proposed Marine Corps, Navy, and Army actions.

In accordance with CEQ regulations (i.e. 40 CFR §1502.22), incomplete or unavailable information exists that hinders a comprehensive understanding and assessment of the functionality, capacity, and condition of off-base water and wastewater systems owned and operated by GWA. As such, it is not possible to fully assess or determine the full significance of the indirect and cumulative impacts of the proposed action associated with induced civilian population growth and workforce housing and logistics. Because these off-base systems are owned and operated by GWA and regulated by USEPA and GEPA, DoD has no authority to conduct required surveys and assessments. Therefore, the DoD must rely on the information provided by these entities outlining the current conditions of these systems. Further, efforts to accurately survey, map, and assess the conditions of these systems would involve exorbitant costs and necessitate extensive excavation of neighborhoods and key roadways. Based on the best available information, which is presented in the following sections, DoD has identified, to the extent possible, the indirect and cumulative impacts of the proposed action associated with induced civilian population growth and workforce housing and logistics and their significance. In making these assessments, DoD employed industry and regulatory standards to make its determinations of impacts and significance.

For roadway projects, potential impacts on public and military utilities and infrastructure that would result from construction and operation of the associated roadway improvements for each of the proposed project alternatives are analyzed separately. The utility information gathered to date was acquired using geographic information systems. Therefore, it inherently contains a fairly high level of approximation regarding horizontal location. Furthermore, no information is currently available regarding the vertical depth of buried utilities. Another factor considered in the analysis of impacts on utilities is the methods of construction. It has been safely ascertained through historical reference and observation that many of the existing underground utilities were constructed rather hastily and did not adhere to generally accepted construction standards. Therefore, an analysis of utility impacts must include that any particular utility within the area of a construction project involving digging and/or grading activities has been identified as needing to be relocated.

3.2.1.2 Determination of Significance

A determination of significant adverse effect is made when the projected increase in demand for a utility would exceed the planned capacity for that utility such that the utility provider would not be able to service additional demands while maintaining the same level of service for existing customers.

Potential adverse effects of demand exceeding capacity include brownouts/blackouts for power, low water pressure or rotating water shutoffs for potable water, discharge of inadequately treated wastewater or sewer backups, and solid waste accumulation at various collection points if a landfill is unable to accept additional waste.

Utility impacts caused by the proposed roadway improvements are assessed following the Federal Highway Administration's Guidance for Preparing and Processing Environmental and Section 4(f) Documents (T 6640 8A) (Federal Highway Administration 1987). Utility impacts would involve project effects that are assessed within this document under the category of construction impacts.

3.2.1.3 Issues Identified during Public Scoping Process

The public scoping process identified concerns, both from the public and regulatory stakeholders, about impacts from the proposed military relocation to public utilities on Guam and received comments for DoD to partner with GovGuam to improve utilities and infrastructure for all residents.

With regard to power, respondents requested that the military evaluate options for developing alternative energy sources, such as wind generation, waste-to-energy, solar power, and ocean thermal energy conversion. Respondents requested that the EIS address impacts of the proposed military relocation on the civilian power supply and plans for the military to partner with local utility providers to increase the capacity of public power facilities.

With regard to potable water, respondents requested that the EIS evaluate the impact that the military relocation would have on the existing potable water supply and the sustainable yield of the NGLA. Respondents requested that alternative sources of potable water, such as surface water, groundwater, recycled water, and desalination, be considered to meet the projected increase in potable water demand.

Wastewater concerns were primarily focused on assessing impacts on sewer lines, pump stations, and sewage outfalls. Respondents expressed a desire for the military to fund improvements to GWA wastewater facilities that accept military wastewater flows as a way of mitigating impacts on these facilities and bringing them into regulatory compliance.

With regard to solid waste, respondents requested that the EIS assess impacts of the military relocation on landfill capacity and operations, including potential impacts on the planned GovGuam landfill and impacts associated with the temporary construction workforce. Respondents requested that the EIS consider opportunities for the military to partner with the local government to share solid waste facilities.

3.2.2 Power

Projected interim power demands from the proposed military relocation are summarized in Table 3.2-1. For purposes of assessing impacts, the following demand categories are included in Table 3.2-1:

- Existing Guam civilian and DoD power demands, and projected increases in Guam civilian demands caused by natural population growth are considered baseline conditions;
- Projected DoD increases associated with the military relocation are considered direct effects; and
- Increases associated with the imported construction workforce, and civilian increases that could result from induced growth are considered indirect effects.

The projections account for all on base DoD power demands that would be generated by active duty personnel and their dependents, the on base civilian workforce, and industrial demands from on base facilities. Power demands from projected civilian induced growth caused by the military relocation are also included. It is anticipated that a transient aircraft carrier and its escort ships would rely on shoreside utility infrastructure for water, wastewater, and solid waste after 2015. Electric power would be provided in accordance with customer service agreements between GPA and the U.S. Navy. Any GPA commitments for additional power to support the aircraft carrier and its escort ships would be determined by future CSA modifications. Any required changes in the shoreside power infrastructure or their operations to meet the requirements for the aircraft carrier and its escort ships may require additional NEPA review. It should be noted that the projected DoD demand load of 30.5 MW does not include a 25% growth factor used in the *Guam Power Generation Study Report* (NAVFAC Pacific 2010c). The growth factor is not used as the anticipated impact of the Marine Corps relocation and other DoD facilities is assessed on the actual projected demand load.

Table 3.2-1. Projected Power Demand and Supply

	Megawatts (MW)									
GPA Power System	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Islandwide, including anticipated growth (existing DoD and GPA baseline projected growth included)										
Existing Guam	272	278	285	290	294	297	300	303	306	309
Guam Induced Civilian Increase (induced growth caused by military increase)	4.93	12.25	19.99	23.44	29.24	22.08	11.23	7.75	7.75	7.88
Construction Worker Increase	1.18	2.99	5.19	6.51	6.70	4.43	1.38	0.00	0.00	0.00
DoD Increase	1.83	2.18	5.04	11.35	17.99	27.55	29.53	29.53	29.53	30.5
Total Demand	279.94	295.42	315.22	331.3	347.93	351.06	342.14	340.28	343.28	347.38
Total Baseload Demand (80%)	223.95	236.34	252.18	265.04	278.34	280.85	273.71	272.22	274.62	277.90
Total Peaking Demand (20%)	55.99	59.08	63.04	66.26	69.59	70.21	68.43	68.06	68.66	69.48
Base Load Supply	352	352	352	352	352	352	352	372	372	372
Other Load Supply (medium load, peaking and reliability reserve)	140.8	140.8	200.8	200.8	200.8	200.8	200.8	200.8	200.8	200.8
Total Supply	492.8	492.8	552.8	552.8	552.8	552.8	552.8	572.8	572.8	572.8
Baseload Supply – Baseload Demand	128.05	115.66	99.82	86.96	73.66	71.15	78.29	99.78	97.38	94.10
Total Supply/1.52 reliability factor	324.21	324.21	363.68	363.68	363.68	363.68	363.68	376.84	376.84	376.84
Total Supply/1.52-Total Demand	44.27	28.79	48.46	32.38	15.75	12.62	21.54	36.56	33.56	29.46

Legend: DoD = Department of Defense; GPA = Guam Power Authority.
Source: NAVFAC Pacific 2010c; GPA 2008 for existing Guam growth projections.

To meet the increased power demand as the military relocation progresses, GPA would provide power from baseload power plants. Peaking and reserve capacity would be provided from CTs and diesel generators. The proposed basic alternative requires reconditioning these existing reserve facilities to ensure they are fully operational and available for dispatch. T&D lines are also included in the basic alternative. The basic alternative, therefore, is centered on improving the reliability of the IWPS. The work associated with the basic alternative would begin soon enough to have the first CT reconditioned and available by 2012, in time to service the projected demand as a reserve or peaking facility. The power demands of the construction workforce while working on base are considered part of the proposed action as a direct impact and are included under the basic alternative. The additional reserve and peaking power would be available by 2012 and available in time to service the projected demand.

The power demands of the construction workforce while working on base are considered by the basic alternative. The additional power capacity would be available to the IWPS at that time. GPA would need to upgrade local power T&D systems to accommodate housing for the construction workforce.

A socioeconomic analysis of the proposed military relocation has estimated that civilian growth induced by the military relocation could increase the islandwide civilian population on Guam by up to 33,000 in the peak year of 2014. Preliminary evaluation of the affects of this population increase on the electrical system shows a power demand of approximately 0.74 kilowatt (kW) per person. This amount represents two-thirds of the current average electrical demand per person on Guam of 1.1 kW. Per person power consumption was obtained from CIA world factbooks using 2006 data (9,682.897 kW-hours per person / 365 days per year / 24 hours per day = 1.1 kW per person), the most recent available data from this source (NationMaster 2006).

The predicted population growth on Guam induced by the DoD relocation varies from 6,651 people in 2010 to 39,481 people in 2014 (peak impact) and down to 10,639 in 2019. These changes correspondingly increase demands on the electrical system by 4.93 MW (2010 initial) to 29.24 MW (2014 peak) to 7.88 MW (2019). The expected growth rate on Guam was obtained from GPA data for baseline growth of power demand and shows a projected demand increase of 37 MW between 2010 and 2019 (10 years in the future).

3.2.2.1 Basic Alternative 1 (Preferred Alternative)

Description

Basic Alternative 1 would recondition up to 5 existing CTs and upgrade T&D systems and would not require new construction or enlargement of the existing footprint of the facilities. These reconditioned units would have the necessary reliability to serve as reserve capacity to ensure reliable operation of the IWPS. They would serve as peaking and reserve units. This work would be undertaken by the GPA on its existing permitted facilities, and potentially utilize a Special Purpose Entity (SPE) to obtain funds, recondition the CTs, install the T&D upgrades, and operate the CTs for a fee to enable repayment of the financing. Reconditioning would be made to existing permitted facilities at the Marbo, Yigo, Dededo, and Macheche CTs. These CTs are not currently being used up to permit limits. T&D system upgrades would be on existing above ground and underground transmission lines. This alternative supports Main Cantonment Alternatives 1 and 2, Main Cantonment Alternatives 3 and 8 would require additional upgrades to the T&D system.

Proposed Mitigation Measures

Adequate power supply during the interim period is based on ensuring that the DoD requirements for power are presented to the utility provider, GPA, in sufficient time to allow GPA to plan for the increased loads. DoD has had many discussions with GPA to outline the potential loads to allow GPA to do the necessary due diligence to plan for these requirements. Those discussions are ongoing.

The PUC requires that GPA maintain a generation reliability standard that their outages cannot exceed “1 day in 4.5 years.” To reliably meet this requirement, past GPA analysis has identified that a generation capacity in the installed system of approximately 1.52 times the system’s peak demand level is required to provide the necessary reserve margin. During the interim period the peak load for the IWPS is not projected to reach 363.68 MW, applying the 1.52 reserve capacity. GPA would need a generation capacity of 543 MW to meet the PUC requirement. GPA has an installed generation capacity of 552.8 MW. To reach its installed capacity, GPA would need to recondition existing generation units and return them to full service capability, which would provide a capacity of 363.68 MW.

If necessary, other actions could be taken to mitigate the impact of the new development that would occur off base as a result of the relocation. The improvements to GPA’s IWPS’ T&D capability to support the increased on base demand for power would result in new power lines, thereby freeing up capacity on the existing infrastructure to address the anticipated off base growth in demand for power. Reconditioning GPA’s CTs located in northern Guam would increase the reliability of the IWPS by providing increased peaking and reserve power generation capacity to support the existing and future off base population growth. Efforts are continuing to work closely with GPA to ensure that the new requirements imposed on the IWPS do not degrade the overall reliability of the system to the detriment of all users. GPA is in the process of modeling the identified relocation power demands and will be working with DoD to identify system improvements that can be implemented to sustain system reliability and improve it where deemed appropriate. DoD would help GPA develop strategies to obtain funding to implement the necessary improvements mentioned above.

Currently, DoD has 33 MW of power generation capability. 18.6 MW at the Orote Power Plant, 7.5 MW at the Finegayan Plant and the remainder in various locations as backup power for critical infrastructure. In addition to this existing capacity, it is expected that the new Marine Corps Base at Finegayan would incorporate another 5 MW or more of emergency/standby generator capability to support its critical infrastructure. If requested by GPA, these assets could be utilized to reduce peak demand on the GPA system during days when GPA capacity might be insufficient for short time periods. This arrangement may be a possibility at any future time in the event GPA has a system failure and needs the support.

If it appears that demand would exceed the generation capacity of the GPA system, which is not anticipated, DoD could implement force flow reductions and/or adaptive program management, as discussed further in Volume 7.

3.2.2.2 Summary of Impacts

The following is a summary of operational impacts on existing utilities associated with increased power demands. Environmental impacts are not included in this section, but are detailed in the individual resource chapters of Volume 6. Table 3.2-2 shows anticipated supply and demand in 2014 and 2016.

Table 3.2-2. Power Supply and Demand in 2014 and 2016

Alternatives	*Supply (2014)*	*Demand (2014)*	*Power Surplus (2014)*	*Supply (2016)*	*Demand (2016)*	*Power Surplus (2016)*
Basic Alternative 1	552.8	347.48	15.75	552.8	355.51	21.54

Implementation of the preferred basic alternative would result in adequate power in all years, including the peak year of 2014. However, this scenario depends upon reconditioning the required CTs to restore the system capacity to current rated capacity and upgrade the T&D systems. It is anticipated that needed power upgrades would be implemented by an SPE, which would finance, upgrade, operate, and manage these systems under business arrangements with GPA. DoD is seeking financing for the necessary upgrades from GoJ. Alternatively, GPA may elect to finance and retain the direct operation of these facilities. If the required upgrades do not happen, the resulting impacts could be occasional power brownouts or blackouts during times of peak power demand. Several potential mitigations are discussed above as a contingency should this scenario occur. Table 3.2-3 summarizes the potential impacts on the power utility for Basic Alternative 1 based on successful reconditioning of existing generation units in time to meet the increased demand.

Table 3.2-3. Summary of Basic Alternative 1 Impacts for Power

Potentially Affected Resource	*Basic Alternative 1**
Power (direct and indirect impacts same)	LSI

Legend: LSI = Less than significant impact. *Preferred Alternative.

Because all power demands are met in the interim and long-term by implementing Basic Alternative 1 and the power system would be subject to greater demand but could be operated within existing permitted capacity, the impact of the proposed DoD relocation on the power utility for Basic Alternative 1 was determined to be less than significant.

No mitigations are deemed necessary for electrical power since the existing utility would be able to make the necessary upgrades to their current system to meet increased demand within the required time frame. Volume 7 provides a full discussion on mitigation measures and describes two additional mitigation measures; force flow reduction and adaptive program management of construction. Implementing either of these mitigation measures could further reduce impacts to the power utility by lowering peak population levels during construction, thus also lowering peak power demand.

3.2.3 Potable Water

3.2.3.1 Basic Alternative 1 (Preferred Alternative)

DoD Water System

Basic Alternative 1 would provide additional water capacity of 11.3 MGd (42.8 MLd), which is anticipated to be met by an estimated 22 new wells at Andersen Air Force Base (AFB), rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 2.5 MG (9.5 ML) water storage tanks would be constructed at ground level at NCTS Finegayan. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

Implementing Alternative 1 would result in a total planned water supply of 30.4 MGd (115 MLd) for the DoD water system at buildout (Table 3.2-4) accounting for water transferred to GWA of up to 4 MGd (15 MLd) from Fena Reservoir. Andersen AFB has determined that on average up to 1.7 MGd (6.4 MLd) is available for transfer to GWA. It is estimated that 1.6 MGd (6.1 MLd) would be required for transfer to GWA in 2019. The planned supply also meets the projected average daily demand at each military base.

Table 3.2-4. Potable Water Alternative 1 Proposed DoD Water Supply and Demand

Water Supply Source	*Marine Corps Finegayan*	*Andersen AFB*	*Navy*	*Total*
Cantonment Alternatives 1 & 2				
Current Surface Water Supply			10.97	10.97
Current Groundwater Supply		4.73	2.21	6.94
Development of New Water Supply Wells	11.28			11.28
Rehabilitation of Existing Navy Well			1.23	1.23
Planned Supply Cantonment Alternatives 1 & 2	**11.28**	**4.73**	**14.41**	**30.42**
Maximum Daily System Capacity using UFC Guidance	10.61	4.88	12.98	28.48
GWA Transfer Projected Need in 2019	0.00	1.55	4.00	5.55
Maximum Daily System Capacity using UFC Guidance+ GWA Transfer	**10.61**	**6.43**	**16.98**	**34.03**

Legend: AFB = Air Force Base; GWA = Guam Waterworks Authority; UFC = Unified Facilities Criteria. *Source:* NAVFAC Pacific 2010e. All units are MGd.

If a supply shortfall occurs within the GWA water system, it is possible that water outages or low pressure conditions would take place. The outages and low water pressure occurrences that GWA currently experiences can result in microbiological and other contaminants entering the distribution system, potentially resulting in illness. Water outages or low water pressure can also prevent effective fire fighting and degrade the basic sanitary needs of the population. A supply shortfall could worsen this situation.

Given the planned supply, the Navy system has adequate water to meet Unified Facilities Criteria (UFC) system capacity requirements for average daily demand but a shortfall for maximum daily demand of 2.6 MGd (9.8 MLd). The Air Force system has adequate water to meet UFC system capacity requirements for average daily demand but has a shortfall for maximum daily demand of 1.7 MGd (6.4 MLd). Based on personal communications with Navy utility managers on Guam, there are currently no water shortages being experienced in the DoD water systems, except during severe drought periods. The 2.6 MGd (9.8 MLd) and 1.7 MGd (6.4 MLd) shortfall estimates for maximum daily demand are based on UFC planning criteria, which provides guidance for future project programming. Implementing long-term alternatives would fully resolve the projected shortfall for the Navy. Installing the five planned wells on Andersen AFB and making improvements to reduce UFC would address the shortfall. Alternatively, the shortfall can be addressed through transfer of excess water from northern Guam through interconnections with the Marine Corps Base, Navy islandwide system, and the Andersen AFB water system.

Water distribution and transmission lines would be constructed for DoD to deliver water from the new DoD wells to the water storage tanks that would be constructed at the new Marine Corps Base. GWA does not have an independent islandwide water transmission system that is capable of moving water throughout the main areas of Guam. There are numerous existing interconnections between the two independent systems, which allow for transfer of water from the DoD to the GWA water systems. These interconnections are used to transfer water from Fena Reservoir to the GWA system. Proposed interconnections and system upgrades to restore the ability to transfer excess water from the Andersen AFB system to the Navy islandwide water system would be needed to facilitate water transfer to GWA to address the GWA shortfall. These upgrades would allow the DoD water needed to meet GWA shortfalls during the military relocation to be transferred through the DoD transmission system to the closest interconnection to the GWA system where water is needed. Maximizing the use of the DoD islandwide water transmission system would minimize the negative impacts that occasionally occur within the substandard GWA distribution system. Details of the proposed DoD water system improvements that facilitate transfer of excess water capacity to GWA are described later in this section under *Mitigation for Potential GWA Potable Water Shortfalls within DoD Control*.

A draft MOU has been developed between DoD and GWA that establishes a framework of cooperation, and information/resource sharing with the goal of devising utility service solutions to meet the projected additional water requirements associated with the military relocation. This division of utility services would be accomplished through joint planning and cooperation such that the requirements of both the DoD and civilian community would be met in a manner that is mutually beneficial and maximizes the effectiveness of the overall utility systems. Transfers and exchanges of water between the DoD and GWA systems would be accomplished through this MOU.

As discussed in Volume 6, Chapter 2, Section 2.2, by using sustainability measures, the Marine Corps Base could reduce its estimated maximum daily demand by 40% compared to UFC guidance. Additionally, the existing bases are expected to comply with Executive Order 13423, which specifies a 16% reduction in water usage over the 2007 baseline by 2015. Table 3.2-5 presents the DoD water supply and demand estimates assuming reductions for compliance with the executive orders regarding water conservation and sustainability efforts for this project. Using an estimate of the revised demand, the planned water supply is sufficient overall to meet the average daily demand and maximum daily demand at all bases.

Table 3.2-5. DoD Water Supply and Demand Estimates Using Executive Order Compliance and Sustainability Factor

Water Supply Source	*Marine Corps Finegayan*	*Andersen AFB*	*Navy*	*Total*
Cantonment Alternatives 1 & 2				
Current Surface Water Supply			10.97	10.97
Current Groundwater Supply		4.73	2.21	6.94
Development of new water supply wells	6.60			6.60
Rehabilitation of existing Navy well			1.23	1.23
Supply Cantonment Alternatives 1 & 2	**6.60**	**4.73**	**14.41**	**25.74**
Maximum Daily Demand Using Executive Order Compliance and Sustainability Principles	6.33	2.99	9.75	19.08
GWA Transfer Projected Need in 2019	0.00	1.55	4.00	5.55
Maximum Daily Demand Using Executive Order Compliance and Sustainability Principles + GWA Transfer	6.33	4.30	13.75	24.39

Legend: AFB = Air Force Base; GWA = Guam Waterworks Authority.
Source: NAVFAC Pacific 2010e. All units are MGd.

To meet the increased maximum direct water demand as the military relocation progresses, construction of planned water components would begin in 2010. Pilot test wells would be drilled to verify the production capacity of the wells. DoD well development would be coordinated with GWA and would comply with GEPA permit requirements to optimize groundwater withdrawal from the NGLA. Pilot test well results and/or coordination of groundwater withdrawal with GWA could result in some adjustment to the proposed locations of wells.

It is anticipated that the DoD proposed water system would be implemented by an SPE, which would likely be a private business entity formed to finance, develop, operate and manage the DoD water system infrastructure (e.g. wells, storage tanks, treatment, and transmission lines and distribution lines). It is anticipated that the SPE would utilize GoJ financing provided in accordance with the Realignment Roadmap, as described in the Executive Summary of Volume 1. DoD would then likely purchase utilities from the SPE under a Utilities Service Contract. Fees generated through utilities service contracts could be used to repay financing costs. The established DoD rate structure would reflect current rates adjusted for inflation. DoD is working to secure financing for the DoD water system from the GoJ. Currently, the GoJ is considering financing DoD's proposed water system projects.

GWA Water System

Use of the GWA water system is not a component of the Alternative 1 water supply. According to GWA, there is adequate supply to meet the demand from the current civilian population, but there is no excess water available for DoD use on base. It is assumed that GWA would continue to meet the current civilian demand including baseline growth not related to the action, but that supply is not available to meet off-base Marine Corps relocation related demands from induced, construction workers and civilian worker populations. It is assumed that GWA would not have sufficient resources to install potable wells to meet the short term peak demands resulting from the Marine Corps relocation.

Projected initial water demands on the GWA water system are shown in Table 3.2-6, which summarizes the existing demand on the GWA water system (including projected increases in civilian demand related to natural population growth), projected increases associated with the indirect water demands from imported construction workforce, and civilian increases in demand that would result from induced growth as a result of the military relocation. Demand projections are then compared to the planned GWA potable water supply to identify whether shortfalls would be expected during the construction phase.

The total civilian demand on the GWA water system (including demand associated with the construction workforce and induced civilian growth) is projected to reach 51.9 MGd (196 MLd) in 2014. Of this total demand, 43.5 MGd (165 MLd) is needed to meet demands from the baseline population and the population growth that is independent of impacts from this action. It is assumed that GWA would decrease system leakage such demand from baseline growth is met. This would result in 1.5 MGd (5.7 MLd) reduction in demand in 2014. In 2014, the GWA water system would have the capacity to supply 42.4 MGd (161 MLd) of potable water from the existing resources. DoD has agreed to transfer water to meet the off-base Marine Corps relocation-related water demand. DoD would continue to transfer up to 4 MGd (15 MLd) to GWA under the current MOU. DoD would also transfer up to 1.7 MGd (6.4 MLd) from the Andersen AFB water system and up to an additional 2.0 MGd (7.6 MLd) from the Navy water system to GWA under an agreement to be negotiated. If necessary, DoD would install five wells planned by Andersen AFB and make the excess water available for transfer to GWA. It is estimated that up to 4.7 MGd (17.8 MLd) would be required from the Marine Corps Base water system.

As described above, DoD proposes to construct facilities that would facilitate transfer of water to GWA to meet the shortfall. Alternately, or in conjunction with the above, force flow reductions and/or adaptive program management practices could be implemented by DoD to slow the pace of DoD and construction-related population increases. More information on force flow reduction and adaptive program management is provided in Volume 7.

GWA supply and demand estimates are shown on Figure 3.2-1. As discussed in Volume 6, Chapter 2, the percent of water loss due to leakage in the GWA water system is not well defined. GWA states that the leakage is 10% with the remaining UFW being unmetered or under metered connections. USEPA Region 9 disagrees and recommends using a range of 25% to 40%. As such, for these water demand estimates, 25% leakage has been chosen as the best estimate. Volume 6, Chapter 2, Section 2.2.2.2 provides the basis for use of 25% leakage. In Figure 3.2-1, the GWA water demand estimates are shown for 10%, 25% and 40% leakage. The water demand is less than the GWA water supply supplemented by excess DoD water as shown in Table 3.2-6 for leakage of 25% or less. At 40% leakage, additional water is required in 2012 (0.4 MGd [1.5 MLd]) and 2014 (0.6 MGd [2.3 MLd]). The additional water would be available in the DoD water system and could be provided to GWA, if needed. However, the estimates provided above are worst case scenarios and do not consider factors the following which are likely to increase supply or reduce UFW between 2010 and 2019:

- GWA plans to upgrade the Ugum water treatment plant.
- GWA has stated that 7 MGd (26 MLd) additional groundwater supply is planned for installation.
- DoD would support rehabilitation of existing DoD wells.
- No rehabilitation of GWA wells is considered.

Table 3.2-6. Projected Water Supply and Demand on the GWA Water System

GWA Water System	*Year*									
	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Potable Water Demand [a]										
Existing Guam Civilian [b]	42.0	42.4	42.7	43.1	43.5	43.8	44.2	44.5	44.9	45.2
Construction Workforce	0.5	1.3	2.1	2.5	2.7	1.7	0.6	0.0	0.0	0.0
DoD Civilian Workforce & Dependents	0.0	0.1	0.1	0.1	0.5	0.6	0.6	0.6	0.6	0.6
Induced Civilian Increase	0.8	2.1	3.6	4.3	5.2	3.9	1.9	1.4	1.4	1.4
Projected Demand (without leak reduction)	43.4	45.9	48.5	50.0	51.9	50.1	47.2	46.4	46.8	47.1
Leakage Reduction [e,j]	0.0	-0.4	-0.7	-1.1	-1.5	-1.8	-2.2	-2.5	-2.9	-3.2
Total Projected Demand	43.4	45.5	47.8	48.9	50.4	48.3	45.1	43.9	43.9	44.0
Potable Water Supply										
GWA Groundwater and Surface Water Sources Production	40.4	40.4	40.4	40.4	40.4	40.4	40.4	40.4	40.4	40.4
Lower Production of Agana Wells with Elevated Chloride Levels [c]	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Navy Transfer from Fena Reservoir	4	4	4	4	4	4	4	4	4	4
Existing GWA Supply	44.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4
Projected Excess (Supply-Demand)	1.0	-3.1	-5.4	-6.5	-8.0	-5.9	-2.7	-1.5	-1.5	-1.6
AAFB Water System Excess Supply	0.0	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Navy Water System Excess Supply [g]	0.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Marine Corps Base Excess Supply [h,i]	0.0	0.0	2.0	4.7	4.7	4.7	4.7	4.7	4.7	4.7
DoD Excess Supply [f]	0.0	3.7	5.7	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Total Planned Supply	44.4	46.1	48.1	50.8	50.8	50.8	50.8	50.8	50.8	50.8
Projected Excess after Expansion (Supply-Demand)	1.0	0.6	0.3	1.9	0.4	2.5	5.7	6.9	6.9	6.8
DoD water transfer to GWA - needed	0.0	3.1	5.4	6.5	8.0	5.9	2.7	1.5	1.5	1.6

Notes: All units are MGd. This table does not include GWA's effort to detect and fix leaks, Unaccounted for Water.

[a] Demand is based on calculations using the UFC, 50% Unaccounted for Water rate, and population estimates provided in Volume 6, Table 2.2-3.

[b] Includes projected increases in civilian demand related to natural population growth.

[c] GWA stated to DoD that a 2 MGd (7.6 MLd) reduction in production would be made.

[d] GWA Draft Capital Improvement Plan 2010-2014.

[e] Assumes GWA increase well capacity to meet baseline growth.

[f] Does not include rehabilitation of Tumon Maui or Marbo #2.

[g] Excess water from Navy water system (Fena Reservoir or wells).

[h] Excess water from MCB water system (system capacity - MDD assuming sustainability measures are integrated).

[i] Available water *from* MCB water system would be transferred to GWA using temporary pipes if necessary in 2012.

[j] GWA water supplies estimates do not include the 1.8 MGd (6.8 MLd) planned expansion to Ugum water treatment plant in southern Guam.

Legend: AFB = Air Force Base; DoD = Department of Defense; GWA = Guam Waterworks Authority.

Source: GWA 2007b

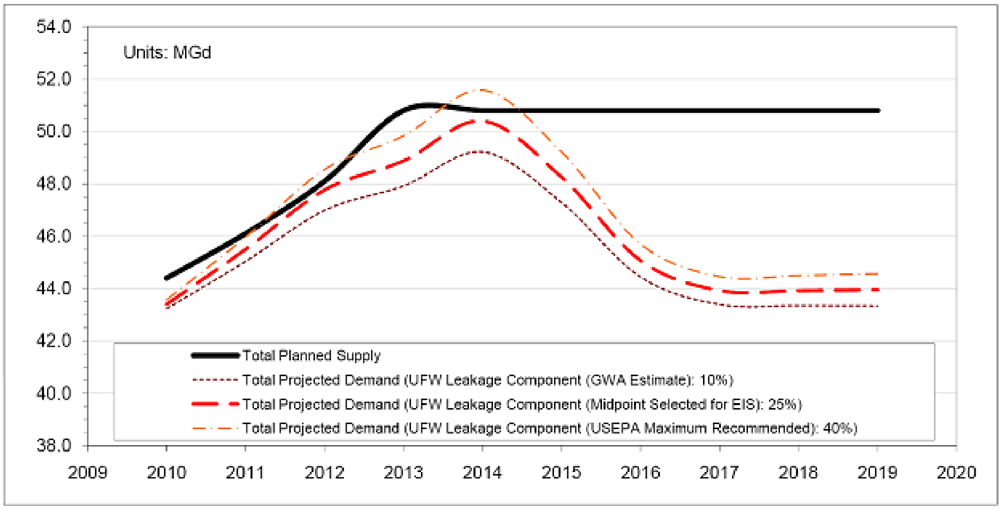

Figure 3.2-1. GWA Supply and Demand

The baseline condition of the GWA water system is described in the GWA WRMP. The overall condition of the water system equipment is identified as poor with substantial corrosion in the entire infrastructure. Initial results from the leak detection program indicate leakage of 4 MGd (15 MLd) from the GWA water system and 20 MGd (76 MLd) in unmetered or undermetered water. Problems with the GWA infrastructure result from the effects of natural disasters, poor maintenance, and vandalism. According to the WRMP, the water system infrastructure does not meet the basic flow and pressure requirements for all customers. Maintenance to improve the system has been conducted since the water system assessment was made in 2005. GWA plans improvements to the distribution system principally to improve continuity of the water supply. Improvements include a corrosion program, pipe and equipment replacement, distribution system improvements, northern system raw water transmission line improvements, and filtration compliance for groundwater under the direct influence of surface water.

Comparison of supply to the estimated demand for southern Guam is shown in Table 3.2-7. The current supply from surface water resources in southern Guam is 2.2 MGd (8.3 MLd). The estimated demand in southern Guam is currently 8.0 MGd (30.3 MLd). Approximately 5.8 MGd (22.0 MLd) must be transferred from the central or northern water systems to southern Guam to meet the demand in the south. In 2019, the additional water required in southern Guam would increase to 6.8 MGd (25.7 MLd). Although the WRMP indicates that the water systems are interconnected, it is unclear whether interconnections are effective and efficient.

Transmission lines are used to make bulk water transfers. Distribution lines are used to deliver water from the transmission lines to the customers. It is assumed that the primary challenge in delivering water to GWA customers while maintaining adequate supplies and pressures throughout the system is difficult because the existing transmission lines are incapable of serving current requirements. According to the 2007 WRMP there are deficiencies in the transmission:

> "GWA's water system network does not have a separate water transmission system that conveys water from supply to storage and then from storage through the distribution system. Transmission and distribution are combined into a common network for GWA's system. Water supply sources feed the same pipes to which service connections are made. The installed system provides severe challenges to GWA in attempting to meet the SDWA disinfection requirements because some of the customer

> connections are adjacent to the wells, or the inception point for disinfection. This shortcoming is one of the high priority CIP projects that must be pursued by GWA to enhance the integrity and reliability of its potable water system."

Table 3.2-7. GWA Water Supply and Demand Estimates by Region 2015

Water Supply Source	*North and Central*	*South*	*Total*
Current Conditions			
Current Production	38.2	2.2	40.4
Navy GWA Transfer to Central (purchased)	4	0	4.0
Current Supply	42.2	2.2	44.4
Current Demand	34.0	8.0	42.0
Projected Excess (Supply – Demand)	**8.2**	**-5.8**	**2.4**
Future Conditions			
Planned Lower Well Production	-2	0	-2.0
DoD Transfer	8.4	0	8.4
Future Supply	48.6	2.2	50.8
Future Demand not adjusted for Leakage Reduction	42.6	9.2	51.9
Future Demand adjusted for Leakage Reduction	41.4	9.0	50.4
Projected Excess (Supply – Demand)	**7.2**	**-6.8**	**0.4**

Legend: DoD = Department of Defense; GWA = Guam Waterworks Authority.
Source: NAVFAC Pacific 2010e. All units are MGd.

Deficiencies and losses in the GWA distribution system necessitate introducing water supplies at strategic locations as close to the localized demands as possible. Introducing water at limited interconnection points in northern Guam would be ineffective due to leaks, losses, and capacity restrictions that would hinder effective delivery through the GWA distribution system to demands in central Guam. As opposed to GWA's water system, the DoD has a transmission system that is capable of delivering bulk water to population centers in central and northern Guam from established wells and the Fena Reservoir. DoD water system functions independently and has the capability to transfer water to the GWA water system. DoD is not dependent on any water transfers from GWA. Improvements in the Navy transmission and storage system would benefit all island users with interconnection transfer points made available to GWA. Since GWA currently relies on the Fena Reservoir supply, improvements to the DoD water transmission system would enhance the capability of transferring water from the Fena Reservoir to northern Guam to the benefit of all island users. Further improvements as proposed in the EIS to the DoD transmission loop that currently exists in northern Guam would provide increased capability and reliability to better serve all residents of northern Guam with the ability of GWA to interconnect with this transmission system. DoD and GWA are identifying locations for interconnections between the water systems. Improvements to the Navy Island Wide water systems may include line replacement, expansion of the Navy Island Wide water transmission mains from the Harmon pump station to Andersen South Annex, and rehabilitation of existing pump stations to facilitate water transfer from northern Guam to central and southern Guam. DoD is also considering additional storage tanks. However, the optimum location of these storage tanks has not been determined. Once determined, DoD would conduct a NEPA review for these tanks. These modifications would allow the expanded water capacity of the DoD water system to be transferred throughout the island to support the GWA customers through transfer to the GWA water distribution system as near to the demands as possible.

Discussions between DoD and GWA can facilitate an understanding of the total impact of the development on the community infrastructure, the NGLA, the NDWWTP, and on the construction progress. Although control of location of temporary housing for construction workers resides with construction contractors and GovGuam through its planning process, DoD is interested in avoiding adverse impacts through effective planning. Contractors proposing workforce housing would be responsible for coordinating site approvals and permits with local Guam planning and zoning agencies, and with GWA. DoD can require minimum housing standards for worker housing through contract provisions and selection criteria, which should guide the contractors to select locations with adequate utility infrastructure.

Potential contractor housing locations and capacity are listed in Table 3.2-8 with an estimated water demand. Water demands range from 0.002 MGd (0.008 MLd) for Area 9 to 1.4 MGd (5.3 MLd) for Area 1 assuming a per person demand of 70 gallons per capita per day (265 liters per capita per day) and 10% loss due to leakage assuming the water would be transferred to the campus primarily through newly installed water mains. As discussed above, DoD has agreed to transfer excess water supply from existing and planned water resources to GWA to support off-base water demands resulting from the Marine Corps relocation. Therefore, GWA should have adequate water to meet construction worker water demands. The Area 1 compound would be located just south of the Finegayan base. DoD may consider supplying the compound directly from DoD resources for example rehabilitation of existing DoD wells (water treatment for volatile organic compounds contamination) with upgrades to the DoD distribution system. With the exception of Areas 8 and 9, which have relatively few workers living on the compounds, the water demands may be significant locally. More detailed information on the water system infrastructure is required to determine whether the size and condition of the water mains is adequate to distribute the required quantity of water to these areas.

Table 3.2-8. Construction Worker Housing Facilities

Area	*Municipal District*	*Location*	*Capacity No. of Workers*	*Demand (MGd)*	*Percent of Current Production*
1	Dededo/Tamuning	North	18000	1.4	3.6%
2	Yigo	North	1176	0.1	0.24%
3	Barrigada	Central	390	0.03	0.08%
4	Tamuning	Central	1200	0.1	0.24%
5	Tamuning	Central	350	0.03	0.07%
6	Tamuning	Central	696	0.1	0.14%
7	Tamuning	Central	856	0.1	0.17%
8	Mangilao	Central	64	0.005	0.01%
9	Ordot	Central	30	0.002	0.01%

Legend: MGd = million gallons per day.

Potential scenarios for water supply to the primary construction workers campus include rehabilitation of existing DoD water wells and water transmission through rehabilitated DoD water transmission mains and a new transmission main from northern Guam to the Harmon area. This approach would limit pumping requirements throughout the system and reduce system losses through extensive distribution networks by delivering bulk water directly from source areas to village or neighborhood demand centers. This approach would help to ensure overall adequate off-base water supplies and pressures and also allow GWA to more efficiently assess the location of their distribution system losses by evaluating localized water transfer quantities into specific villages and neighborhoods. For the primary worker camp (up to 18,000 workers), DoD anticipates the construction contractor selected to build the facility would install new water supply pipes from GWA mains that would be close to transfer points from DoD water system, thereby limiting UFW due to leakage and reducing potential negative impacts to existing GWA customers. Potentially, the water main from the primary worker camp would be connected to a DoD main circumventing the GWA water system.

It is anticipated that the DoD proposed water system would be implemented by an SPE, which would likely be a private business entity formed to finance, develop, operate and manage the DoD water system infrastructure (e.g. wells, storage tanks, treatment, and transmission lines and distribution lines), including the proposed transmission lines and interconnects that would allow transfer of DoD excess water capacity to the GWA system. It is anticipated that the SPE would utilize GoJ financing provided in accordance with the Realignment Roadmap, as described in the Executive Summary of Volume 1. DoD would then likely purchase utilities from the SPE under a Utilities Service Contract. Fees generated through utilities service contracts could be used to repay financing costs. The established DoD rate structure would reflect current rates adjusted for inflation. DoD is working to secure financing for the DoD water system from the GoJ. Currently, the GoJ is considering financing DoD's proposed water system projects.

If the DoD fails to secure necessary financing from the GoJ for the proposed DoD water system, significant environmental impacts such as those experienced today in the GWA system would continue to occur. These impacts may include water supply shortage for the DoD population and for Guam's civilian population, low water pressure, and loss of reliable water service to portions of the island. Consistent with the Navy's commitment to keep from significantly impacting utilities on Guam, the DoD would apply force flow reductions and/or adaptive program management of construction as explained in Volume 7, Chapter 2. Failure to secure necessary funding may require that DoD delay or not issue construction contracts or task orders until such time as the financing is received from the GoJ and the necessary projects are implemented. Such action would severely impact the construction pace and the ability of Navy to complete required construction to support the Marine Corps relocation.

Northern Guam Lens Aquifer

"Sustainable yield" is defined as the rate at which groundwater can be continuously withdrawn from an aquifer without impairing the quality or the quantity of the pumped water. The peak average well withdrawal from the NGLA is shown in Table 3.2-9. The estimated well production includes the average daily demand for the Marine Corps relocation, Andersen AFB, and Navy Hospital; full use of the Navy wells on Finegayan; and the production rate from GWA wells assuming the current production rate minus 2 MGd (7.6 MLd) for lowered production of several wells in the Agana subbasin and additional water supply from the Agafa-Gumas subbasin to meet baseline growth for the civilian population.

Table 3.2-9. Total Well Withdrawal and Yield Estimates Projected for 2014 (Peak Year)

Wells	*Total (MGd)*
GWA Average Daily Demand on Wells (A)	37.5
Cantonment Alternatives 1 & 2	
DoD Estimated Average Daily Demand on Groundwater Resources based on UFC (Finegayan, Andersen AFB, and Navy Hospital) (B)	17.3
Total Well Withdrawal (Using UFC) (A+B)	54.7
DoD Estimated Average Daily Demand based on Sustainability (C)	15.3
Total Well Withdrawal (Using Sustainability) (A+C)	**52.7**

Legend: AFB = Air Force Base; DoD = Department of Defense; GWA = Guam Waterworks Authority; MGd = million gallons per day; UFC = Unified Facilities Criteria.

To compare the estimated available yield of the NGLA with peak groundwater demand occurring in 2015, Table 3.2-9 presents the approximate DoD and civilian well withdrawal assuming average daily demand. Because sustainable yield defines the rate at which groundwater can be continuously withdrawn from an aquifer without impairing the quality or the quantity of the pumped water, it is more appropriate to consider the average daily demand instead of the maximum daily demand when assessing potential impacts on the aquifer. The maximum average well demand from the NGLA occurring in 2014 of 53.3 MGd (202 MLd) is below the 1991 and 1982 sustainable yield estimates of 80.5 MGd (304.7 MLd) and 57.5 MGd (217.7 MLd), respectively. Figure 3.2-2 graphically represents DoD and GWA wells production relative to the combined sustainable yield estimates for the subbasins. As shown in Figure 3.2-2, planned DoD well expansion would not exceed the estimated sustainable yield and would therefore have less than significant impact on the NGLA.

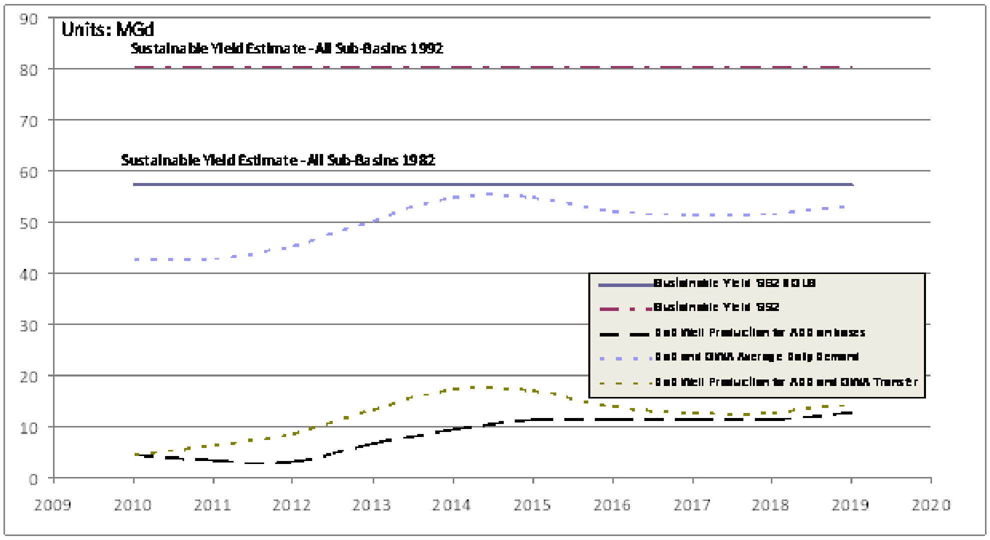

Figure 3.2-2. Well Withdrawal to Meet DoD Average Daily Demand and GWA Average Daily Demand in 2014

Figure 3.2-3 shows the average demand on the individual subbasins for 2014 when groundwater production is highest during the relocation period from DoD demands and water transfer to GWA. Water production currently exceeds both sustainable yield estimates for the Yigo subbasin. Water production currently exceeds the 1982 sustainable yield estimate for the Finegayan subbasin. Average well production with the planned well development for the Marine Corps in the Agafa-Gumas and Andersen subbasins is below both sustainable yield estimates for these underdeveloped portions of the aquifer. Average well production is below the 1992 sustainable yield estimate for Finegayan including the demand for the Marine Corps Base. The two subbasins which would be primarily developed to meet demand at the Marine Corps Base have production rates which are compliant with the lower 1982 sustainable yield estimates even at peak groundwater production.

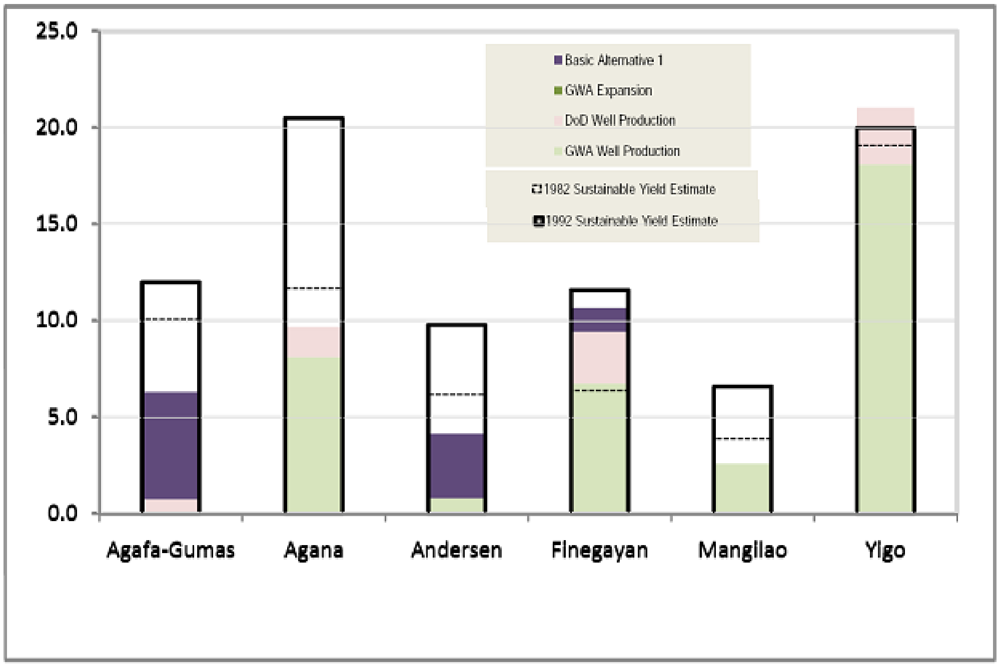

Figure 3.2-3. Well Withdrawal to Meet DoD Average Daily Demand and GWA Average Daily Demand By Subbasin in 2015

<u>Proposed Mitigation Measures</u>

Mitigation for Potential GWA Potable Water Shortfalls within DoD Control

The GWA water supply does not currently have adequate capacity to meet off-base indirect demand resulting from the induced civilian population growth of the Marine Corps relocation. DoD proposes to help mitigate the off-base water shortfall by providing excess water capacity to GWA from its existing system and from the early installation of DoD wells. A MOU is being developed between DoD and GWA that would address procedures to cooperate in the overall management of the NGLA, the source of water for the new DoD wells. In addition, it is expected that a Customer Service Agreement would be created to address the exchange of water between NAVFAC Marianas and GWA. It is presumed that the best potential sites for future wells in the NGLA are located beneath DoD lands and meeting future water demands on Guam would require utilizing water resources under DoD land for the benefit of all of Guam.

Transmission lines are used to make bulk water transfers. Distribution lines are used to deliver water from the transmission lines to the customers. It is assumed that the primary challenge in delivering water to GWA customers while maintaining adequate supplies and pressures throughout the system is difficult because the existing transmission lines are incapable of serving current requirements. According to the 2007 WRMP there are deficiencies in the transmission:

> "GWA's water system network does not have a separate water transmission system that conveys water from supply to storage and then from storage through the distribution system. Transmission and distribution are combined into a common network for GWA's system. Water supply sources feed the same pipes to which service connections are made. The installed system provides severe challenges to GWA in attempting to meet the SDWA disinfection requirements because some of the customer connections are adjacent to the wells, or the inception point for disinfection. This shortcoming

> is one of the high priority CIP projects that must be pursued by GWA to enhance the integrity and reliability of its potable water system."

Deficiencies and losses in the GWA distribution system necessitate introducing water supplies at strategic locations as close to the localized demands as possible. Introducing water at limited interconnection points in northern Guam would be ineffective due to leaks, losses, and capacity restrictions that would hinder effective delivery through the GWA distribution system to demands in central Guam. As opposed to GWA's water system, the DoD has a transmission system that is capable of delivering bulk water to population centers in central and northern Guam from established wells and the Fena Reservoir. DoD water system functions independently and has the capability to transfer water to the GWA water system. DoD is not dependent on any water transfers from GWA. Improvements in the Navy transmission and storage system would benefit all island users with interconnection transfer points made available to GWA. Since GWA currently relies on the Fena Reservoir supply, improvements to the DoD water transmission system would enhance the capability of transferring water from the Fena Reservoir to northern Guam to the benefit of all island users. Further improvements as proposed in the EIS to the DoD transmission loop that currently exists in northern Guam would provide increased capability and reliability to better serve all residents of northern Guam with the ability of GWA to interconnect with this transmission system. DoD and GWA are identifying locations for interconnections between the water systems. Improvements to the Navy Island Wide water systems may include line replacement, expansion of the Navy Island Wide water transmission mains from the Harmon pump station to Andersen South Annex, and rehabilitation of existing pump stations to facilitate water transfer from northern Guam to central and southern Guam. DoD is also considering additional storage tanks. However, the optimum location of these storage tanks has not been determined. Once determined, DoD would conduct a NEPA review for these tanks. These modifications would allow the expanded water capacity of the DoD water system to be transferred throughout the island to support the GWA customers through transfer to the GWA water distribution system as near to the demands as possible.

Potential scenarios for water supply to the primary construction workers campus include rehabilitation of existing DoD water wells and water transmission through rehabilitated DoD water transmission mains and a new transmission main from northern Guam to the Harmon area. This approach would limit pumping requirements throughout the system and reduce system losses through extensive distribution networks by delivering bulk water directly from source areas to village or neighborhood demand centers. This approach would help to ensure overall adequate off-base water supplies and pressures and also allow GWA to more efficiently assess where their distribution system losses are by evaluating localized water transfer quantities into specific villages and neighborhoods. For the primary worker camp (up to 18,000 workers), DoD anticipates the contractor selected to build the facility would install new water supply pipes from GWA mains that would be close to transfer points from DoD water system, thereby limiting UFW due to leakage and reducing potential negative impacts to existing GWA customers. Potentially, the water main from the primary worker camp would be connected to a DoD main circumventing the GWA water system.

The availability of excess DoD water production capacity to GWA water systems may be encumbered by the following:

- Repair and maintenance of wells would periodically reduce DoD water supplies.
- Droughts that would reduce the DoD water production capacity.

It is anticipated that the DoD proposed water system would be implemented by an SPE, which would likely be a private business entity formed to finance, develop, operate and manage the DoD water system infrastructure (e.g. wells, storage tanks, treatment, and transmission lines and distribution lines), including the proposed transmission lines and interconnects that would allow transfer of DoD excess water capacity to the GWA system. It is anticipated that the SPE would utilize GoJ financing provided in accordance with the Realignment Roadmap, as described in the Executive Summary of Volume 1. DoD would then likely purchase utilities from the SPE under a Utilities Service Contract. Fees generated through utilities service contracts could be used to repay financing costs. The established DoD rate structure would reflect current rates adjusted for inflation. DoD is working to secure financing for the DoD water system from the GoJ. Currently, the GoJ is considering financing DoD's proposed water system projects.

If the DoD fails to secure necessary financing from the GoJ for the proposed DoD water system, significant environmental impacts like those experienced today in the GWA system would continue to occur. These may include water supply shortage for DoD's population and for Guam's civilian population, low water pressure, and loss of reliable water service to portions of the island. Consistent with the Navy's commitment to keep from significantly impacting utilities on Guam, the DoD would apply force flow reductions and/or adaptive program management of construction as explained in Volume 7, Chapter 2. Failure to secure necessary funding may require that DoD delay or not issue construction contracts or task orders until such time as the financing is received from the GoJ and the necessary projects are implemented. Such action would severely impact the construction pace and the ability of Navy to complete required construction to support the Marine Corps relocation.

Mitigation for Potential GWA Potable Water Shortfalls outside DoD Control

Water quality is related to water treatment and the condition of the water system infrastructure. Increasing the quantity of water alone would not mitigate potential public health impacts associated with low pressure, insufficient treatment, corrosion of tanks and piping, and from failing infrastructures. In the absence of water system repairs and upgrades, the GWA system would continue to be at risk for significant public health impacts, and the additional demands on the system from the relocation would simply make this already significant risk even worse.

DoD has identified mitigation measures within DoD control and outside DoD control, including measures that GWA and GovGuam could implement to address the shortfalls provided funding sources could be found. Because it is doubtful that GWA could fund and implement required upgrades in time for the start of the proposed DoD relocation, it is anticipated that public health and safety impacts from increased demand on potable water would be significant until the necessary off base infrastructure improvements could be completed either by GWA or through financing from the GoJ.

As described above, DoD proposes to construct facilities to assist with the transfer of water to GWA's distribution system. This action would allow for DoD water needed to meet GWA shortfalls during the military relocation to be transferred through DoD transmission mains to the closest interconnection to the GWA system where water is needed. Maximizing the use of the DoD islandwide water transmission system would minimize the negative impacts that could occur from using the substandard GWA distribution system. Monitoring of water transfers at specific transfer points would help GWA evaluate UFW and system losses as well as prioritize maintenance/repairs in isolated areas of their distribution system.

The draft MOU that is being developed between DoD and GWA to address the GWA water shortfall also addresses interconnection points. DoD is working to secure financing for the DoD water system from the GoJ, which includes construction of systems to facilitate the transfer of excess water capacity to GWA. Currently, the GoJ is considering financing DoD's proposed water system projects.

For GWA solely rely on the DoD system to mitigate impacts associated with the water system would ignore long-standing substandard conditions of the GWA system, and the ability of the GovGuam and GWA to contribute toward mitigating impacts. GovGuam has historically implemented control measures such as accepting private consortiums infrastructure development, moratoriums, and measures through building permit approvals or other mechanisms to steer new development to areas with adequate water supply, providing localized areas with surplus water capacity. GWA would have the ability to assess a system development charge to contractors and workforce housing developers that could be used to fund improvements to the water system. To address the timing gap between availability of system development charge funds and construction of needed improvements to meet the anticipated demands, GWA may request an interconnection with the DoD water system, as discussed above, or seek other federal funding sources. These options would minimize impacts to existing rate payers.

If the GWA cannot meet the projected increase in demand resulting from induced civilian growth, GovGuam could implement measures to control the rate of induced growth through the building permit process and/or by restricting the number of water and sewer connection requests that are approved. Limitations on permits and water or sewer connections could delay completion of the DoD relocation.

GovGuam could also incentivize water conservation measures by offering rebates on upgrades to water saving devices. These incentives are given periodically on the mainland. Upgrading current water devices to low-flow water saving models would reduce current demand.

In meetings with DoD, GWA has indicated that it would install new wells to meet some, if not all, of the project indirect water demand from the military relocation in accordance with the WRMP. This action would include installing 16 additional wells to offset existing wells that need to be taken out of service due to high chlorides or contamination, and new wells to meet normal population growth and induced civilian growth from the military relocation. However, since funding for these new wells has yet to be secured by GWA, this EIS assumes that these wells would not be in service during the construction phase of the military relocation, and therefore would not offset the shortfalls expected. The impacts assessed in this EIS are based on this assumption.

Apart from the DoD efforts to secure financing from GoJ for the proposed DoD water system, there are other U.S. Government efforts to address utilities infrastructure funding shortfalls on Guam. USEPA Region 9 and GovGuam have identified the need for $1.3B in funding to implement necessary water and wastewater infrastructure improvements that must be accomplished in the first five years to accommodate the military relocation. The CEQ has facilitated interagency meetings with DoD and appropriate federal agencies to identify funding sources to meet this need. Additionally, the EAC is evaluating overall Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD military relocation. As part of this evaluation the EAC is specifically examining federal funding options for water and wastewater infrastructure improvements that may not be funded through GoJ financing.

If the DoD fails to secure necessary financing from the GoJ for the proposed DoD water system, significant environmental impacts like those experienced today in the GWA system would continue to occur. These impacts may include water supply shortage for DoD’s population and for Guam’s civilian population, low water pressure, and loss of reliable water service to portions of the island. Consistent with the Navy’s commitment to keep from significantly impacting utilities on Guam, the DoD would apply force flow reductions and/or adaptive program management of construction as explained in Volume 7, Chapter 2. Failure to secure necessary funding may require that DoD delay or not issue construction contracts or task orders until such time as the financing is received from the GoJ and the necessary projects are implemented. Such action would severely impact the construction pace and the ability of Navy to complete required construction to support the Marine Corps relocation.

Mitigation for Potential Impacts on NGLA

As a result of the ongoing discussions between GWA, CCU, GEPA, and DoD representatives it was generally agreed that a joint planning effort was needed for water resource development in the NGLA to provide responsible development and preservation of the sole source aquifer. This planning effort could be done with an advisory panel composed of representatives from the various stake holders. Some of the proposed responsibilities of the advisory panel included:

- Co-management of the NGLA
- Measures to protect the NGLA
- Well placement
- Water exchange
- Rate structure
- Interconnections
- Well Head protection
- Support for workforce housing and DoD housing

As part of the proposed mitigation measures, DoD would also undertake monitoring of groundwater quality during well development and use would be performed to confirm that increased pumping does not adversely affect the NGLA. Careful monitoring of the chloride concentrations in the subbasins and the capability to shift demand to wells farther from affected subbasins would reduce any potential negative impacts on groundwater. Additional details on mitigation are provided in Volume 7.

Mitigation for Potential Impacts on NGLA outside of DoD Control

Added protection of the NGLA that is outside of DoD control is to provide sewer services to current users of septic tanks and leach fields.

3.2.3.2 Basic Alternative 2

DoD and GWA Water Systems

Basic Alternative 2 would provide additional water capacity of 11.7 MGd (44.3 MLd), which is anticipated to be met by an estimated 20 new wells at Andersen Air Force Base (AFB) and 11 new wells at Air Force Base Barrigada, rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 1.8 MG (6.8 ML) water storage tanks would be constructed at ground level at NCTS Finegayan and one 1 MG (3.8 ML) water storage tank would be construction at Air Force Base Barrigada. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint. Therefore, impacts on the DoD and GWA water systems under Alternative 2 would be similar to those described for Alternative 1.

Northern Guam Lens Aquifer

Total DoD and GWA well production estimates under Alternative 2 would be similar to those described for Alternative 1 (Section 3.2.3.1). However, relocation of water supply wells to Navy Barrigada would change well production estimates by aquifer subbasin with increased well withdrawal of approximately 1 MGd (3.8 MLd) within the Agana and Mangilao subbasins and decreased production from the

Agafa-Gumas, Andersen, and Finegayan subbasins. Peak average well withdrawal from the NGLA would be similar to Alternative 1 (Table 3.2-9).

Proposed Mitigation Measures

Proposed mitigation measures would be as described for Alternative 1.

3.2.3.3 Long-Term Alternative 1

Develop Lost River

Development of the Lost River (Tolaeyuus River) is considered a long-term alternative to provide additional supply to the Navy water system during the dry season. It is estimated that the Lost River supply would yield 1.7 to 5.6 MGd (6.4 to 21 MLd) during the dry season, based on the U.S. Geological Survey data collected between 1998 and 2001. Supply from the Lost River would be limited by downstream habitat considerations. The U.S. Fish and Wildlife Service has identified a minimum conservation flow of 1 cubic foot per second (0.03 m^3 per second). Upstream use of the resource by GWA would also be considered prior to development of the Lost River. The existing cofferdam would be rehabilitated, the reservoir area dredged, and a pump station and discharge pipeline would be installed for distributing the supply to the existing Fena Reservoir pump station. The water would be delivered either to the Navy reservoir or the Fena WTP. The capacity of the Fena WTP and Navy distribution system would not be expanded, because the added supply is needed to compensate for the drawdown on the Navy reservoir during the dry season. Additional study is required to define the conceptual design of this alternative.

No mitigation measures are considered at this time since this is a programmatic level long-term alternative.

3.2.3.4 Long-Term Alternative 2

Desalination

Desalination (removal of salt) of brackish water by reverse osmosis is a long-term alternative to meet projected DoD water demands in the event that the supply from freshwater wells is insufficient to meet DoD demand. Desalination of brackish water would replace the development of up to 31 new potable water supply wells at Andersen AFB and Barrigada.

No mitigation measures are considered at this time since this is a programmatic level long-term alternative.

3.2.3.5 Long-Term Alternative 3

Dredge Fena Reservoir

Sediment dredging of the Navy Reservoir is included as a long-term option. This option is retained as part of the ongoing maintenance of the reservoir and to provide additional supply to DoD in southern Guam by increasing the storage capacity of the reservoir up to the original design capacity. Additional assessment is required to address potential obstacles related to mobilizing a dredge over long distances to the project site, which is in a remote location, as well as logistical difficulties in managing dredged material on Guam.

No mitigation measures are considered at this time since this is a programmatic level long-term alternative.

3.2.3.6 Summary of Impacts

Table 3.2-10 summarizes the potential impacts of each basic alternative. An analysis of long-term alternatives was not developed because those alternatives are not ready for project-specific analysis. A text summary is provided below.

Table 3.2-10. Summary of Potential Potable Water Impacts

Potentially Affected Resource	*Basic Alternative 1**	*Basic Alternative 2*
DoD Water System (direct impact)	LSI	LSI
GWA Water System (indirect impact)	SI	SI
Supply	SI-M	SI-M
Transmission	SI-M	SI-M
Distribution	SI	SI
NGLA (combined direct and indirect impact)	LSI	LSI

Legend: DoD = Department of Defense; GWA = Guam Waterworks Authority; LSI = less than significant impact; NGLA = Northern Guam Lens Aquifer; SI-M = Significant impact mitigable to less than significant. *Preferred Alternative.

Implementation of Basic Alternative 1 would result in a total planned water supply of 30.4 MGd (115 MLd) for the DoD water system of which 11.3 MGd (42.8 MLd) is to serve the Marine Corps Base. This planned supply is expected to fully meet the projected future DoD demand of 28.5 MGd (108 MLd) and provide excess water for transfer to GWA. Therefore, the proposed military relocation would have less-than-significant impact on the existing DoD water system.

The GWA water system does not have adequate water supply to meet the projected off-base demands from induced population growth (construction workers and civilians) resulting from the proposed DoD relocation. DoD has agreed to transfer water to meet the off-base Marine Corps relocation-related water demand. The Navy would continue to transfer up to 4 MGd (15 MLd) to GWA from Fena Reservoir under the current MOU. The Air Force would transfer up to 1.7 MGd (6.4 MLd) to GWA under an agreement to be negotiated. DoD would install wells planned as part of Basic Alternative 1 earlier than needed and make the excess water available for transfer to GWA. It is estimated that up to 4.7 MGd (17.8 MLd) would be required from the Marine Corps Base water system. Therefore, the proposed military relocation would have significant impact mitigable to less than significant on the existing GWA water system supply.

The GWA water system does not have adequate transmission capability to meet the projected off-base demands from the induced population growth (construction workers and civilians) resulting from the proposed DoD relocation. Improvements in the DoD transmission and storage system would benefit all island users with interconnection transfer points made available to GWA. Since GWA currently relies on the Fena Reservoir supply, improvements to the DoD water transmission system would enhance the capability of transferring water from the Fena Reservoir to northern Guam to the benefit of all island users. Further improvements as proposed in the EIS to the DoD transmission loop that currently exists in northern Guam would provide increased capability and reliability to better serve all residents of northern Guam with the ability of GWA to interconnect with this transmission system. New housing developments and new workforce camps would provide their own distribution systems, which could connect to the transmission system; thereby, mitigating adverse impacts to existing distribution systems and minimizing UFW and pressure losses in existing systems. Therefore, the proposed military relocation would have significant impact mitigable to less than significant on the existing GWA water system transmission capability.

Distribution issues within the GWA water system may persist resulting in inadequate water service to some customers despite having adequate water supply and transmission capability within the water system as a whole. The DoD cannot take full responsibility to repair GWA's off-base water distribution system to remedy these serious existing conditions because DoD's ability to fund infrastructure improvements is limited by federal law. Therefore, the proposed military relocation would have significant impact on the existing GWA water system distribution capability.

DoD is seeking funding from the GoJ for the proposed DoD water system, including transmission lines to facilitate transfer of excess water capacity to GWA to areas off base where water shortfalls are anticipated during the construction phase of the proposed military relocation. The Executive Summary of Volume 1 provides more detail on the funding sought and timeframes for construction of the facilities. If DoD fails to secure necessary financing from the GoJ, significant environmental impacts like those experienced on Guam today would continue to occur. These impact may include water supply shortage for both DoD and Guam's civilian population, low water pressure, and loss of reliable water service to portions of the island. Consistent with the Navy's commitment to keep from significantly impacting utilities on Guam, the DoD could apply force flow reductions and/or adaptive program management of construction as explained in Volume 7, Chapter 2, such as adjusting the construction tempo if off base water demand from construction workforce housing and induced population growth outpaces available supply and infrastructure. Exact methodology, monitoring, and implementation methods of forceflow adjustments and adaptive program management would be worked out after the ROD issued. Failure to secure the necessary funding may require that the DoD delay or not issue construction contracts or task orders until such time as the financing is received from the GoJ and the necessary projects are implemented. Such action would severely impact the construction pace and the ability of Navy to complete required construction to support the Marine Corps relocation.

USEPA Region 9 and GovGuam have identified the need for $1.3B in funding to implement necessary water and wastewater infrastructure improvements that must be accomplished in the first five years to accommodate the military relocation. The CEQ has facilitated interagency meetings with DoD and appropriate federal agencies to identify funding sources to meet this need. Additionally, the EAC is evaluating overall Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD military relocation. As part of this evaluation the EAC is specifically examining federal funding options for water and wastewater infrastructure improvements that may not be funded through GoJ financing.

GovGuam could implement measures to control connection to the GWA water system by workforce housing developers, private developers, and commercial developments, such as accepting private consortiums infrastructure development, moratoriums, and measures through building permit approvals or other mechanisms to steer new development to areas with adequate water supply, providing localized areas with surplus water capacity. GovGuam could implement measures to control the rate of induced growth through the building permit process and/or by restricting the number of water and sewer connection requests that are approved. GovGuam could also incentivize water conservation measures by offering rebates on upgrades to water saving devices.

GWA could assess a system development charge to contractors and workforce housing developers that could be used to fund improvements to the water system. To address the timing gap between availability of system development charge funds and construction of needed improvements to meet the anticipated demands, GWA may request an interconnection with the DoD water system, as discussed above, or seek other federal funding sources.

The projected impact on the GWA water system is deemed significant but mitigable by the DoD transfer of excess water production capacity to GWA in the interim to meet the increased demand, securing funding to mitigate deficiencies in the water system infrastructure, and reduction of the relocation pace through GovGuam permitting and slowing the rate of contractor award by DoD.

Planned DoD well expansion would increase groundwater withdrawal from the NGLA but would not exceed the estimated sustainable yield and would therefore have less than significant impact on the NGLA. If groundwater monitoring data indicate that the groundwater withdrawal by DoD would compromise the sustainable yield of the NGLA, the DoD would pursue other long-term alternatives or other mitigation measures, including adaptive program management. These mitigation measures are discussed further in Volume 7.

The summary of impacts for Basic Alternative 2 is the same as described for Basic Alternative 1.

3.2.4 Wastewater

3.2.4.1 Wastewater Direct Impacts

Direct impacts from the proposed DoD relocation would occur from increased wastewater flows from the direct DoD population on the GWA-operated NDWWTP and the Navy-operated Apra Harbor WWTP and their collection systems. This analysis is focused on impacts to the treatment plants and collection systems themselves, and evaluates plant and collection system capacities, treatment capabilities, impacts related to sludge handling capabilities. Impacts to the environment from these wastewater treatment facilities can be found in the various resource chapters of this Volume.

As explained in Section 3.1.3, the GWA NDWWTP would handle most of the increased direct wastewater treatment demand from the DoD relocation. The Navy Apra Harbor WWTP would handle the increased direct wastewater treatment demand from visiting ships at Apra Harbor. The Navy Apra Harbor WWTP has been shown to have adequate capacity, both physically and in its permit, to handle the estimated future wastewater demand. However, ongoing problems with metals in the effluent discharge would likely continue to be a problem until a new mixing zone is approved for the outfall.

As a result of the proposed military relocation, if Cantonment Alternative 1 or 2 is selected, the total year 2019 average daily flows to the NDWWTP from military and civilian sources are projected to increase to 10.5 MGd (39.9 MLd) (Table 2.3-4). If Cantonment Alternative 3 or 8 is selected, the total year 2019 end state average daily flows to the NDWWTP from military and civilian sources are projected to increase to 10.5 MGd (39.9 MLd) (Table 2.3-7). The year 2019 flow projections for the NDWWTP account for all anticipated population growth for the foreseeable future as described in Volume 6, Chapter 2.

Including these sources, the projected end state increase in wastewater flow in northern Guam as a result of the military relocation would not exceed the NDWWTP's design capacity of 12 MGd (45 MLd). At the end state, however, the permit limit of 6.0 MGd (23.0 MLd) would still be exceeded, and the plant would still need refurbishment to restore it to the original design capacity. A socioeconomic analysis of the proposed military relocation has estimated that induced civilian growth could increase the islandwide population on Guam by up to approximately 33,000 in the peak year of 2014. Assuming this induced civilian growth would be distributed among the north at 38%, central at 43%, and south at 19% on Guam, the induced civilian demand for wastewater treatment in northern Guam is estimated to reach 1.5 MGd (5.7 MLd). The construction workforce would generate up to an additional 1.4 MGd (5.3 MLd) wastewater flow to be treated at the NDWWTP in the peak year of 2014.

Thus, while the year 2019 wastewater treatment demand estimates would be within the physical capability of the NDWWTP design basis, the demand would peak in 2014 with the combined impacts of the Marine Corps relocation, construction workforce, and civilian growth and be in excess of that physical capacity at approximately 12.1 MGd (45.9 MLd) average. In addition, a compliance agreement issued from USEPA Region 9 to GWA would be needed to allow for the additional flows and resolve the requirements for secondary treatment as part of the Section 301(h) waiver denial.

Basic Alternative 1a (Preferred Alternative) and 1b

Basic Alternative 1 (Alternative 1a supports Main Cantonment Alternatives 1 and 2; Alternative 1b supports Main Cantonment Alternatives 3 and 8) combines upgrade to the existing primary treatment facilities and expansion to secondary treatment at the NDWWTP. The difference between Alternatives 1a and 1b is a requirement for a new sewer line from the proposed Barrigada housing to NDWWTP for Alternative 1b.

Basic Alternative 1a

Projected direct and indirect wastewater flows to the NDWWTP are summarized in Table 3.2-11. Table 3.2-11 also summarizes existing Guam civilian and DoD flows, projected increases in flows from Guam civilians related to natural population growth, projected DoD increases associated with the military relocation, increases associated with the imported construction workforce, and civilian increases that could result from induced growth under Main Cantonment Alternatives 1 and 2 for northern Guam.

Table 3.2-11. Projected Wastewater Flows to the NDWWTP under Main Cantonment Alternatives 1 and 2

Source of Wastewater Flow	*Year*									
	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Existing Guam Civilian	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20
Existing DoD	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Guam Civilian Increase	0.23	0.37	0.48	0.58	0.95	1.08	1.18	1.28	1.38	1.48
DoD Increase	0.23	0.46	0.51	0.55	2.56	2.79	2.83	2.87	2.91	2.97
Construction Workforce	0.28	0.67	1.10	1.31	1.40	0.91	0.30	0.00	0.00	0.00
Subtotal Direct DoD And Guam Civilian	**6.44**	**7.19**	**7.78**	**8.14**	**10.62**	**10.47**	**10.00**	**9.85**	**9.99**	**10.14**
Induced Civilian Increase	0.25	0.63	1.05	1.25	1.51	1.15	0.56	0.40	0.40	0.41
Total Flow – All Sources	**6.68**	**7.82**	**8.83**	**9.39**	**12.13**	**11.63**	**10.57**	**10.25**	**10.39**	**10.55**

Note: All units are in million gallons per day.
Legend: DoD = Department of Defense.
Source: NAVFAC Pacific 2010d.

Direct DoD wastewater flows include all on base DoD wastewater flows that would be generated by active duty personnel and their dependents, the on base civilian workforce, and industrial flows from on base facilities. Indirect wastewater flows include increased flow from induced civilian population growth resulting from the military relocation, construction workforce, and Guam civilian population growth. For the analysis of the NDWWTP, the total flows from all the sources listed in the aforementioned table are combined when evaluating treatment plant capacity and performance. This is because DoD is proposing to upgrade and repair the NDWWTP to be capable of handling all flows. Repairing and upgrading only a portion of the plant to address DoD's flows is not technically feasible.

Near-term wastewater flows to the NDWWTP from military and civilian sources are projected to increase to a peak of 12.13 MGd (45.91 MLd) in 2014, which would slightly exceed the design capacity of 12 MGd (45.4 MLd). DoD and GWA are assessing options to enhance treatment until primary treatment upgrades can be implemented. One option being investigation is to add chemical coagulants (enhanced primary treatment) or increase the surface overflow rate (within the normal design range) of the clarifier, which would improve plant operations so that the primary clarifier would be able to treat the additional flow without adverse effect on the NDWWTP. Normally, a chemically enhanced primary treatment system can significantly increase overflow rate of a conventional primary clarifier as recommended by the Water Environment Federation's Manual of Practice No. 8 (2010). However, the permit limit of 6 MGd (22.7 MLd) would still be exceeded and the plant would still need some refurbishment and upgrades to restore it to the original design capacity and pollutant removal efficiencies.

The existing NPDES permit for the NDWWTP is based on a maximum daily flow of 6 MGd (22.7 MLd). Under this alternative, the liquid treatment system of the NDWWTP would be refurbished to restore the plant's originally designed treatment capacity of 12 MGd (45.4 MLd) so that the plant would comply with regulations associated with treating the increased wastewater flow from the military relocation. At the same time, the plant's solids treatment system would be refurbished and upgraded to process sludge produced by treatment of 12 MGd (45.4 MLd) of influent wastewater. The solids treatment system has two anaerobic digesters and a dewatering complex that are currently nonfunctional and in disrepair. The system would need to be rehabilitated and upgraded with sufficient capacity to treat solids generated at the plant. The dewatered stabilized solids would then be hauled away, most likey to a landfill. Potential future beneficial use of the dewatered stabilized solids somewhere on Guam could be explored in the future.

The Navy has completed an evaluation of capacity and required improvements needed at NDWWTP entitled *Evaluation of Northern District Wastewater Treatment Plant Capacity* (NAVFAC Pacific 2009). Based on the plant's current capacity to accommodate anticipated near-term flow and loadings while still achieving the existing primary-treatment requirement, the following necessary improvements would have to be implemented at the NDWWTP to restore its primary treatment capacity and pollutant removal efficiencies:

- Septage and fat/oil/grease receiving
- Headworks improvement
- Primary clarifier rehabilitation
- Sludge digester rehabilitation
- Centrifuge building replacement and one centrifuge
- Sludge-drying bed rehabilitation
- Standby power
- Hydraulic improvements to the chlorine contact tank
- Third digester
- Second centrifuge
- Odor control
- Digester gas utilization
- Administration/laboratory, office, and workshop/storage areas rehabilitation

Implementing Basic Alternative 1a would accomplish the required refurbishment of the NDWWTP to accept the projected increase in wastewater flows. DoD would coordinate with GWA to expedite the planned improvements and request a NPDES permit modification to increase the effluent discharge limitation from 6.0 MGd (22.7 MLd) to 12.0 MGd (45.4 MLd), then comply with its modified NPDES permit requirements.

This alternative also provides secondary treatment at NDWWTP in response to the USEPA Region 9 secondary treatment waiver denial (Section 301(h) waiver) in the event that secondary treatment is ultimately required at the NDWWTP. A trickling filter system is proposed as the secondary treatment process.

The following new process components and upgrades for the secondary treatment upgrade would be required at the NDWWTP for this alternative:

- One primary clarifier (the same size as existing ones)
- Three trickling filters
- Four secondary clarifiers
- One chlorine contact tank
- Two additional anaerobic digesters (the same size as existing ones)
- One additional centrifuge solids-dewatering system and odor control
- Effluent monitoring and measurement expansion
- Outfall diffuser capacity expansion

These upgrades are the same to support either Main Cantonment Alternatives 1 and 2 or Main Cantonment Alternatives 3 and 8.

DoD is seeking funding from the GoJ for the proposed primary and secondary treatment upgrades to the NDWWTP. The Executive Summary of Volume 1 provides more detail on the funding sought and timeframes for construction of the facilities. If DoD fails to secure necessary financing from the GoJ, significant environmental impacts like those experienced on Guam today would continue to occur. These would include increased flows to already non-compliant treatment plants, resulting in further impacts to receiving waters due to poorly treated wastewater, and adverse impacts to fishing and recreational use of these waters. Consistent with the Navy's commitment to keep from significantly impacting utilities on Guam, the DoD could apply force flow reductions and/or adaptive program management of construction as explained in Volume 7, Chapter 2, such as adjusting the construction tempo if off base water demand from construction workforce housing and induced population growth outpaces available supply and infrastructure. Exact methodology, monitoring, and implementation methods of force flow adjustments and adaptive program management would be worked out after the ROD issued. Failure to secure necessary funding may require that DoD delay or not issue construction contracts or task orders until such time as the financing is received from the GoJ and the necessary projects are implemented. Such action would severely impact the construction pace and the ability of Navy to complete required construction to support the Marine Corps relocation.

USEPA Region 9 and GovGuam have identified the need for $1.3B in funding to implement necessary water and wastewater infrastructure improvements that must be accomplished in the first five years to accommodate the military relocation. The CEQ has facilitated interagency meetings with DoD and appropriate federal agencies to identify funding sources to meet this need. DoD is seeking from GoJ approximately $580 million for water and wastewater improvement projects from the GoJ pursuant to the terms of the Realignment Roadmap Agreement, described in Volume 1. The EAC is evaluating overall

Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD military relocation. As part of this evaluation the EAC is specifically examining federal funding options for water and wastewater infrastructure improvements that may not be funded through GoJ financing.

Basic Alternative 1b

Basic Alternative 1b supports the proposed Main Cantonment Alternatives 3 and 8. This alternative includes upgrades to the NDWWTP to allow direct DoD wastewater generated at the proposed Barrigada housing site to be conveyed to the GWA NDWWTP for treatment. The upgrades to the NDWWTP under this alternative would be identical to those described under Basic Alternative 1a.

Under this alternative, a new sewer line and two pump stations would need to be installed to convey wastewater generated at Barrigada to the GWA NDWWTP for treatment. The primary-treatment facilities of the NDWWTP would be refurbished and upgraded to accept the additional DoD flows and military relocation–related flows in northern Guam. The estimated wastewater flows to the NDWWTP under Main Cantonment Alternatives 3 and 8 are shown in Table 3.2-12.

Table 3.2-12. Projected Wastewater Flows to the NDWWTP under Main Cantonment Alternatives 3 and 8

Source of Wastewater Flow	*Year*									
	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Existing Guam Civilian	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20
Existing DoD	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Guam Civilian Increase	0.23	0.37	0.48	0.58	0.95	1.08	1.18	1.28	1.38	1.48
DoD Increase	0.23	0.46	0.51	0.55	2.56	2.79	2.83	2.87	2.91	2.97
Construction Workforce	0.28	0.67	1.10	1.31	1.40	0.91	0.30	0.00	0.00	0.00
Subtotal Direct DoD and Guam Civilian	**6.44**	**7.19**	**7.78**	**8.14**	**10.62**	**10.47**	**10.00**	**9.85**	**9.99**	**10.14**
Induced Civilian Increase	0.25	0.63	1.05	1.25	1.51	1.15	0.56	0.40	0.40	0.41
Total Flow – All Sources	**6.68**	**7.82**	**8.83**	**9.39**	**12.13**	**11.63**	**10.57**	**10.25**	**10.39**	**10.55**

Note: All units are in million gallons per day.
Legend: DoD = Department of Defense.
Source: NAVFAC Pacific 2010d.

Under Alternative 1b, a new sewer line would need to be installed to convey wastewater generated at Barrigada to the GWA NDWWTP for treatment. Figure 2.3-3 indicates the most likely routing of the proposed sewer lines.

Under Alternative 1b impacts would be identical to those described under Alternative 1a.

Long-Term Alternative 1

Long-term Alternative 1 consists of a phased implementation of refurbishment to the primary treatment system at the NDWWTP to address the interim wastewater treatment needs and the addition of a secondary WWTP on DoD land with its own outfall as a long-term wastewater treatment solution. The proposed modifications to the primary treatment facilities at the NDWWTP would be the same as described in Basic Alternative 1 covered in Section 3.2.4.1 and is not repeated here. Projected interim wastewater flows to the NDWWTP are summarized in Table 3.2-11. Table 3.2-11 also summarizes existing Guam civilian and DoD flows, projected increases in flows from Guam civilians related to natural population growth, projected DoD increases associated with the military relocation, increases associated with the imported construction workforce, and civilian increases that could result from induced population growth under Main Cantonment Alternatives 1, 2, 3, and 8.

The final phase consists of construction of a DoD only primary/secondary wastewater treatment facility at Finegayan on DoD land with its own outfall. The collection sewer would be changed to take wastewater from Finegayan directly to this new treatment plant. If the Main Cantonment Alternative 3 or 8 is chosen, the sewer modification would be expanded to extend the sewer from Barrigada to the existing GWA sewer that feeds NDWWTP all the way to this new DoD treatment plant. This final phase is a long-term alternative and will be addressed programmatically.

3.2.4.2 Wastewater Indirect Impacts

Indirect impacts from the proposed DoD relocation would occur from increased wastewater flows from the construction workforce and induced civilian population growth on the GWA-operated WWTPs and collection systems. This analysis is focused on impacts to the treatment plants and collection systems themselves, and evaluates plant and collection system capacities, treatment capabilities, impacts related to sludge handling capabilities. Impacts to the environment from these wastewater treatment facilities can be found in the various resource chapters of this Volume. These indirect impacts would affect all of the GWA sewer collection systems on Guam except for those proposed for upgrades to support the DoD, and would also affect all GWA WWTPs except NDWWTP.

Hagatna Wastewater Treatment Plant

The GWA Hagatna WWTP would handle some of the increased wastewater treatment demand from the construction workforce and increased civilian population. As a result of the proposed military relocation, if Cantonment Alternative 1 or 2 is selected, the total year 2019 average daily flows to the Hagatna WWTP from the construction workforce, induced civilian population growth and Guam population natural growth are projected to increase from current 5.38 MGd (20.4 MLd) to 6.48 MGd (24.5 MLd). If Cantonment Alternative 3 or 8 is selected, the total year 2019 average daily flows to the Hagatna WWTP from the construction workforce, induced civilian population growth and Guam population natural growth are projected to increase from current 5.38 MGd (20.4 MLd) to 6.48 MGd (24.5 MLd). The year 2019 flow projections for the Hagatna WWTP account for all anticipated population growth for the foreseeable future as described in Volume 6, Chapter 2.

At the Hagatna WWTP, the projected peak treatment demand at 2014 is estimated at 7.86 MGd (29.8 MLd) and the year 2019 flow is about 6.48 MGd (24.5 MLd). Both are still below the Hagatna WWTP permitted treatment capacity of 12 MGd (45 MLd).

Although Hagatna WWTP has undergone recent repairs and effluent quality has improved, the plant continues to violate permit effluent limits due to septage discharge to the plant from septage haulers. It is likely that this would increase due to port-o-lets at construction sites during the relocation but the proposed improvements at NDWWTP include a septage receiving stations that would eliminate the septage discharges at Hagatna WWTP. The Hagatna collection system currently experiences frequent sewer overflows. GWA has a development moratorium project planned to correct this problem but it is unclear when this project would be funded and implemented. Until the moratorium project is completed, additional flows to the Hagatna collection system would likely result in more frequent sewer overflows.

The repairs and upgrades to the Hagatna WWTP and collection system are not part of DoD's proposed action; however, DoD is seeking funding for these repairs and upgrades from the GoJ as described in the Executive Summary of Volume 1. If the DoD fails to secure necessary financing from the GoJ, significant environmental impacts will continue to occur as they do today. These would include increased flows to an already non-compliant primary treatment plant, resulting in further impacts to receiving waters due to poorly treated wastewater, and adverse impacts to fishing and recreational use of these waters. It would also result in failure to meet an impending enforcement order regarding secondary treatment requirements. Failure to secure necessary funding may require that DoD delay or not issue construction contracts or task orders until such time as the financing is received from the GoJ and the necessary improvements to the GWA Hagatna treatment capability are implemented. Such action would severely impact the construction pace and the ability of Navy to complete required construction to support the Marine Corps relocation.

Southern Guam Wastewater Treatment Plants

Several small GWA wastewater treatment facilities in southern Guam that would not receive direct DoD wastewater flows could be also indirectly affected by the military relocation from indirect wastewater flows from the induced civilian growth in the region. These are Agat-Santa Rita WWTP, Baza Gardens WWTP, Umatac-Merizo WWTP, and Inarajan WWTP. Total wastewater flows to these plants from the induced population growth are estimated to be 0.21 MGd (0.8 MLd). Table 3.2-13 shows information for each of these treatment plants including current influent flows to the plants, how effluent is disposed, and increased flows from the induced population. The following assumptions were used to calculate the increased flows:

- Current flow data at each of the four plants was used to derive a flow ratio between plants. Suing the current flow date resulted in the following ratios:
  - Agat-Santa Rita WWTP – 65%
  - Baza Gardens WWTP – 18%
  - Umatac-Merizo WWTP – 15%
  - Inarajan WWTP – 3%
- Islandwide induced population would be 33,126 during the peak year 2014 and 8,895 at the end of the construction period in 2019. These numbers are based on the socioeconomic study in Volume 9, Appendix F, which are also summarized in Volume 1, Chapter 4.
- Based on the socioeconomic study, it is estimated that 19% of islandwide induced population would settle in southern Guam. This percentage equates to 6,294 in 2014 and 1,690 in 2019.
- According to the GWA’s WRMP, 72% of the population in southern Guam is served by septic tanks and 28% are served by the four wastewater treatment plants. Therefore, the induced population that would be serviced by the four southern wastewater treatment plants is 1,762 in 2014 and 473 in 2019.
- To calculate the induced population serviced by each treatment plant, the total induced population was allocated to each plant based on the current plant flow ratios (see first bullet above).
- 120 gpcd was used to calculate induced population wastewater flows.

Table 3.2-13. Wastewater flow generated by USMC relocation induced population growth at each Southern Guam WWTP

Induced Population/ Wastewater Treatment Plants	*Effluent Discharge Methods*	*Current WW Flow (MGd)*	*Year 2014*			*Year 2019*		
			Induced Population Growth	*WW Flow by Induced Pop. (MGd)*	*Increased WW to Current WW Flow (%)*	*Induced Population Growth*	*WW Flow by Induced Pop. (MGd)*	*Increased WW to Current WW Flow (%)*
Induced Population in Southern Guam								
Induced Population	—	—	6,294	—	—	1,690	—	—
Sewered Induced Population	—	—	1,762	—	—	473	—	—
Treatment Plant in Southern Guam								
Agat–Santa Rita	Ocean Outfall	1.81	1,143	0.137	8%	307	0.037	2%
Baza Gardens	Surface River	0.5	316	0.038	8%	85	0.010	2%
Umatac Merizo	Percolation to Ground	0.41	259	0.031	8%	70	0.008	2%
Inarajan	Percolation to Ground	0.07	44	0.005	8%	12	0.001	2%

Notes: 1) Island-wide induced population is 33,126 in 2014, and 8,895 in 2019 based on the socioeconomic study that supports this EIS. 2) Induced population in the south is 19% of island-wide population (based on the socioeconomic study), which is 6,294 in 2014 (19% x 33,126), and 1,690 in 2019 (19% x 8,895). 3) 28% of induced population is sewered (from WRMP), which is 1,762 in 2014 (28% x 6,294) and 473 in 2019 (28% x 1,690). 4) Induced population serviced by each treatment plant is determined by its proportion of the current WW flow. 5) WW generated by induced population is assumed at 120 gpcd.
Legend: EIS = Environmental Impact Statement; WRMP = Water Resources Master Plan; MGd – million gallons per day; WW = wastewater.

As shown in Table 3.2-13, the induced population would result in only a slight increase to wastewater flows to the southern treatment plants. Two of the treatment plants, Umatac-Merizo WWTP and Inarajan WWTP, do not discharge to surface waters but percolate into the ground. Agat-Santa Rita WWTP discharges to an ocean outfall. The remaining treatment plant, Baza Gardens WWTP, discharges to surface waters. These treatment facilities in southern Guam generally have inadequate treatment capacity, deterioration of equipment, bypassing of treatment processes, and lack of maintenance as described in Section 3.1.3.5 to Section 3.1.3.9. There are currently environmental impacts from the discharges from these noncompliant plants. The small increase of wastewater flow from the induced population to these plants would not contribute significantly to these existing impacts.

GWA Wastewater Collection System

Under Basic Alternative 1a, all existing wastewater flows from Andersen AFB and all new wastewater flows from the proposed Marine Corps relocation would be conveyed to the NDWWTP for treatment. All flows from the current and proposed future military relocation at Andersen AFB would be conveyed through the existing GWA sewer to the NDWWTP, while wastewater flow generated from the proposed Marine Corps relocation at Finegayan would be conveyed via a new relief sewer line to the NDWWTP (as shown in Figure 2.3-2). The existing GWA sewer along Route 3 adjacent to the proposed cantonment at Finegayan would be used during construction of the base at Finegayan until the new relief sewer would be constructed. DoD is currently determining the timeframe when the new line needs to be installed to avoid exceeding the capacity of the existing sewer trunk main. The proposed modifications to the NDWWTP collection system should be completed by 2013.

Under Basic Alternative 1a, projected peak average daily flow of 2.41 MGd (9.1 MLd) wastewater generated by the military relocation associated temporary construction workforce and induced civilian growth in central Guam area would be discharged into GWA central sewage collection system and treated at the Hagatna WWTP. Although Hagatna WWTP has been shown to have adequate capacity to handle this estimated increased demand, increased wastewater flow may exacerbate the sewer overflows that currently occur in the collection system at central Guam, if the on-going GWA development moratorium project is not executed soon. Although changes to Hagatna WWTP are not part of DoD's proposed action, DoD is seeking funding from GoJ to make repairs and upgrades to this plant and its collection system (for more detail, see Volume 6, Chapter 1).

Under Basic Alternative 1b, the direct and indirect impacts the military relocation would have on the Hagatna WWTP and the central Guam sewage collection system would be identical to those described under Basic Alternative 1a.

Indirect impacts resulting from the construction workforce and induce populations would also occur in the GWA wastewater collection system. The condition of the GWA's collection systems are assumed to be relatively poor and additional wastewater flows from the induced population may result in more frequent overflows from the collection system. If improvements are not made to the collection systems, then sewage overflows would continue to occur and may become more frequent as increased flows from the indirect civilian population growth overwhelm the already inadequate system. These indirect impacts would likely cause further degradation to water resources with increased potential for sewage spills. Depending on the location of overflows, a sewage spill has the potential to impact surface water, groundwater (including the NGLA), nearshore water, and wetlands. Therefore, indirect impacts from construction workforce and induced population wastewater would result in significant impacts to the GWA wastewater collection system due to increased potential for sewage overflows from the collection systems.

Needed repairs and upgrades to the GWA collection system are not part of DoD's proposed action; however, DoD is seeking funding for some repairs and upgrades to the GWA northern and central wastewater collection systems from the GoJ as described in the Executive Summary of Volume 1. If the DoD fails to secure necessary financing from the GoJ, significant environmental impacts will continue to occur as they do today and as described above. Failure to secure necessary funding may require that DoD delay or not issue construction contracts or task orders until such time as the financing is received from the GoJ and the necessary improvements to the collection systems are implemented. Such action would severely impact the construction pace and the ability of Navy to complete required construction to support the Marine Corps relocation.

GWA Controls

GovGuam has historically implemented control measures, such as accepting private consortiums infrastructure development, moratoriums, and measures through building permit approvals or other mechanisms to steer new development to areas with adequate wastewater service. GWA would have the ability to assess a system development charge to contractors and workforce housing developers that could be used to fund improvements to the wastewater systems.

If the GWA cannot meet the projected increase in wastewater demand resulting from induced civilian growth, GovGuam could implement measures to control the rate of induced growth through the building permit process and/or by restricting the number of sewer connection requests that are approved. Limitations on permits and sewer connections could delay completion of the DoD relocation.

GovGuam could also incentivize water conservation measures by offering rebates on upgrades to water saving devices in an effort to reduce wastewater flows. These incentives are given periodically on the mainland. Upgrading current water devices to low-flow water saving models would reduce current demand.

Apart from the DoD efforts to secure financing from GoJ for repairs and upgrades to the Hagatna WWTP, and repairs and upgrades for the GWA northern and central wastewater collection system, there are other U.S. Government efforts to address utilities infrastructure funding shortfalls on Guam. USEPA Region 9 and GovGuam have identified the need for $1.3B in funding to implement necessary water and wastewater infrastructure improvements that must be accomplished in the first five years to accommodate the military relocation. The CEQ has facilitated interagency meetings with DoD and appropriate federal agencies to identify funding sources to meet this need. Additionally, the EAC is evaluating overall Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD military relocation. As part of this evaluation the EAC is specifically examining federal funding options for water and wastewater infrastructure improvements that may not be funded through GoJ financing.

3.2.4.3 Proposed Mitigation Measures

Proposed mitigation measures have been divided into two categories: those within DoD control and those outside of DoD control.

Proposed mitigations within DoD control:

1. The construction tempo could be reduced to reduce the peak construction workforce. This option is discussed further in Volume 7 under adaptive program management.
2. The DoD could alter the force flow as discussed in Volume 7.
3. The execution of construction could be incentivized to reduce on-island construction workforce requirements by using off-island prefabrication techniques and/or sequencing labor intensive construction activities in such a way to reduce the peak construction workforce needs.

Mitigations outside of DoD control:

1. Add chemical coagulants and/or increase the surface overflow rate (within the normal design range) of the clarifier to improve plant operations so that the primary clarifier would be able to treat the additional 0.1 MGd (0.5 MLd) without adverse effects on the NDWWTP.
2. GoJ financing could be provided for the repairs and upgrades to the Hagatna WWTP.
3. GoJ financing could be provided for the repairs and upgrades to the GWA northern and central wastewater collection systems.
4. GWA could improve the southern WWTPs and the Hagatna WWTP and their associated collection systems or impose development moratoriums for areas served by those plants until appropriate upgrades have been made.
5. GovGuam could implement control measures, such as accepting private consortiums infrastructure development, moratoriums, and measures through building permit approvals or other mechanisms to steer new development to areas with adequate wastewater service.
6. GWA could assess a system development charge to contractors and workforce housing developers that could be used to fund improvements to the wastewater systems.

7. GovGuam could implement measures to control the rate of induced growth through the building permit process and/or by restricting the number of sewer connection requests that are approved.
8. GovGuam could also incentivize water conservation measures by offering rebates on upgrades to water saving devices in an effort to reduce wastewater flows. These incentives are given periodically on the mainland. Upgrading current water devices to low-flow water saving models would reduce current demand.

3.2.4.4 Summary of Impacts

Table 3.2-14 summarizes the potential impacts of the basic alternative, including the interim phase for long-term alternative, shown below as impacts on NDWWTP treatment capacity and water quality. Indirect impacts to GWA wastewater systems of increased civilian population growth are also presented. An analysis of long-term alternative was not developed because the alternative is not ready for project-specific analysis. A text summary is provided below.

Table 3.2-14. Summary of Potential Wastewater Impacts

Potentially Affected Resource	*Basic Alternative 1**
NDWWTP Treatment Capacity	SI-M/BI
NDWWTP Effluent (Discharge) Quality (short/intermediate term)	BI/BI
Apra Harbor WWTP Treatment Capacity (direct impact)	LSI
Apra Harbor WWTP Effluent (Discharge) Quality (direct impact)	LSI
Hagatna WWTP Treatment Capacity (indirect impact)	LSI
Hagatna WWTP Effluent (Discharge) Quality (indirect impact)	LSI
Southern Guam WWTPs (indirect impact)	LSI
GWA Collection Systems (indirect impact)	SI

Legend: BI = Beneficial impact; GWA = Guam Waterworks Authority; LSI = Less than significant impact; NDWWTP = Northern District Wastewater Treatment Plant; SI = Significant impact; SI-M = Significant impact mitigable to less than significant; WWTP = Wastewater Treatment Plant. * Preferred Alternative.

Direct Impacts

Implementation of Basic Alternative 1, which is the Preferred Alternative, would accomplish the required refurbishment of the NDWWTP primary treatment system to accept the projected increase in wastewater flows. The refurbished NDWWTP would be physically able to handle the increased interim wastewater flows. A compliance agreement issued by USEPA Region 9 to GWA would be needed to temporarily allow increased wastewater flows that exceed the design capacity of the plant. Thus, the impact to treatment capacity from the proposed DoD relocation is deemed significant but mitigable during the period of time when flows exceed design capacity. Once primary upgrades are completed, then there would be a beneficial impact to the design capacity. Beneficial impacts to effluent quality would be realized in the interim period when chemical treatment is added, once primary treatment repairs and upgrades are completed, and once secondary treatment upgrades are completed. Impacts to water quality and the marine environment are discussed in Volume 6, Chapters 6 and 13.

Apra Harbor WWTP and upgraded collection system capacities are sufficient to treat the new wastewater flows from the transient ship population. Therefore, there would be less than significant impacts to capacities. Upon approval of the mixing zone at the ocean outfall, there would be less than significant impacts to effluent discharge quality.

DoD is seeking funding from the GoJ for the proposed primary and secondary treatment upgrades to the NDWWTP. The Executive Summary of Volume 1 provides more detail on the funding sought and timeframes for construction of the facilities. If DoD fails to secure necessary financing from the GoJ, significant environmental impacts like those experienced on Guam today would continue to occur. These would include increased flows to already non-compliant treatment plants, resulting in further impacts to receiving waters due to poorly treated wastewater, and adverse impacts to fishing and recreational use of these waters. Consistent with the Navy's commitment to keep from significantly impacting utilities on Guam, the DoD could apply force flow reductions and/or adaptive program management of construction as explained in Volume 7, Chapter 2, such as adjusting the construction tempo if off base water demand from construction workforce housing and induced population growth outpaces available supply and infrastructure. Exact methodology, monitoring, and implementation methods of force flow adjustments and adaptive program management would be worked out after the ROD issued. Failure to secure necessary funding may require that DoD delay or not issue construction contracts or task orders until such time as the financing is received from the GoJ and the necessary projects are implemented. Such action would severely impact the construction pace and the ability of Navy to complete required construction to support the Marine Corps relocation.

USEPA Region 9 and GovGuam have identified the need for $1.3B in funding to implement necessary water and wastewater infrastructure improvements that must be accomplished in the first five years to accommodate the military relocation. The CEQ has facilitated interagency meetings with DoD and appropriate federal agencies to identify funding sources to meet this need. DoD is seeking from GoJ approximately $580 million for water and wastewater improvement projects from the GoJ pursuant to the terms of the Realignment Roadmap Agreement, described in Volume 1. The EAC is evaluating overall Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD military relocation. As part of this evaluation the EAC is specifically examining federal funding options for water and wastewater infrastructure improvements that may not be funded through GoJ financing.

Indirect Impacts

Indirect impacts at the Hagatna WWTP systems would likely occur if improvements are not implemented due to increased septage hauled to the plant from port-o-lets at construction sites during the relocation. Additionally, increased flows from the induced population resulting from the relocation may contribute to more frequent permit violations at the plant. However, effluent quality would be expected to remain the same as it is today since the plant capacity would not be exceeded. Therefore, there would be less than significant impacts to the Hagatna WWTP effluent resulting from the military relocation. Indirect impacts to the Hagatna WWTP treatment capacity would be less than significant since the estimated total demand would remain within the plant's design capacity.

Indirect impacts to other GWA wastewater treatment plants would be less than significant because the flows to these plants represent a relatively small percent of the total capacity of the plants.

Indirect impacts to the GWA wastewater collection system would be significant because the system is already inadequate, resulting in frequent sewer overflows. This issue would be exacerbated as increased flows from the construction workforce and induced population would contribute to an already taxed system.

Needed repairs and upgrades to the Hagatna WWTP and collection system are not part of DoD's proposed action. However, DoD is seeking funding for these repairs and upgrades from the GoJ as described in the Executive Summary of Volume 1. If the DoD fails to secure necessary financing from the GoJ, significant environmental impacts will continue to occur as they do today. These would include increased flows to an already non-compliant primary treatment plant, resulting in further impacts to receiving waters due to poorly treated wastewater, and adverse impacts to fishing and recreational use of these waters. It would also result in failure to meet an impending enforcement order regarding secondary treatment requirements. Failure to secure necessary funding may require that DoD delay or not issue construction contracts or task orders until such time as the financing is received from the GoJ and the necessary improvements to the GWA Hagatna treatment capability and collection system are implemented. Such action would severely impact the construction pace and the ability of Navy to complete required construction to support the Marine Corps relocation.

3.2.5 Solid Waste

3.2.5.1 Basic Alternative 1 (Preferred Alternative)

The Preferred Alternative would be to continue to use the Navy landfill at Apra Harbor for municipal solid waste (MSW) until the new GovGuam Layon Landfill at Dandan is available for use. Disposal of other waste streams excluded from Layon Landfill would continue at the Navy landfill. Construction and demolition (C&D) debris would continue to be disposed at the Navy hardfill.

As described in Section 2.4.2, the Navy Sanitary Landfill has about a 10 years capacity based on the computed demand in Table 2.4-2 (416,561 tons [377,900 metric tons]) and a capacity of 1,200,000 CY (917,500 m^3) or 540,000 tons (490,000 metric tons), assuming a landfill height of 54 ft (16 m) above mean sea level and minor operational improvements. Such operational improvements include reducing the daily cover (which is required) and using larger compaction equipment to achieve greater densities. Because the Navy Sanitary Landfill is unlined, leachate has the potential to affect the underlying groundwater. Results from the on-going groundwater monitoring program indicate that low-level concentrations of volatile organic compounds were detected in the downgradient wells in 2006. However, subsequent assessment monitoring events resulted in no detections of these compounds. Chlordane has also been detected in the past in one of the wells during a single event in 2006. Since that time, chlordane has not been detected.

This alternative would also consist of using the planned new GovGuam Layon Landfill in the municipality of Inarajan. The site selected for the Layon Landfill is approximately 317 ac (128 ha) in size, with a landfill footprint of 127.4 ac (51.6 ha). Based on studies of future solid waste disposal quantities in GEPA's ISWMP (GEPA 2006), GEPA and GDPW established a minimum design capacity of 14 million CY (11 million m^3) as an estimate of the volume required to manage Guam's municipal solid waste for a 30-year period. Based on detailed design documents completed since the ISWMP was completed, the Layon Landfill is estimated to have a capacity of 15.8 million CY (12.1 million m^3) or 9.5 million tons (8.6 million metric tons), assuming an in-place density of 1,200 pounds per CY (TG Engineers 2009).

The landfill would be constructed in phases, with Cells 1 and 2 scheduled for completion at the same time, in July 2011. Cells 1 and 2 would cover approximately 11.1 ac (4.5 ha) and 11.3 ac (4.6 ha), respectively, with a combined waste capacity of 1.4 million CY (1.1 million m^3) (GEPA 2009). Table 2.4-4 presents the projected solid waste generation rates from both the military relocation and the civilian Guam population by year. Solid waste rates are shown as two categories: DoD solid waste and Guam general population solid waste. These two categories were added together to determine total estimated solid waste in tons, which were then converted into cubic yards. In 2014, Cells 1 and 2 would have reached their capacity and would have provided approximately 4 years of useful life. The operations plan for the Layon Landfill (TG Engineers 2009) indicates that subsequent disposal cells would normally be constructed at intervals of 2-5 years. Therefore, the demand from the military relocation would have a less than significant impact on the short-term capacity of the Layon Landfill.

Table 2.4-4 also provides an estimate of when the Layon Landfill would reach its ultimate capacity from solid waste generated by DoD and the Guam general population. Using a landfill airspace capacity of 15.8 million CY (12.0 million m^3), the table indicates that the landfill would reach capacity in 2044, which is 33 years after opening. The estimated 33 years of capacity is greater than the 30 years used by GDPW and GEPA for planning and designing of the Layon Landfill. Therefore, the military relocation would have a less than significant impact on the long-term capacity of the landfill.

GovGuam completed the *Final Supplemental EIS for the Siting of a Municipal Solid Waste Facility*, Guam (GDPW 2005) in July 2005. The report evaluated all aspects of siting a new landfill, including potential impacts on geology, groundwater, soils, air quality, noise, hydrology, water quality, wetlands, coastal zone management, vegetation, wildlife, aquatic ecology, land use, zoning, demographics, economics, recreation, sensitive receptors, utilities, road network, energy use and conservation measures, public health/safety, aesthetics, archaeological resources, and historical resources. Whenever impacts from the landfill development were identified, suitable mitigation measures were developed.

The Final Supplemental EIS evaluated impacts to haul routes, highway safety, and traffic for the Layon Landfill site. Population and solid waste volume projections included an estimated increase in population from the military relocation. The Final Supplemental EIS concluded the following:

- Access to the Malojloj area would be via Route 4, then through Dandan Road extending from Route 4 at Malojloj to the former NASA Tracking Station. A suitable access road would have to be developed from Route 4 to the proposed landfill site with an approximate length of 2.75 miles; development of the access road would involve the upgrading of Dandan Road and construction of new road improvements from its terminus to the landfill footprint. Route 4, from Yona to Malojloj, is proposed for reconstruction by the revised Guam Highway Master Plan as part of the Short Range Highway Improvement Program.
- The upgrading of Dandan Road and the reconstruction of Route 4 would address any highway safety issues involved with the movement of traffic to and from the Dandan site. GovGuam's integrated solid waste management strategy, which features the use of regional transfer stations as the destination for smaller solid waste collection vehicles, would effectively limit landfill-bound solid waste related traffic to street-legal large waste haulers.
- The new solid waste management strategy that limits access to the landfill to large waste haulers would significantly reduce the volume of landfill-bound traffic by a factor in the range of 8 to 14. Furthermore, it is anticipated that the frequency and hours of operation of bulk waste hauling from transfer stations to the landfill would be regulated as required to minimize impacts to the travelling public.

Two studies were recently completed that address solid waste reduction. The first study, *Recycling and Solid Waste Diversion Study for DoD Bases, Guam* (NAVFAC Pacific 2010b), is related to municipal solid waste recycling for long-term DoD waste generation on Guam, including waste generated as part of the military relocation. The second study, *Construction and Demolition Debris Reuse and Diversion*

Study for DoD Bases, Guam (NAVFAC Pacific 2010a), is related to C&D debris associated with the construction phase of the military relocation. The results of these studies were discussed in Sections 2.4.5.2 and 2.4.5.3 and contained in Volume 9, Appendix K. The results will be incorporated into an updated military ISWMP to reflect how wastes will be managed now and in the future. It is anticipated that DoD would reduce both solid waste and C&D debris waste streams by 50% by fiscal year 2015, thereby reducing impacts related to solid waste disposal.

C&D debris generated by construction activities related to the military relocation would be diverted either by requirements placed on DoD contractors to divert/reuse during onsite construction or through the use of a central processing facility that would allow DoD to temporarily store C&D until it can be recycled or reused. The remaining C&D debris that cannot be recycled would be disposed of at the Navy Sanitary Landfill that has sufficient capacity (1,200,000 CY [917,500 m^3]) to accommodate the 268,500 CY (205,300 m^3) of debris (50% of the estimated C&D debris waste stream of 537,000 CY [410,600 m^3]). Therefore, C&D debris generation from on base construction projects would have a less than significant impact on DoD's landfill capacity.

Proposed Mitigation Measures

The following mitigation measures are proposed for solid waste.

Transfer Stations

DoD may construct and/or use non-DoD transfer stations to allow consolidation of solid waste before it is hauled to Layon Landfill. The primary reasons for utilizing a transfer station are to reduce hauling costs and allow screening of waste prior to disposal.

Recycling Center

It is anticipated that DoD would construct recycling centers, one in Northern Guam and possibly one in Southern Guam. The recycling centers are needed to process recyclable materials collected by the source separation recycling program and to serve as a drop-off facility for recyclable materials generated by on-base residential, commercial, and industrial sectors.

C&D Debris Diversion

DoD agencies must comply with Executive Order 13514, which establishes a goal of diverting at least 50% of C&D debris by the end of fiscal year 2015. Based on the characteristics of the projected C&D debris, waste generated by the military relocation construction projects, diverting concrete without lead-based paint, asphalt concrete, and scrap metal, would achieve the DoD goal of at least 50% diversion of C&D debris by the end of fiscal year 2015.

Materials Resource Recovery Facility

It is anticipated that DoD would construct at least one materials resource recovery facility. A materials resource recovery facility would recover and segregate targeted recyclable materials from the solid waste stream prior to solid waste being disposed at the Layon or Navy Sanitary Landfill.

3.2.5.2 Summary of Impacts

Table 3.2-15 summarizes the potential impact of the Preferred Alternative. A text summary is provided below.

Table 3.2-15. Summary of Potential Solid Waste Impacts

Potentially Affected Resource	*Preferred Alternative*
Construction Impacts (direct and indirect are the same)	
C&D Debris Disposal Capacity	LSI
Operation Impacts (direct and indirect are the same)	
Solid Waste Disposal Capacity	LSI

Legend: C&D = Construction and Demolition; LSI = Less-than-significant impact.

The proposed action would result in increased solid waste generation. Implementation of the preferred solid waste alternative would provide sufficient disposal capacity for this increase in municipal solid waste and C&D debris. However, this would reduce the projected life of the Layon Landfill and the Navy Sanitary Landfill. Because this reduction would be minimal, this EIS concludes that impacts on solid waste disposal capacity would be less than significant.

3.2.6 Roadway Projects

3.2.6.1 Alternative 1

North

Roadway widening, pavement strengthening, and intersection improvement activities in the north region's study area would require utilities to be relocated along Routes 1, 3, 9, 15, and 28, as shown in Table 3.2-16. Utility relocation would include GPA and Navy utility system components for power, telephone, cable television, fiber optic, and GWA and Navy sanitary sewer and water.

Central

In the central region's study area, roadway widening, roadway realignment, pavement strengthening, intersection improvement, or bridge replacement projects would require utilities to be relocated along Routes 1, 7, 8, 8A, 10, 15, 16, 25, 26, and 27, as shown in Table 3.2-16. Utility relocation would include GPA and Navy utility system components for power, GPA fuel, telephone, cable television, fiber optic, and GWA and Navy sanitary sewer and water.

Apra Harbor

As shown in Table 3.2-16, utilities in the Apra Harbor region's study area would require relocation because of pavement strengthening and intersection improvement activities along Routes 1, 2A, and 11. Utility relocation would include GPA and Navy utility system components for power, telephone, cable television, fiber optic, and GWA and Navy sanitary sewer and water.

South

In the south region's study area, utility relocation would be required as a result of pavement strengthening and intersection improvement activities along Routes 2, 5, and 12, as shown in Table 3.2-16. Utility relocation would include GPA and Navy utility system components for power, telephone, cable television, and GWA and Navy sanitary sewer and water.

Table 3.2-16. Utility Relocation within Guam Road Network Routes

Region	*Route*	*Power*	*Navy Power*	*GPA Fuel*	*Telephone*	*Cable TV*	*Fiber Optic*	*GWA Sanitary Sewer*	*Navy Sanitary Sewer*	*GWA Water*	*Navy Water*
North	1	X			OH	OH	X		X	X	
	3	X	X		OH and UG	OH	X	X	X	X	X
	9	X			OH	OH and UG	X	X		X	
	15	X			OH	OH	X			X	
	28				OH			X		X	
Central	1	X	X	X	OH and UG	OH and UG	X	X	X	X	X
	7	X			OH			X		X	
	8	X			OH and UG	OH and UG	X	X		X	X
	8A	X			OH and UG	OH		X	X	X	
	10	X			OH and UG	OH	X	X		X	
	15	X			OH and UG	OH		X		X	
	16	X		X	OH and UG	OH and UG	X	X		X	X
	25*										
	26*										
	27	X			OH and UG	OH	X	X		X	X
Apra Harbor	1	X	X		OH and UG	OH and UG	X		X		X
	2A	X	X		OH and UG	OH and UG					X
	11	X	X			OH and UG	X	X	X	X	X
South	2	X			OH and UG			X		X	
	5	X	X		OH and UG	OH		X	X	X	X
	12	X			OH			X		X	

Note: * Utility data are not currently available for Routes 25 and 26.
Legend: GPA = Guam Power Authority; GWA = Guam Waterworks Authority; OH = overhead; UG = underground.
Source: Parsons Transportation Group.

Proposed Mitigation Measures

Planning and continued coordination with utility providers during the preliminary engineering and final design and the construction stages of the project would be necessary to minimize or eliminate interruption in utility service to customers. The Joint Region Marianas would coordinate with the affected service provider in each instance to ensure that work is conducted in accordance with the appropriate requirements and criteria. In addition, coordination efforts would lay out utility reroutes, identify potential conflicts, ensure that construction of the proposed project minimizes disruption to utility operations, and formulate strategies for overcoming problems that may arise. If interruptions of utility service are required, they would be restricted in duration and geographic extent. Careful scheduling of these disruptions and advance notification to occupants of the adjacent properties that would be affected by temporary service interruptions would help to avoid any critical service periods. Where feasible, utility relocations would be undertaken before roadway construction activities begin.

3.2.6.2 Alternative 2 (Preferred Alternative)

North

Utility relocation would be similar to that described for Alternative 1.

Central

Utility relocation would be similar to that described for Alternative 1.

Apra Harbor

Utility relocation would be similar to that described for Alternative 1.

South

Utility relocation would be similar to that described for Alternative 1.

Proposed Mitigation Measures

Proposed mitigation measures would be similar to those described for Alternative 1.

3.2.6.3 Alternative 3

North

Utility relocation would be similar to that described for Alternative 1.

Central

Utility relocation would be similar to that described for Alternative 1.

Apra Harbor

Utility relocation would be similar to that described for Alternative 1.

South

Utility relocation would be similar to that described for Alternative 1.

Proposed Mitigation Measures

Proposed mitigation measures would be similar to those described for Alternative 1.

3.2.6.4 Alternative 8

North

Utility relocation would be similar to that described for Alternative 1.

Central

Utility relocation would be similar to that described for Alternative 1.

Apra Harbor

Utility relocation would be similar to that described for Alternative 1.

South

Utility relocation would be similar to that described for Alternative 1.

Proposed Mitigation Measures

Proposed mitigation measures would be similar to those described for Alternative 1.

3.2.6.5 Summary of Impacts

Table 3.2-17 summarizes the potential impacts of anticipated utility relocations under each action alternative. The types of improvements proposed under the project alternatives would not create new demand for water supplies, stormwater or wastewater transport or treatment, or solid waste disposal capacity or facilities. The potential for impact is limited to physical disruption of existing utilities, the need for relocation of utilities before construction of new transportation facilities, or unanticipated interruptions in utility services.

Table 3.2-17. Summary of Potential Roadway Projects Impacts

Potentially Affected Resource	*Alternative 1*	*Alternative 2**	*Alternative 3*	*Alternative 8*
Utility Relocations Needed before Construction	LSI	LSI	LSI	LSI

Legend: LSI = less than significant impact. * Preferred Alternative.

3.2.6.6 Summary of Proposed Mitigation Measures

Table 3.2-18 summarizes the mitigation measures for impacts to relocation of utilities during construction of the roadway projects.

Table 3.2-18. Summary of Proposed Mitigation Measures for Roadway Projects Impacts to Utility Relocations

Phase	*Mitigation Measure*
Construction	• Plan/coordinate with utility providers. • Restrict utility outages in duration and geographic extent. • Schedule disruptions and notify in advance.
Operation	None

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CHAPTER 4.
ROADWAYS

4.1 INTRODUCTION

4.1.1 Definition of Resource

4.1.1.1 On Base Roadways

On base roadways herein refers to transportation roadway features that support vehicular and pedestrian traffic within the Department of Defense (DoD) military bases. This chapter describes the existing roadway conditions and known operations within Andersen Air Force Base (AFB), Andersen South, Naval Computer and Telecommunications Station (NCTS) Finegayan, Finegayan South, Navy Barrigada, Air Force Barrigada, Naval Base Guam, and the Naval Munitions Site (NMS). Additionally, off base existing road conditions and operations for features directly connected to various alternatives (such as, Former Federal Aviation Administration [FAA] parcels, Harmon Annex, and Route 15 lands) have been addressed under the section of non-DoD land within each area of interest. As described in the Affected Environment subsection of Volume 2, the island is divided up into four regions: North, Central, Apra Harbor, and South.

The possible effects on roadways within the bases as a result of the increase in the number of vehicle and vehicle movements from the proposed relocation of Marines from Okinawa to Guam are also assessed and presented in Section 4.2 of this chapter.

4.1.1.2 Off Base Roadways

Off base roadways herein refers to transportation roadway features that support vehicular traffic, public transit service, pedestrian facilities and bicycle facilities outside of the DoD military bases. This section describes the existing conditions of the off base roadways within their respective regions – North, Central, Apra Harbor, and South.

<u>Data Collection</u>

Traffic Volumes and Congestion

Existing traffic volumes for all of the roadways included in this study were determined by using a TransCAD model and existing traffic counts. To understand existing traffic conditions, the existing 2003 TransCAD model was calibrated for 2008 conditions. In addition, traffic counts were taken at multiple locations across the island and compared to the TransCAD results, and they were found to be within the tolerance limits for accuracy. TransCAD is a traditional three-step model that includes:

- Trip generation – where the vehicle trips are originating from
- Trip distribution – the destination to where the vehicles are traveling
- Trip assignment – the route(s) used to get to the destination

Population and employment data are used to calculate the daily to and from trips between Traffic Analysis Zones, which are areas of land that are usually residential or commercial in nature. The results of this analysis can be found in maps for each region.

Traffic congestion is measured by dividing the number of cars on the road (i.e., volume) by the number of cars the road was designed to carry (i.e., capacity). A volume to capacity (v/c) ratio greater than 1 indicates that the roads are carrying more vehicles than they were designed to handle – the roads are congested.

Intersection Operations

Forty-two intersections along the major street network across the island were analyzed for traffic operations for signalized and unsignalized intersections. The intersections were evaluated using the methodologies outlined in the Highway Capacity Manual (Transportation Research Board 2000). Traffic counts were taken at each of the 42 intersections in 2008. The Synchro computer model, that incorporates the Highway Capacity Manual methodology, used these traffic counts to determine traffic operations for the signalized and unsignalized intersections and military access points for a.m. and p.m. peak hours.

The results of the intersection operational analyses were used to assess the Level of Service (LOS) experienced by the drivers. The LOS describes the quality of traffic operating conditions, ranging from A to F, and is measured as the duration of delay that a driver experiences at a given intersection. LOS A represents free-flow movement of traffic and minimal delays to motorists. LOS F generally indicates severely congested conditions with excessive delays to motorists. Intermediate grades of B, C, D, and E reflect incremental increases in congestion.

The duration of delay was measured differently for signalized intersections compared to unsignalized intersections. Because an unsignalized intersection does not generally have as much traffic as a signalized intersection, the LOS delay is typically shorter than at a signalized intersection. In addition, studies have shown that at unsignalized intersections, drivers tend to become impatient with long delays and may use inadequate and unsafe gaps in the traffic stream to make left turns or enter the major street. Table 4.1-1 provides the delay thresholds for signalized and unsignalized intersections.

Table 4.1-1. Delay Thresholds for Level of Service

LOS	*Signalized Intersection (seconds/vehicle)*	*Unsignalized Intersection (seconds/vehicle)*
A	0.0-10.0 Seconds	0.0-10.0 Seconds
B	10.1-20.0 Seconds	10.1-15.0 Seconds
C	20.1-35.0 Seconds	15.1-25.0 Seconds
D	35.1-55.0 Seconds	25.1-35.0 Seconds
E	55.1-80.0 Seconds	35.1-50.0 Seconds
F	Greater than 80.0 Seconds	Greater than 50.0 Seconds

Legend: LOS = Level of Service.
Source: Transportation Research Board 2000.

The LOS rating deemed acceptable varies by jurisdiction, facility type, and traffic control device. At signalized intersections, LOS D is generally recognized as the minimum desirable operating condition; however, according to the 2030 Guam Transportation Plan it is recommended that, "All intersections and roadway segments should operate at LOS E during peak periods. Improvements undertaken by Guam DPW would be designed to alleviate substandard LOS conditions to the extent feasible, with due consideration to physical and environmental constraints" (Guam Department of Public Works [GDPW] 2008:7-2). For purposes of this study, any LOS better than LOS F would be considered acceptable.

Roadway Network

Guam's existing roadway network has developed into a multi-lane roadway system that serves commercial, retail, military, and tourist-based travel demands. Based on a preliminary classification map, roadways included in this study are classified as one of the following:

- Major Arterial – Roadways with four to six lanes, that have a high degree of mobility and limited access points.
- Minor Arterial – Roadways with two to four lanes, that still have a higher degree of mobility and fewer access points, however, not to the extent of major arterials.
- Major Collector – Roadways with two lanes that have lower speeds than arterials and often connect local roads to arterials.

As part of the Guam and Commonwealth of the Northern Mariana Islands Military Relocation Project, much of the roadway network would require improvements from their current conditions. The proposed improvements are discussed in the Proposed Action and Alternatives chapter, Off Base Roadways section (Volume 6, Chapter 2, Section 2.5). The roads proposed for improvement with this project include (see Project Description in Volume 6, Chapter 2, Section 2.5, Figure 2.5-8):

- Route 1
- Route 2A
- Route 3
- Route 5
- Route 8
- Route 8A
- Route 9
- Route 10
- Route 11
- Route 12
- Route 15
- Route 16
- Route 25
- Route 26
- Route 27
- Route 28
- Chalan Lujuna
-

The existing conditions of the off base roadways are described in the following sections. This includes a discussion of traffic volumes and congestion, as well as intersection operations for 42 intersections. A list of the intersections both signalized and unsignalized, also included in this project can be found within each region.

Public Transportation

Public transportation on Guam includes the following modes and service types:

- Tour buses
- Shopping buses
- Taxis
- School buses
- Special service for Navy shore leave
- Guam Mass Transit
- Fixed-route (buses on designated routes at prescribed headways)
- Demand-response (reservation-type service linking residential areas with fixed-route service or nearby activity centers)
- Paratransit

For purposes of this project, the discussion focuses on Guam Mass Transit. It describes the existing conditions for fixed-route, demand-response service (DRS) areas, and paratransit service in each of the four regions. DRS provides service by reservation to activity centers or areas with fixed-route service.

There is overlap between the routes, DRS areas, and paratransit areas in the regions, so descriptions of routes and areas may be described in multiple areas.

There are currently six fixed-routes, seven DRS areas, and five paratransit areas on the island. A section of Chamorro Village, located in Hagatna, currently acts as a transit center consisting of a shared-use parking lot with two bus shelters. Only one route in the fixed system is not anchored by this location.

In addition to the fixed routes, all DRS routes originate and terminate at Chamorro Village. In this respect, the current network acts as a low-frequency "pulse" system, having most of the routes service one central location simultaneously to maximize transfer potential.

The third type of mass transit on Guam is paratransit. Paratransit service, provided by Guam Mass Transit, supplies door-to-door transportation for persons with certified disabilities and is available by advance reservation. Hours of operation are 5:30 a.m. to 7:30 p.m., Monday through Saturday, and 7:30 a.m. to 6:30 p.m. on Sundays and holidays.

There are overall scheduling issues with mass transit on the island. Buses generally run ahead of the published schedule, and they do not adhere to slower speeds or wait time to follow the schedule, that often causes passengers to miss the bus and thus does not provide a reliable public transportation system on the island.

The 2030 Guam Transportation Plan (GDPW 2008) outlines recommendations for an improved mass transit system on Guam. These recommendations included forming the Guam Mass Transit Authority and implementing high-capacity bus service on the island. In late 2009/early 2010, the Guam Regional Transit Authority was formed and will now be responsible for all public transit functions. The Guam Regional Transit Authority approved the Guam Transit Business Plan in January 2010, which includes purchasing new buses, constructing a bus maintenance facility, and modifying the bus schedule.

Pedestrian and Bike Facilities

Guam has limited accommodations for pedestrian and bicycle travel; and the type, quantity, and quality of facilities varies throughout the island. Sidewalks and roadway shoulders comprise the existing pedestrian and bicycle system. Most of the 26 miles (mi) (42 kilometers [km]) of sidewalk is on the central western portion of the island, in the Hagatna and Tumon Bay area, as described in the Central Region. No marked or designated bicycle lanes or paths exist at this time. Where no sidewalks are present, the shoulder generally functions as a pedestrian and bicycle space and is used for running and cycling. The width and condition of roadway shoulders varies throughout the island. Shoulders are present along large segments of Route 1 and on Route 3 from Route 1 to Route 28; however, pedestrian and bicycle mobility and safety on road shoulders can be impeded by conflicting uses, such as parking.

Most of the signalized intersections included in this study contain a pedestrian indication on at least one of the intersection legs. Marked crosswalks and pedestrian safety devices are present at all signalized intersections. Crosswalks use the standard (i.e., two parallel lines) or continental marking pattern.

The condition of pedestrian facilities generally mirrors general road conditions and is deteriorated in some areas. Sidewalks often contain obstructions, such as fire hydrants, power poles, traffic signal controllers, or other utilities.

Pedestrian/auto accidents are a common occurrence on Guam. Most of these accidents occur at night in areas where street lighting levels are low and where pedestrian crosswalks do not exist, are not clearly marked, or are spaced too far apart. In addition, along village streets, there is a lack of sidewalks and, in many instances, minimal shoulder space for pedestrians.

Recently passed, Guam public law (Bill 273) requires the consideration and construction of bicycle and pedestrian paths with all new road construction projects. The 2030 Guam Transportation Plan (GDPW 2008) also identifies a plan for bicycle facilities that includes detached paths, paved shoulders, and wide outside lanes, depending on the roadway. Bicycle and pedestrian improvements will be incorporated into the off base roadway improvement project as much as practicable.

4.1.2 North

4.1.2.1 On Base Roadways

<u>Andersen AFB</u>

Andersen AFB has two access gates. The Main Gate provides access between Route 1 and Arc Light Boulevard. Arc Light Boulevard is the main roadway on base and provides an east-west route across the base. The Back Gate is about 1.1 mi (1.8 km) southeast of the Main Gate and provides access between Route 15 and Santa Rosa Boulevard. Santa Rosa Boulevard passes through housing areas on base. All of the base roadways are two lanes (one lane in each direction) with additional separate turning lanes at major intersections. All the on base intersections are currently controlled by two- or all-way stop signs.

The Andersen Air Force Base Traffic and Safety Engineering Study (Andersen AFB 2008) found that most of the on base intersections were operating at acceptable levels of service with the exception of several intersections along Arc Light Boulevard. The study recommended improvements for these problem intersections.

4.1.2.2 Finegayan

NCTS Finegayan is accessed by the gate between Route 3 and Bullard Avenue. South Finegayan can be accessed at two points; the intersection between Royal Palm Drive and Route 3, and the intersection between Coral Tree Drive and Route 3. All of the base roadways are two lanes (one lane in each direction).

Based on the relatively low traffic demand on Finegayan, all roadways and intersections should be operating at acceptable levels of service for both the a.m. and p.m. peak hours.

4.1.2.3 Off Base Roadways

<u>Existing Roadway Conditions</u>

Route 1

Route 1, also known as Marine Corps Drive, is a major arterial roadway that extends approximately 22.0 mi (35.4 km) from Andersen AFB in Yigo on the northeastern corner of the island down to Naval Base Guam in Santa Rita in the central western area of the island. Route 1 from Andersen AFB to Route 29 in Yigo is a four-lane road with a raised median. The lanes are approximately 12.0 feet (ft) (3.6 meters [m]) wide. There is a shoulder on either side of the road; however, there is no curb and gutter or sidewalk. The median becomes flush at Route 29 and continues to Chalan Lujuna in Yigo. Portions of Route 1 are not structurally capable of handling heavy truck loads due to the current condition of the pavement.

Route 3

Route 3 is located on the northern end of the island in Dededo. It connects with Route 9 at the Route 3A intersection and intersects Route 1 at its southern terminus. Route 3 is 5.7 mi (9.2 km) long. From Route 1 to Route 28, it is a minor arterial that consists of four lanes with intermittent center turn lanes and shoulders and no curb and gutter or sidewalks. From Route 28 to Route 9, the roadway decreases to two lanes with no median/center lane, shoulders, curb and gutter, or sidewalk. The lanes are generally 12.0 ft (3.6 m) wide. Route 3 is not structurally capable of handling heavy truck loads due to the current condition of the pavement.

Route 9

Route 9 is located on the northern end of the island near Andersen AFB and connects Route 3 at its western terminus with Route 1 at its eastern terminus at the entrance to Andersen AFB. Route 9 is 3.1 mi (5.0 km) long and is classified as a minor collector. The road has two lanes with limited median/center turn lane, intermittent shoulders, curb and gutter, and no sidewalks. Route 9 is not structurally capable of handling heavy truck loads due to the current condition of the pavement.

Route 15

Route 15 is located on the northeastern part of the island, with its northern terminus in Yigo and southern terminus in Chalan-Pago-Ordot at Route 4. Route 15 is 14.2 mi (22.8 km) long and is classified as a minor arterial in the North Region. The portion of Route 15 in the North Region is approximately 0.75-mi (1.2 km). From Smith Quarry to just north of Chalan Lujuna, there are two lanes with no center lane, a flush median, no shoulders, curb and gutter, or sidewalk. The lanes are generally 12.0 ft (3.6 m) wide.

Route 28

Route 28 is located on the northern part of the island and connects Route 1 with Route 3 in Dededo. Route 28 is 3.9 mi (6.3 km) long and is classified as a minor arterial. The road has two lanes with intermittent median or center lane, no shoulders, curb and gutter, or sidewalks. The lanes are generally 11.0 ft (3.4 m) to 12.0 ft (3.6 m) wide.

The intersections and military access points included in the North Region are listed in Table 4.1-2.

Table 4.1-2. Intersections and Access Points – North Region

Intersections and Military Access Points – North	
Signalized	
Route 1/9/Andersen AFB Main Gate	Route 1/29
Route 3/28	
Unsignalized	
Route 3/3A/9	Route 15/29
Military Access Points	
Route 3 – South Finegayan/Residential Gate	

Legend: AFB = Air Force Base.

<u>Existing Traffic Volumes and Capacity</u>

A summary of existing average daily traffic (ADT) volumes and capacity (2008) for the North Region can be found in Table 4.1-3.

Figure 4.1-1 and Figure 4.1-2 show existing levels of traffic congestion in the northern part of Guam for the a.m. and p.m. peak hours, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested.

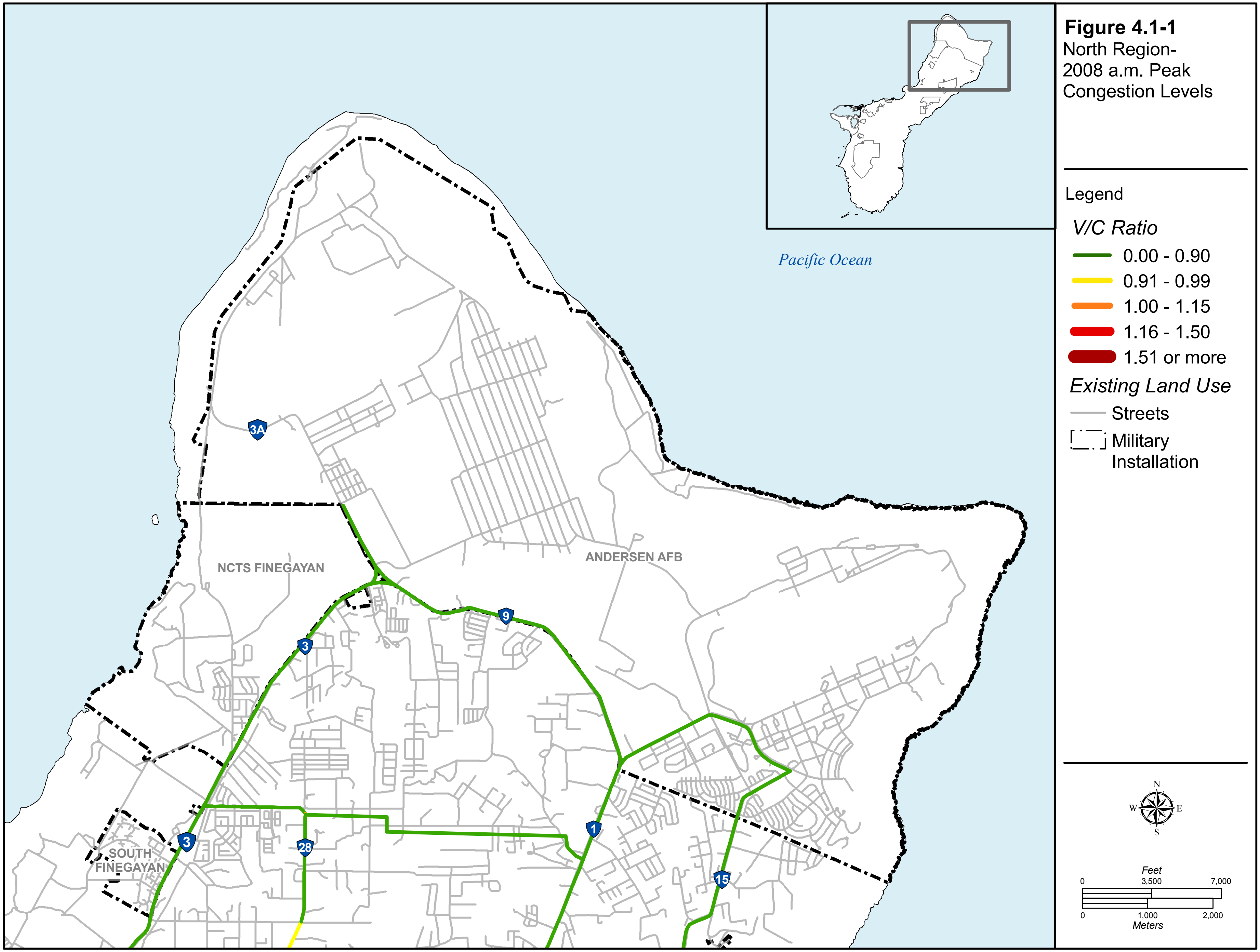

Figure 4.1-1
North Region-
2008 a.m. Peak
Congestion Levels

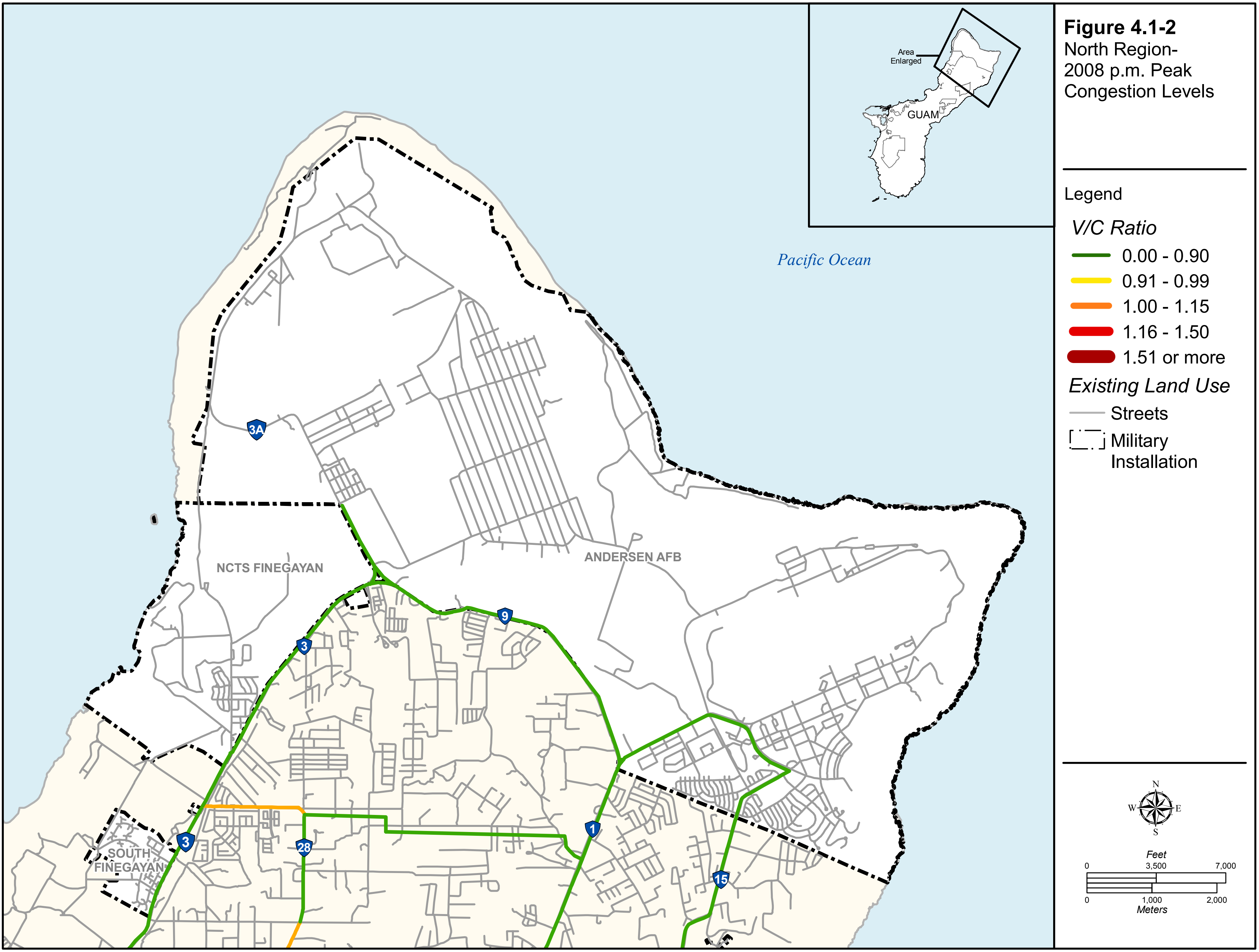

Figure 4.1-2
North Region-
2008 p.m. Peak
Congestion Levels

Printing Date: April 5, 2010

Table 4.1-3. Existing ADT and Volume to Capacity Ratio Summary – North Region

Roadway	*Existing ADT Summary*	*Existing v/c Ratio*
Route 1	Route 1 ranges from 14,000 to 19,000 vehicles per day (vpd). Traffic decreases as Route 1 approaches Andersen AFB.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.80, which indicates that the roadway is not considered congested.
Route 3	Route 3 ranges from 6,800 to 15,000 vpd. Traffic increases south of the intersection with Route 28.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.80, which indicates that the roadway is not considered congested.
Route 9	Route 9 ranges from 2,700 to 4,400 vpd. There is a decrease in traffic east of the two residential developments on Route 9.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.80, which indicates that the roadway is not considered congested.
Route 15	Route 15 has 4,300 vpd.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.80, which indicates that the roadway is not considered congested.
Route 28	Route 28 ranges from 9,400 to 9,500 vpd.	The north/south portion of Route 28 has a v/c ratio of 0.81-0.99, and the east/west portion has a v/c ratio of 0.00-0.80 in the a.m. peak. The roadway is not considered congested in the a.m. The north/south portion of Route 28 has a v/c ratio of 0.81-0.99, and the east/west (and part of the north/south) portion has a v/c ratio of 1.00-1.15 in the p.m. peak. The roadway is considered congested in the p.m. on the east/west portion.

Legend: ADT = average daily traffic; AFB = Air Force Base; v/c = volume to capacity; vpd = vehicles per day.

The roads serving major residential and employment centers, such as Dededo and Tamuning, are currently the most congested. These roads are also roads that would be heavily used by the military. During both the morning and afternoon peaks, the road with the greatest congestion levels in the North Region is Route 28; however, in the a.m. conditions, the ratio is still below 1, which means the road is not considered congested. This is not true for the p.m. conditions, as portions of Route 28 have a v/c ratio between 1 and 1.15, which indicates the road is congested.

Existing Intersection Operations

In the existing conditions, all intersections in the North Region operate at acceptable LOS E or better except for the following intersection:

- Route 1/29 (a.m. peak hour only)

Table 4.1-4 displays the LOS and delay results for the study intersections in the North Region.

Existing Public Transportation

The discussion of existing conditions in this section would focus on the Guam Mass Transit System in the North Region.

Figure 4.1-3 illustrates the fixed routes and DRS areas for the North Region. A demand-response area is a geographical area that is served by the demand-response type of bus service described earlier. Note that all of the Monday through Friday fixed routes originate at Chamorro Village, which is located in Hagatna and is not shown on this map. The Grey Line 4, which only runs on Sundays and holidays, is the only bus route that is partially included in the North Region. The DRS areas located in the North Region are

Grey 1, Grey 2, and Grey 3. These routes provide service on Monday through Saturday only, and they all observe the normal 5:30 a.m. to 7:30 p.m. hours of service. DRS is available on call and normally provides transportation to the nearest fixed-route. Table 4.1-5 shows details about the fixed route and DRS areas in the North Region.

Table 4.1-4. Existing Level of Service and Delay Results – North Region

	a.m. Peak Hour		*p.m. Peak Hour*	
	LOS	*Delay (Seconds)*	*LOS*	*Delay (Seconds)*
Signalized*				
Route 1/9	C	25.8	D	46.1
Route 1/29	F	97.4	C	24.0
Route 3/28	C	26.8	B	17.4
Unsignalized**				
Route 3/3A/9	B	10.1	A	9.6
Route 15/29	D	30.7	C	18.3
Military Access Points**				
Route 3 - Main Cantonment/Commercial Gate**	C	17.9	B	13.0
Route 3 - Main Cantonment/Main Gate**	D	25.7	C	15.9
Route 3 – South Finegayan/ Residential Gate	C	23.9	D	30.0

Legend: LOS = Level of Service.
Notes: *Signalized intersection LOS based on average delay for the overall intersection.
**Unsignalized intersection LOS based on approach delay on STOP-controlled approach.

Table 4.1-5. Fixed Route and DRS Areas – North Region

Route	*Areas Served*	*Headway (hours)*	*Trips per Day, Monday-Saturday*	*Trips per Day, Sunday/Holiday*	*Scheduled Run Time Outbound (minutes)*	*Scheduled DR Time (minutes)*	*Scheduled Run Time Inbound (minutes)*
Fixed Route							
Grey Line 4*	Micronesia Mall—Yigo (Loop)	2	0	5	39 to 40	20 to 21	48 to 49
DRS Area							
Grey Line 1	Dededo, Agafa Gumas, Santa Ana, and vicinity	NA	NA	NA	NA	NA	NA
Grey Line 2	Yigo, Latte Heights, and vicinity	NA	NA	NA	NA	NA	NA
Grey Line 3	Tamuning, Tumon, Harmon, and vicinity	NA	NA	NA	NA	NA	NA

Legend: NA = Not Applicable.
Notes: *Hours of service are 5:30 a.m. to 7:30 p.m. Monday through Saturday and 7:30 a.m. to 5:30 p.m. Sundays and Holidays.

The paratransit services partially located in the North Region are:

- Freedom 1 (northern area) serving Yigo, Agafa Gumas, NCS, Santa Ana Subdivision, Astumbo, Dededo, Harmon, and Tamuning
- Freedom 5 serving the entire island

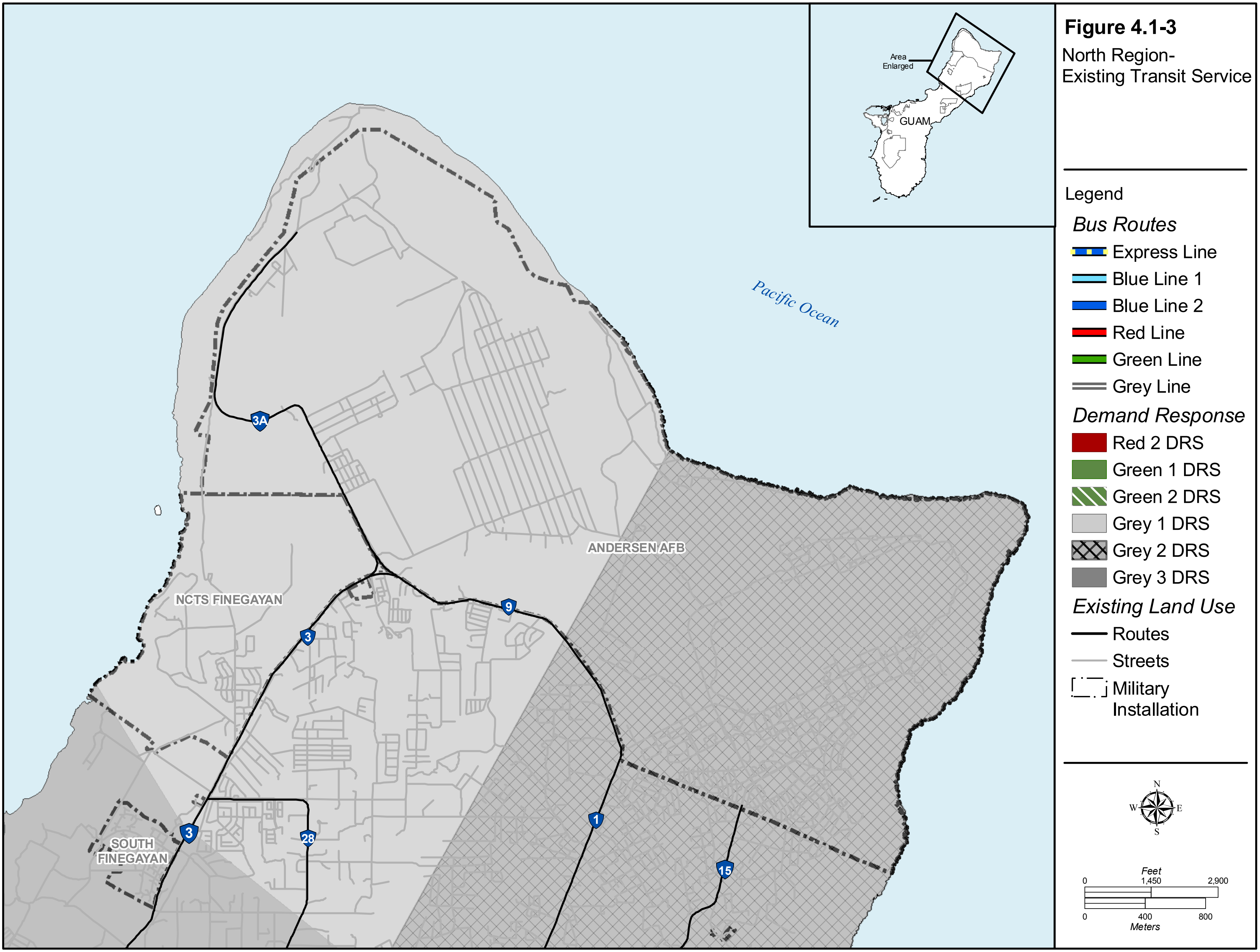

Figure 4.1-3
North Region-
Existing Transit Service

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs Figure 4.1-3. North Region - Existing Transit Service.mxd

The 12-month (2006-2007) ridership for the fixed route, DRS, and paratransit routes in the North Region can be found in Table 4.1-6. Note that there is overlap between several of the routes and service areas between the regions for this project. Because the Freedom 5 serves the entire island, ridership is not included here.

Table 4.1-6. Monthly and Total Fiscal Year 2007 Guam Mass Transit Ridership (Passengers Boarding Each Route)

Service Type	*Route Name*	*12-Month Totals*
DRS	Grey 1	30,823
	Grey 2	25,431
	Grey 3	11,826
Fixed Route	Grey 4	562
Paratransit	Freedom 1	8,129
	Total	**76,771**

Legend: DRS = Demand Response Service.

Existing Pedestrian and Bicycle Facilities

The northern tip of the island does not contain any dedicated pedestrian or bicycle facilities. Shoulders exist along Route 1 and on Route 3 south of Route 28. In these areas, the outside lane or shoulder, which are generally unpaved, function as the pedestrian/bicycle space. Figure 4.1-4 illustrates the existing pedestrian and bicycle facilities.

4.1.3 Central

4.1.3.1 On Base Roadways

Andersen South

Existing roadways and abandoned right–of-ways within areas in Andersen South were originally constructed in the 1950s timeframe and have varying levels of existing use. Air Force operations, with the exception of training at Andersen South, have stopped. The roadway facilities in the area are in a general state of disrepair. Andersen South is bounded on the north side by Route 1 and on the south side by Route 15. Andersen South can be accessed from the southern side at the intersection of Rissi Street and Route 15. The base is accessible from the northern side at the intersection of Turner Street and Route 1 near the northeastern corner of the site. Also, there are other potential access points along Route 1. Manha Street intersects Route 1 at the northwestern edge of the site. Three other unnamed streets intersect Route 1 between Turner Street in the northeast and Manha Street in the northwest. These roads (Turner Street, Manha Street, and the three unnamed streets) run perpendicular to Route 1 and Route 15 in a north-south route across the base.

Based on the relatively low roadway utilization on Andersen South, all roadways and intersections are most likely operating at acceptable levels of service for both the a.m. and p.m. peak hours.

Barrigada

Route 15 forms the eastern bounding edge and Route 16 forms the western bounding edge of the Navy Barrigada parcel. The Navy Barrigada can be accessed by Route 8A. Route 8A approaches the Navy Barrigada parcel from the western side and ends at the central part of the Navy Barrigada parcel. Route 8A provides the most direct access point to the golf course within the Navy Barrigada site. The Navy Barrigada golf course abuts the northeastern edge of the Air Force Barrigada parcel. The Navy Barrigada site also has gated access at Route 16 and Sabana Barrigada Drive.

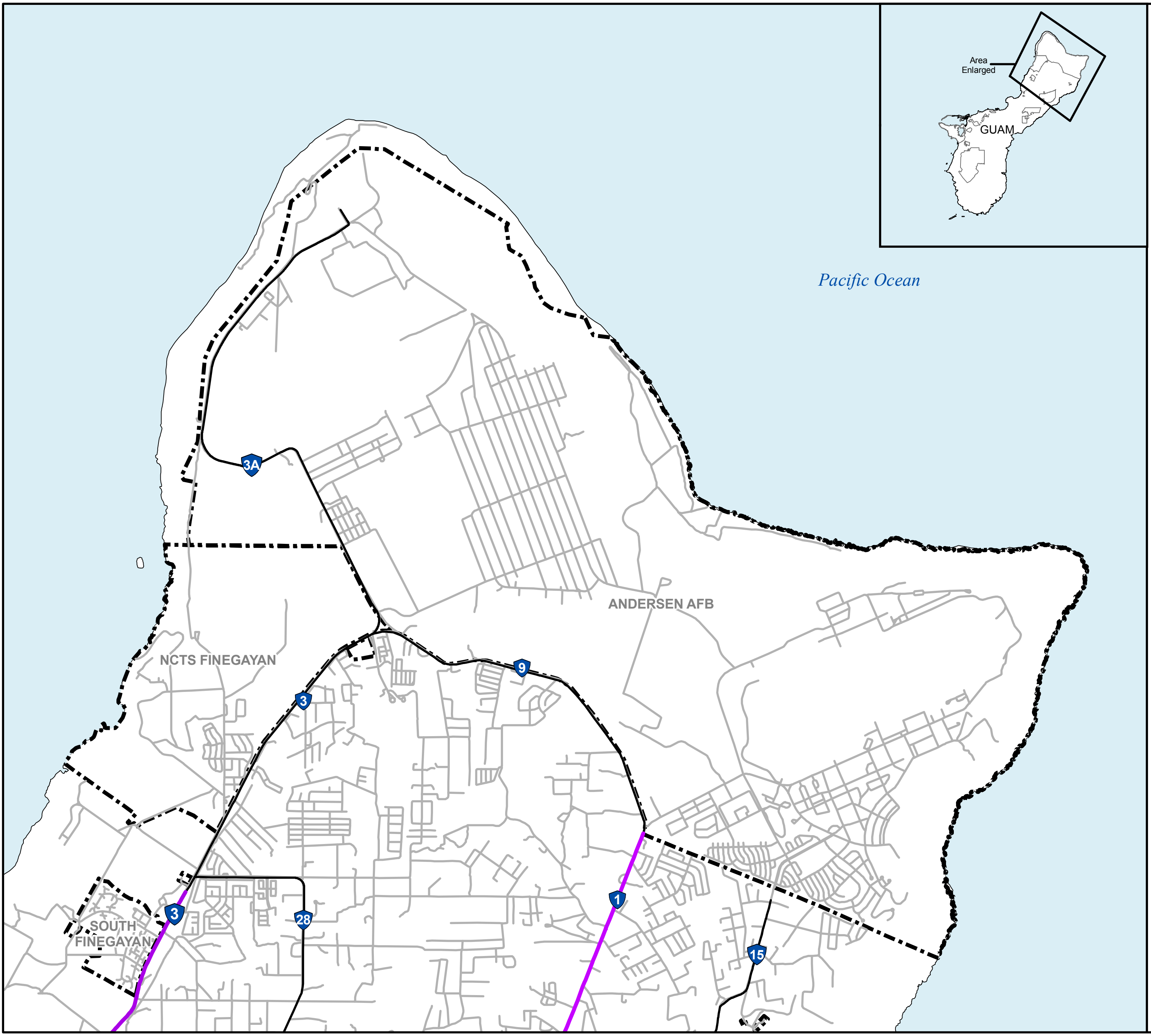

Figure 4.1-4

North Region-
Existing Pedestrian
and Bicycle Facilities

Printing Date: March 11, 2010

Route 15 forms the southern edge of the Air Force Barrigada parcel. The primary point of entry into the Air Force Barrigada site is from the south side where an unnamed access street from the Air Force Barrigada intersects Route 15. This access point is located at the intersection of Chada Street and Route 15. Chada Street is an off base road that intersects Route 15 from the southern side. The Air Force Barrigada parcel could also potentially be accessed from the western side from Route 10 by heading into Lalo Street.

Based on the relatively low traffic demand on Navy and Air Force Barrigada, all roadways and intersections should be operating at acceptable levels of service for both the a.m. and p.m. peak hours.

4.1.3.2 Off Base Roadways

Existing Roadway Conditions

Route 1

Route 1, also known as Marine Corps Drive, is a major arterial roadway that extends approximately 22.0 mi (35.4 km) from Andersen AFB in Yigo on the northeastern corner of the island down to Naval Base Guam in Santa Rita, which is located on the central western area of the island. Route 1 from Chalan Lujuna to Route 28 in Dededo is a four-lane road with a flush median. The lanes are approximately 12.0 ft (3.6 m) wide. There is a shoulder on either side of the road; however, there is no curb and gutter or sidewalk.

South of Route 28 in Dededo, the roadway becomes six lanes with a raised median. The six-lane portion of Route 1 extends to Route 6 in Hagatna, at which point it becomes four lanes again. The lanes are generally 12.0 ft (3.6 m) wide. There are left-turn queuing (stacking) lanes at intersections and at other access points along Route 1. There are curb and gutter and sidewalks along this section of the roadway.

Just south of the Route 6 intersection in Hagatna, the road becomes four lanes again to where it ends near Naval Base Guam in Santa Rita. There is a raised median from Route 6 to Route 11 in Piti. Portions of Route 1 are not structurally capable of handling heavy truck loads due to the current condition of the pavement.

Route 3

Route 3 is located on the northern end of the island in Dededo. It connects with Route 9 at the Route 3A intersection and intersects Route 1 at its southern terminus. Route 3 is 5.7 mi (9.2 km) long. From Route 1 to Route 28, it is a minor arterial that consists of four lanes with intermittent center turn lanes and shoulders and no curb and gutter or sidewalks. From Route 28 to Route 9, the roadway decreases to two lanes with an intermittent left-turn lane, shoulders, curb and gutter, or sidewalk. The lanes are generally 11.0 ft (3.4 m) wide. Route 3 is not structurally capable of handling heavy truck loads due to the current condition of the pavement.

Route 8/8A

Route 8 is located in the center of the island, with its eastern terminus at the Admiral Nimitz Golf Course in Barrigada and western terminus in Hagatna. Route 8 is 4.3 mi (6.9 km) long and is a major arterial between Route 10/16 and Route 1 and a major collector east of the Route 10/16 intersection. The road has four lanes with a two-way center turn lane, intermittent shoulders and sidewalks, and curb and gutter between Route 10/16 and Route 1. The lanes are generally 12.0 ft (3.6 m) wide. Route 8/8A is not structurally capable of handling heavy truck loads due to the current condition of the pavement.

Route 10

Route 10 is located in the center of the island, with its northern terminus in Barrigada at Route 8/16 and southern terminus in Chalan-Pago-Ordot at Route 4. Route 10 is 3.2 mi (5.1 km) long and is classified as a major arterial. Generally, the road has four lanes with a two-way center turn lane, shoulders, curb and gutter, and sidewalks. The lanes are generally 12.0 ft (3.6 m) wide. Route 10 is not structurally capable of handling heavy truck loads due to the current condition of the pavement.

Route 15

Route 15 is located on the northeastern part of the island, with its northern terminus in Yigo and southern terminus in Chalan-Pago-Ordot at Route 4. Route 15 is 14.2 mi (22.8 km) long and is classified as both a minor arterial (north of Route 10) and a major collector (south of Route 10). The portion of Route 15 in this study is approximately 9.0 mi (14.5 km) and extends from Route 10 to Chalan Lujuna on the north. From Chalan Lujuna to Route 26, there are two lanes with no center lane, a flush median, no shoulders, curb and gutter, or sidewalk. From Route 26 to Route 10, the road has two lanes with an intermittent center lane, a flush median, no shoulders, curb and gutter, or sidewalks. The lanes are generally 12.0 ft (3.6 m) wide. Route 15 is not structurally capable of handling heavy truck loads due to the current condition of the pavement.

Route 16

Route 16 is located on the east side of Guam International Airport and extends from Route 1 to Route 8 in Barrigada. This section of Route 16 is approximately 3.0 mi (4.8 km) long and is classified as a major arterial. From Route 8 to Route 10A, the road has four lanes with a center lane, intermittent raised and flush medians, shoulders, curb and gutter, and no sidewalks. The lanes are generally 12.0 ft (3.6 m) wide in this section. At the intersection with Route 10A, Route 16 continues below-grade under Route 10A, with four through lanes. There are two lanes that exit to the at-grade intersection with Route 10A. From Route 10A to Route 27A, the road has six lanes, a center turn lane, an intermittent raised median, shoulders, no curb and gutter, and no sidewalks. The lanes are generally 12.0 ft (3.6 m) wide in this section. Route 16 is not structurally capable of handling heavy truck loads due to the current condition of the pavement.

Route 25

Route 25 is located in the north-central part of the island and connects Route 16 with Route 26 in Dededo. Route 25 is approximately 1.4 mi (2.3 km) long and is classified as a minor arterial. The road generally has two lanes with a two-way center turn lane, shoulders, and no sidewalks or curb and gutter for approximately 0.5-mi (0.8-km) west of Route 16. The road then decreases in width and has no center lane or median, no curb and gutter, sidewalks, or shoulders for the remainder of the route. The lanes are generally 12.0 ft (3.6 m) wide. Route 25 is not structurally capable of handling heavy truck loads due to the current condition of the pavement.

Route 26

Route 26 is located in the north-central part of the island and connects Route 1 in Dededo with Route 15 in Mangilao. Route 26 is approximately 2.3 mi (3.7 km) long and is classified as a minor arterial. The road has two lanes with no median, intermittent shoulders, no curb and gutter, and intermittent sidewalks in the Latte Heights Estates area. The lanes are generally 12.0 ft (3.6 m) wide. Route 26 is not structurally capable of handling heavy truck loads due to the current condition of the pavement.

Route 27

Route 27 is located in the north-central part of the island and connects Route 16 with Route 1 in Dededo. Route 27 is approximately 1.1 mi (1.8 km) long and is classified as a major arterial. The road has six lanes with a raised median and left-turn queuing lanes at intersections, curb and gutter, sidewalks, and no shoulders. The lanes are generally 12.0 ft (3.6 m) wide. Route 27 is not structurally capable of handling heavy truck loads due to the current condition of the pavement.

Route 28

Route 28 is located on the northern part of the island and connects Route 1 with Route 3 in Dededo. Route 28 is 3.9 mi (6.3 km) long and is classified as a minor arterial. The road has two lanes with intermittent median or center lane, no shoulders, curb and gutter, or sidewalks. The lanes are generally 12.0 ft (3.6 m) wide.

Chalan Lujuna

Chalan Lujuna is located on the northern part of the island and connects Route 1 and Route 15, just south of Route 29 in Yigo. Chalan Lujuna is approximately 0.83-mi (1.3 km) long and is classified as a major collector. The road has two lanes with no median or center lane, no shoulders, curb and gutter, or sidewalks. The lanes are generally 12.0 ft (3.6 m) wide. Chalan Lujuna is not structurally capable of handling heavy truck loads due to the current condition of the pavement.

The intersections and military access points included in the Central Region are listed in Table 4.1-7.

Table 4.1-7. Intersections and Access Points – Central Region

Intersections and Military Access Points – Central Region	
Signalized	
Route 1/28	Route 1/4
Route 1/26	Route 1/6 (Adelup)
Route 1/27	Route 1/6 (West)
Route 1/27A	Route 4/7A
Route 1/3	Route 4/10
Route 1/16	Route 4/17
Route 1/14 (North San Vitores)	Route 8/33 (East)
Route 1/14A	Route 8/10
Route 1/10A	Route 10/15
Route 1/14B	Route 16/27A
Route 1/14 International Trade Center (ITC)	Route 16/27
Route 1/30	Route 16/10A
Route 1/8	
Unsignalized	
Route 7/7A	Route 26/15
Route 26/25	Route 28/27A
Military Access Points	
Route 1 - South Andersen Main Gate/(Turner Street)	Route 15 - South Andersen/Second Gate

<u>Existing Traffic Volumes and Capacity</u>

A summary of existing ADT volumes and capacity (2008) for the Central Region can be found in Table 4.1-8.

Table 4.1-8. Existing ADT and Capacity Summary – Central Region

Roadway	*Existing ADT Summary*	*Existing v/c Ratio*
Route 1	Route 1 ranges from 32,000 to 73,000 vpd. Traffic decreases significantly south of the intersection with Route 4.	The v/c ratio is generally 0.00-0.80 in both the a.m. and p.m. peak conditions; however, there are small segments that have a v/c ratio of 0.81-0.99. The roadway is not considered congested.
Route 3	Route 3 ranges from 6,800 to 15,000 vpd. Traffic increases south of the intersection with Route 28.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.80, which indicates that the roadway is not congested.
Route 8	Route 8 ranges from 37,000 to 39,000 vpd. There is generally no change in volume along the route.	In the a.m. peak hours, Route 8 has a v/c ratio of 0.00-0.80; however, in the p.m. peak hours, the portion of Route 8 between Route 33 and Route 1 has a v/c ratio of 0.81-0.99. The roadway is not considered congested.
Route 10	Route 10 has 30,000 vpd between Route 8 and Route 15.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.80, which indicates that the roadway is not congested.
Route 15	Route 15 ranges from 6,900 to 16,000 vpd. There is a significant increase in traffic south of the intersection with Route 26.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.80, which indicates that the roadway is not congested.
Route 16	Route 16 ranges from 37,000 to 49,000 vpd.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.80, which indicates that the roadway is not congested.
Route 25	Route 25 ranges from 12,000 to 16,000 vpd.	The eastern portion of Route 25 has a v/c ratio of 1.00-1.15 in both the a.m. and p.m. peak hours. The western portion has a v/c ratio of 1.16-1.50 in both the a.m. and p.m. peak hours. The roadway is considered congested in both the a.m. and p.m.
Route 26	Route 26 ranges from 6,900 to 15,000 vpd. There is a decrease in traffic south of the large residential development just north of the intersection with Route 15.	The v/c ratio is generally 0.81-0.99 in both the a.m. and p.m. peak conditions; however, there are small segments that have a v/c ratio of 0.00-0.80. The roadway is not considered congested.
Route 27	Route 27 has 32,000 vpd between Route 16 and Route 1.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.80, which indicates that the roadway is not congested.
Route 28	Route 28 ranges from 12,000 to 15,000 vpd. Traffic increases at the intersection with Route 1.	Route 28 has several v/c ratios in the Central Region. In the a.m., the worst portion of the roadway is north of the intersection with Route 1, with a v/c ratio greater than 1.50. The v/c ratio in the p.m. is the worst at the intersection with Route 1, with a v/c ratio greater than 1.50. The roadway is considered congested in both the a.m. and p.m.
Chalan Lujuna	Chalan Lujuna ranges from 3,600 to 4,000 vpd.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.80, which indicates that the roadway is not congested.

Legend: ADT = Average Daily Traffic; v/c = volume to capacity; vpd = vehicles per day.

Figure 4.1-5 and Figure 4.1-6 show existing levels of traffic congestion in Central Guam for the a.m. and p.m. peak hours, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested.

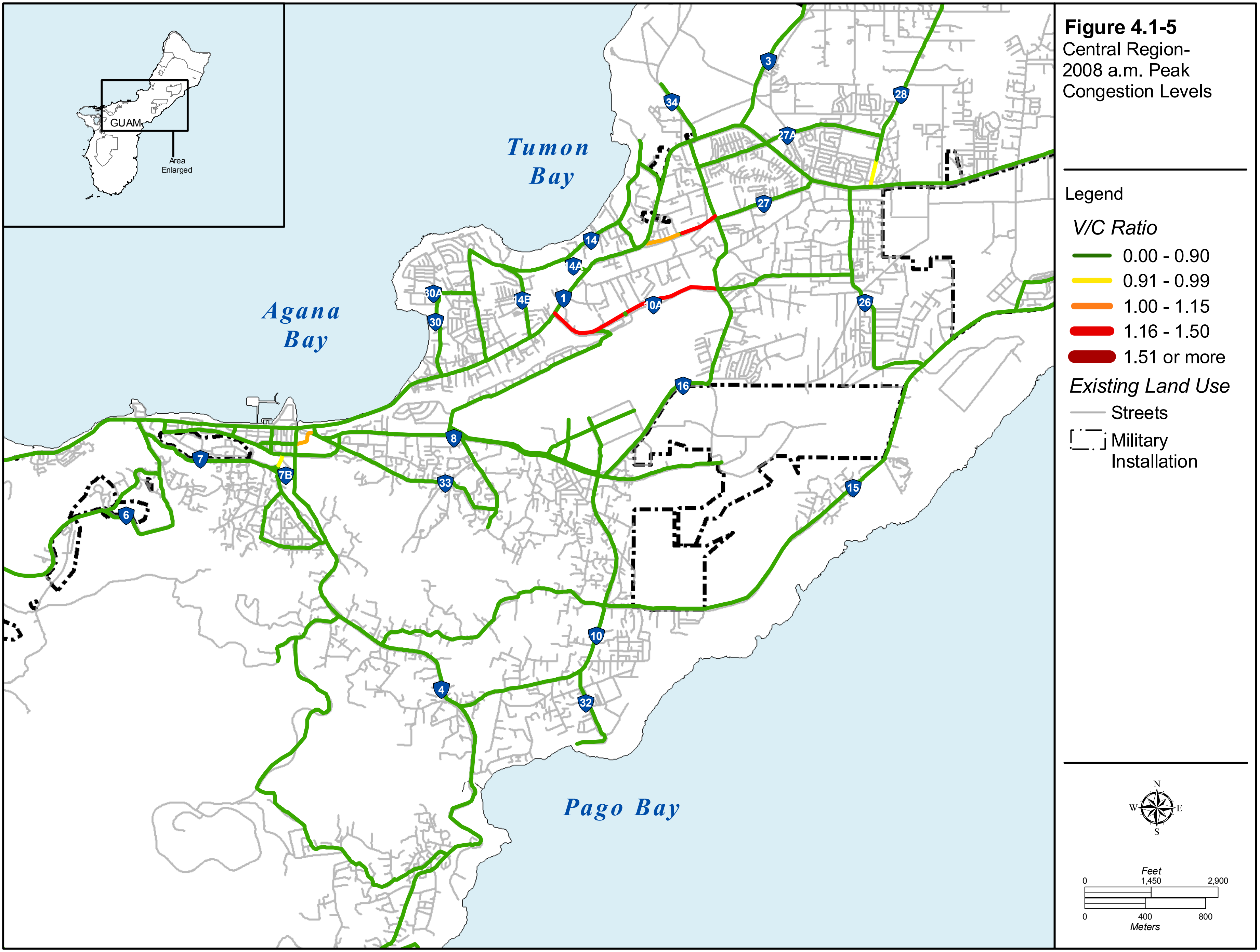

Figure 4.1-5
Central Region-
2008 a.m. Peak
Congestion Levels

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.1-5. Central Region - 2008 a.m. Peak Congestion Level.mxd

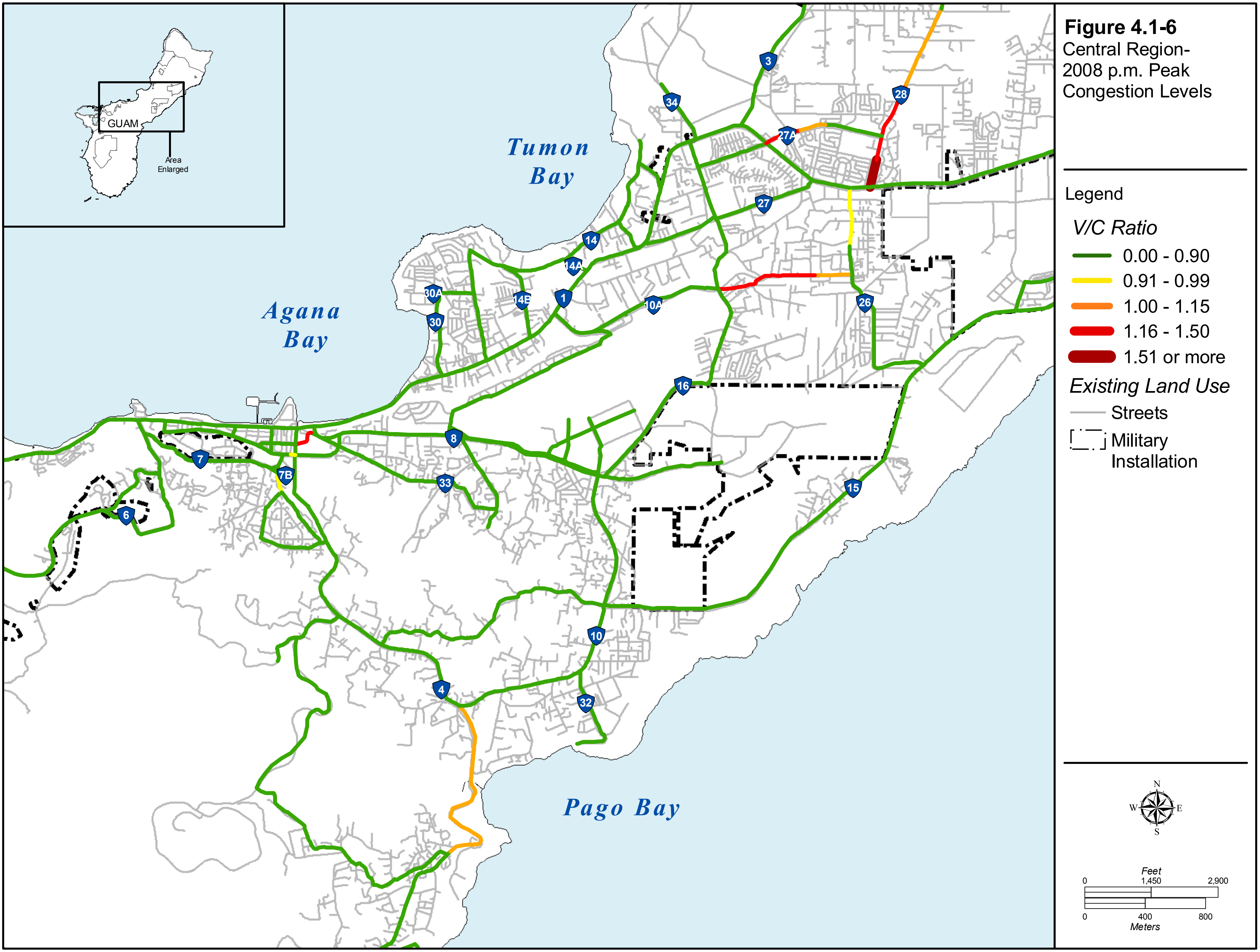

Figure 4.1-6
Central Region-
2008 p.m. Peak
Congestion Levels

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.1-6. Central Region - 2008 p.m. Peak Congestion Levels.mxd

The roads serving major residential and employment centers, such as Dededo and Tamuning, are currently the most congested. These roads are also roads that would be heavily used by the military. During both the morning and afternoon peaks, the roads with the greatest congestion levels in the Central Region are Routes 28 and 25. They both have an LOS F in both the a.m. and p.m. peak hours that is considered congested. Route 28 has the highest level of congestion (v/c ratio greater than 1.50), north of the Route 1 intersection in the a.m. and at the Route 1 intersection in the p.m.

Of particular note is that the model does not show congestion along Route 1 through Tamuning even though many vehicles travel this roadway. This is because the roadway segments are designed to handle the high volume of traffic they presently serve. Even though there are many cars on the road, it does not exceed its design capacity; therefore, it is not technically "congested" (Figure 4.1-5 and Figure 4.1-6). The delay that drivers experience on Route 1 results from poor operations, such as traffic signal timing.

Existing Intersection Operations

In the existing conditions, all intersection in the Central Region operate at acceptable LOS E or better except for the following intersections:

- Route 1/27A (p.m. peak hour only)
- Route 1/3 (a.m. peak hour only)
- Route 1/10A
- Route 1/14 (International Trade Center [ITC]) (p.m. peak hour only)
- Route 8/33
- Route 8/10 (a.m. peak hour only)
- Route 10/15 (a.m. peak hour only)
- Route 16/27
- Route 16/10A
- Route 26/25
- Route 26/15 (a.m. peak hour)
- Route 28/27A (a.m. peak hour)
- Access Point at Route 16 – Navy Barrigada Residential Gate

Table 4.1-9 displays the LOS and delay results for the study intersections in the Central Region.

Existing Public Transportation

The discussion of existing conditions in this section would focus on the Guam Mass Transit System in the Central Region.

Figure 4.1-7 illustrates the fixed routes and DRS areas for the Central Region. Note that all of the Monday through Friday fixed routes originate at Chamorro Village located in Hagatna. The fixed routes included in the Central Region are Blue Line, Blue Line 2, Red Line 1, Express Line, Green Line 1, and Grey Line 4. The DRS areas located in the Central Region are Grey 2, Grey 3, Red 1, Red 2, Green 1, and Green 2. These routes provide service Monday through Saturday only, and all observe the normal 5:30 a.m. to 7:30 p.m. hours of service. DRS is available on call and normally provides transportation to the nearest fixed-route. Table 4.1-10 shows details about the fixed route and DRS areas in the Central Region.

Table 4.1-9. Existing Level of Service and Delay Results – Central Region

	a.m. Peak Hour		*p.m. Peak Hour*	
	LOS	*Delay (Second)*	*LOS*	*Delay (Second)*
Signalized*				
Route 1/28	C	33.9	D	48.6
Route 1/26	C	33.8	E	58.5
Route 1/27	E	74.6	E	51.8
Route 1/27A	D	37.1	F	91.5
Route 1/3	F	165.9	E	71.0
Route 1/16	C	32.6	E	58.6
Route 1/14 (North San Vitores)	C	33.1	F	92.9
Route 1/14A	D	52.1	E	59.6
Route 1/10A	F	96.2	F	81.9
Route 1/14B	D	43.3	C	33.6
Route 1/14 (ITC)	D	51.7	F	116.2
Route 1/30	E	67.8	D	51.5
Route 1/8	B	19.3	C	34.1
Route 1/4	C	23.2	C	20.4
Route 1/6 (west)	B	10.0	C	23.1
Route 1/6 (Adelup)	B	19.9	E	59.9
Route 4/7A	C	23.2	E	57.8
Route 4/10	E	64.5	E	59.5
Route 4/17	C	24.9	C	21.2
Route 8/33	F	81.6	F	162.8
Route 8/10	F	140.1	E	67.5
Route 10/15	F	83.8	E	56.3
Route 16/27A	C	34.4	C	25.9
Route 16/27	F	112.4	F	89.4
Route 16/10A	F	125.4	F	89.3
Unsignalized**				
Route 7/7A	C	15.1	C	19.9
Route 26/25	F	81.5	F	400.4
Route 26/15	F	202.4	E	39.5
Route 28/27A	F	152.9	F	37.4
Military Access Points				
Route 1 - South Andersen Main Gate/(Turner Street)**	B	11.5	D	34.9
Route 15 - South Andersen/Second Gate ***	-	-	-	-
Route 16 - Navy Barrigada Residential Gate *	F	75.5.	F	63.4
Route 8A – Navy Barrigada/(Residential Gate)***	-	-	-	-
Route 15 - Barrigada Air Force/(Chada Point Drive)**	E	37.4	C	18.2

Legend: ITC = International Trade Center; LOS = Level of Service.

Notes: *Signalized intersection LOS based on average delay for the overall intersection.

**Unsignalized intersection LOS based on approach delay on STOP-controlled approach.

***The access is not built in existing conditions.

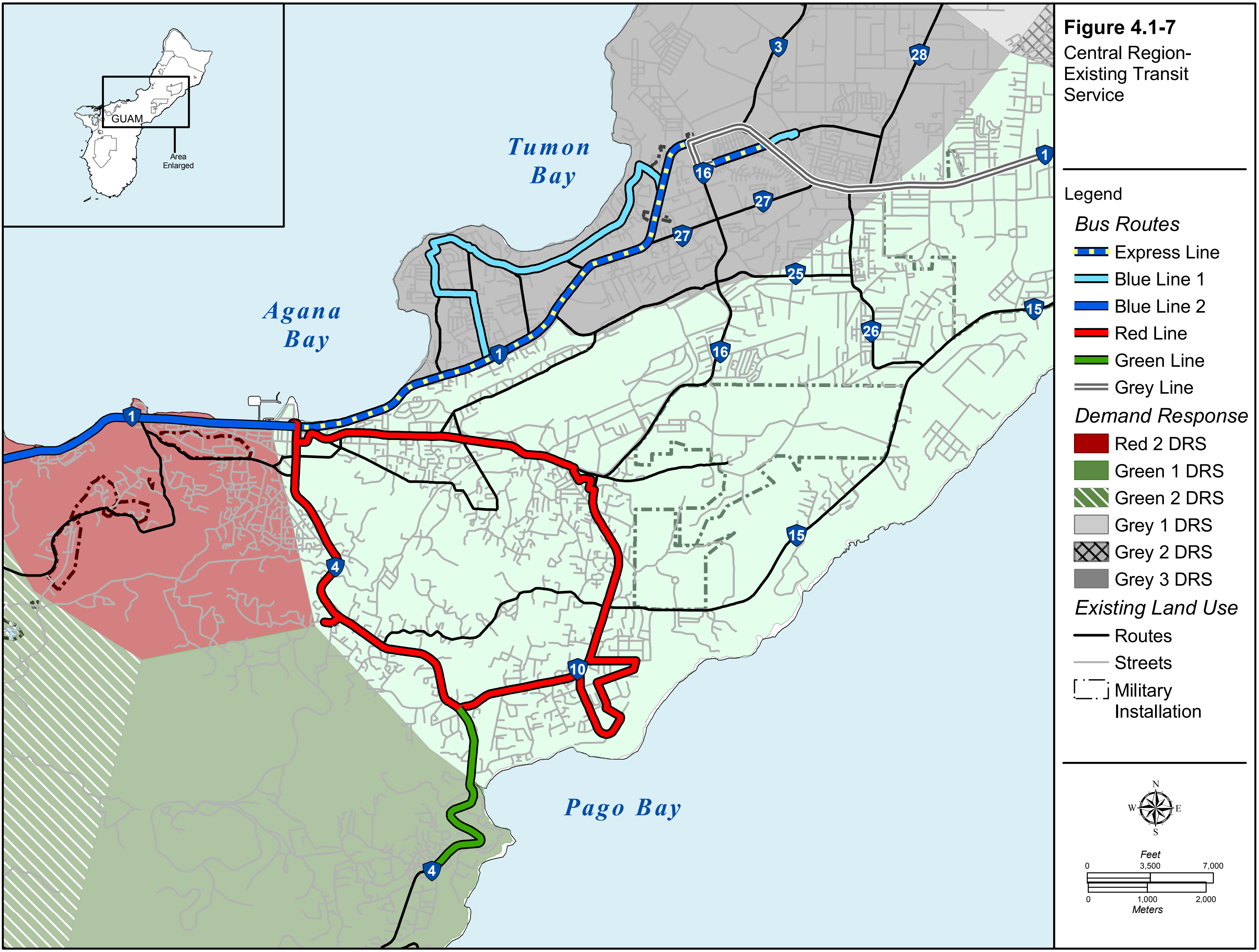

Figure 4.1-7
Central Region-Existing Transit Service

Printing Date: March 11, 2010

Table 4.1-10. Fixed Route and DRS Areas – Central Region

Route	*Areas Served*	*Headway (hours)*	*Trips per Day, Monday-Saturday*	*Trips per Day, Sunday/Holiday*	*Scheduled Run Time Outbound (minutes)*	*Scheduled DR Time (minutes)*	*Scheduled Run Time Inbound (minutes)*
Fixed Route							
Blue Line 1	Hagatna –Tumon – Micronesia Mall (Shuttle)	2	8 OB, 6 IB	6	41 to 52		44 to 54
Blue Line 2	Hagatna – Agat (Shuttle)	2	8 OB, 6 IB	5 OB, 4 IB	35 to 37		32 to 35
Red Line 1	Hagatna – Mangilao (Loop)	1	14	9	22 to 28		28 to 37
Express Line	Hagatna – Micronesia Mall (Loop)	1	13.5	9	25 to 37		28
Green Line 1*	Chamorro Village – Yona (Loop)	2	8	0	10	80	20
Grey Line 4*	Micronesia Mall – Yigo (Loop)	2	0	5	39 to 40	20 to 21	48 to 49
DRS Area							
Grey Line 2	Yigo, Latte Heights, and vicinity	NA	NA	NA	NA	NA	NA
Grey Line 3	Tamuning, Tumon, Harmon, and vicinity	NA	NA	NA	NA	NA	NA
Red Line 1	Hagatna and Asan.	NA	NA	NA	NA	NA	NA
Red Line 2	Hagatna, Anigua, Maina, and vicinity	NA	NA	NA	NA	NA	NA
Green Line 1	Hagatna, Yona, Talofofo, Malojloj, and Inarajan	NA	NA	NA	NA	NA	NA
Green Line 2	Agat, Santa Rita, Umatac, and Merizo	NA	NA	NA	NA	NA	NA

Legend: OB=Outbound; IB = Inbound; NA = Not Applicable.
Notes: *Hours of service are 5:30 a.m. to 7:30 p.m. Monday through Saturday and 7:30 a.m. to 5:30 p.m. Sundays and Holidays.
Source: Government of Guam, Department of Administration, Division of Public Transportation Services 2008.

The paratransit service partially located in the Central Region is:

- Freedom 1 (northern area) serving Yigo, Agafa Gumas, NCS, Santa Ana Subdivision, Astumbo, Dededo, Harmon, and Tamuning
- Freedom 2 (central area) serving Hagatna, Hagatna Heights, Sinajana, Chalan Pago, Pago Bay, Mongmong, and Tamuning
- Freedom 3 (southern area) serving Inarajan, Malojloj, Talofofo, and Yona
- Freedom 4 (southern area) serving Umatac, Agat, Piti, Asan, Maina, Hagatna Heights, and Hagatna
- Freedom 5 serving the entire island

The 12-month (2006-2007) ridership for the fixed route, DRS, and paratransit routes in the Central Region can be found in Table 4.1-11. Note that there is overlap between several of the routes and service areas between the regions for this project. Because the Freedom 5 serves the entire island, ridership is not included here.

Table 4.1-11. Monthly and Total Fiscal Year 2007 Guam Mass Transit Ridership (Passengers Boarding Each Route)

Service Type	*Route Name*	*12-Month Totals*
DRS	Grey 2	25,431
	Grey 3	11,826
	Red 1	NA
	Red 2	21,308
	Green 1	13,050
	Green 2	9,669
Fixed Route	Blue Line 1	30,005
	Blue Line 2	14,870
	Red Line 1	26,620
	Express Line	39,310
	Green Line 1	NA
	Grey Line 4	562
Paratransit	Freedom 1	8,129
	Freedom 2	7,846
	Freedom 3	6,728
	Freedom 4	8,892
All	**Totals**	**224,246**

Legend: DRS = Demand Response Service.

Existing Pedestrian and Bicycle Facilities

There are sidewalks on both sides of Route 1 (Marine Corps Drive) from the intersection with Route 28 in Dededo, through Tamuning, Mongmong-Toto-Maite, and Hagatna, to the intersection with Route 6 in Asan. Table 4.1-12 and Table 4.1-13 list roads with existing and intermittent sidewalks in the Central Region. Note that these are not all of the sidewalks in the Central Region, only the ones on roadways included in this study. Figure 4.1-8 shows the existing bicycle and pedestrian facilities in the Central Region.

Table 4.1-12. Roads with Existing Sidewalks

Route	*Length (miles)*
Route 1	9.42
Route 10	3.73
Route 27	2.52
Total Length	**15.67**

Table 4.1-13. Roads with Intermittent Sidewalks

Route	*Length (miles)*
Route 8	3.29
Route 26	0.97
Route 28	1.12
Total Length	**5.38**

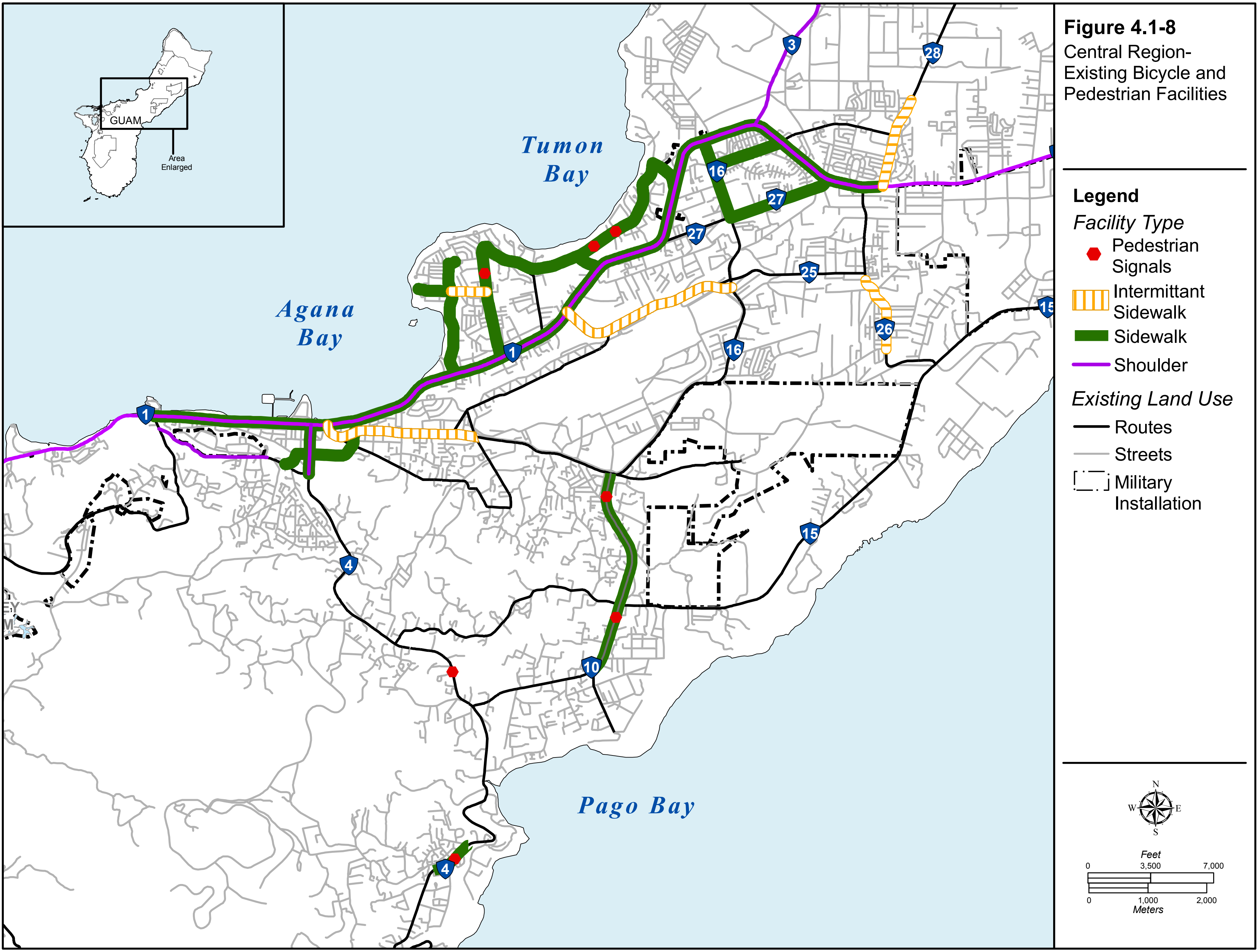

Figure 4.1-8
Central Region-
Existing Bicycle and
Pedestrian Facilities

Printing Date: March 11, 2010

4.1.4 Apra Harbor

4.1.4.1 On Base Roadways

Naval Base Guam

Naval Base Guam main gate is accessed by Marine Corps Drive. Marine Corps Drive is a north-south four-lane arterial roadway that serves as a primary route on the base.

The Traffic Impact Study, BEQ Residential Complex, Naval Base, Guam (Duenas Bordallo & Associates, Inc. 2008) analyzed the LOS for several intersections along Marine Corps Drive (Route 1) within Naval Base Guam and found them all to be operating at an acceptable LOS in both the a.m. and p.m. peak hours.

4.1.4.2 Off Base Roadways

Route 1

Route 1, also known as Marine Corps Drive, is a major arterial roadway and extends approximately 22.0 mi (35.4 km) from Andersen AFB in Yigo on the northeastern corner of the island down to Naval Base Guam in Santa Rita located on the central western area of the island. From Route 11 in Piti to Route 2A in Santa Rita, the road has four lanes. There is a combination of raised and flush median, shoulders, no curb and gutter, and no sidewalks.

Route 2A

Route 2A is located near Naval Base Guam in Santa Rita and connects Route 1 to Route 2. The portion of the road included in this study is from Route 1 to Route 5. This section of Route 2A is approximately 1.0-mi (1.6 km) long and is a two-lane minor arterial with no median, shoulders, curb and gutter, or sidewalk. The lanes are generally 12.0 ft (3.6 m) wide.

Route 11

Route 11 is located on the central west side of the island and serves as the entrance to the Port Authority and Family Beach in Piti. Route 11 is 2.9 mi (4.7 km) long and is classified as a minor arterial. The road has two lanes with no median, and intermittent shoulders, curb and gutter and sidewalks. The lanes are generally 12.0 ft (3.6 m) wide.

The intersections included in the Apra Harbor Region are listed in Table 4.1-14.

Table 4.1-14. Intersections and Access Points – Apra Harbor Region

Intersections and Military Access Points – Apra Harbor	
Signalized	
Route 1/11	Route 5/2A
Route 1/2A	Route 1/Polaris Point

Existing Traffic Volumes and Capacity

A summary of existing ADT volumes and capacity (2008) for the Apra Harbor Region can be found in Table 4.1-15.

Table 4.1-15. Existing ADT and Capacity Summary – Apra Harbor Region

Roadway	*Existing ADT Summary*	*Existing v/c Ratio*
Route 1	Route 1 ranges from 19,000 to 30,000 vpd. The traffic decreases into the entrance of Naval Base Guam, which is at the Route 1/2A intersection.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.80, which indicates that the roadway is not considered congested.
Route 2A	Route 2A ranges from 16,000 to 24,000 vpd. The traffic decreases after the intersection with Route 5.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.80, which indicates that the roadway is not considered congested.
Route 11	Route 11 has 9,100 vpd.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.80, which indicates that the roadway is not considered congested.

Legend: ADT = Average Daily Traffic; v/c = volume to capacity; vpd = vehicles per day.

Figure 4.1-9 and Figure 4.1-10 show existing levels of traffic congestion in the Apra Harbor Region for the a.m. and p.m. peak hours, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested. Although there are numerous intersections with capacity issues, there are currently few roadways included in this study with an existing high v/c ratio.

Existing Intersection Operations

In the existing conditions, all of the intersections in the Apra Harbor Region operate at acceptable LOS. Table 4.1-16 displays the LOS and delay results for the study intersections in the Apra Harbor Region.

Table 4.1-16. Level of Service and Delay Results – Apra Harbor Region

	a.m. Peak Hour		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*				
Route 1/11	B	14.5	C	22.2
Route 1/2A	B	15.9	C	29.1
Route 1/Polaris Point	A	2.1	A	3.9
Route 5/2A	D	37.6	C	33.9

Legend: LOS = Level of Service.
Note: *Signalized intersection LOS based on average delay for the overall intersection.

Existing Public Transportation

This discussion of existing conditions would focus on the Guam Mass Transit System in the Apra Harbor Region. Figure 4.1-11 illustrates the fixed routes and DRS areas for the Apra Harbor Region. A demand-response area is a geographical area that is served by the demand-response type of bus service as described earlier.

Note that all of the Monday through Friday fixed routes originate at Chamorro Village, which is located in Hagatna and is not shown on this map. The Blue Line 2 is the only bus route that is partially included in the Apra Harbor Region. The DRS area located in the Apra Harbor Region is Green 1. This route provides service on Monday through Saturday only, and all observe the normal 5:30 a.m. to 7:30 p.m. hours of service. DRS is available on call and normally provides transportation to the nearest fixed-route.

Table 4.1-17 shows details about the fixed route and DRS areas in the Apra Harbor Region.

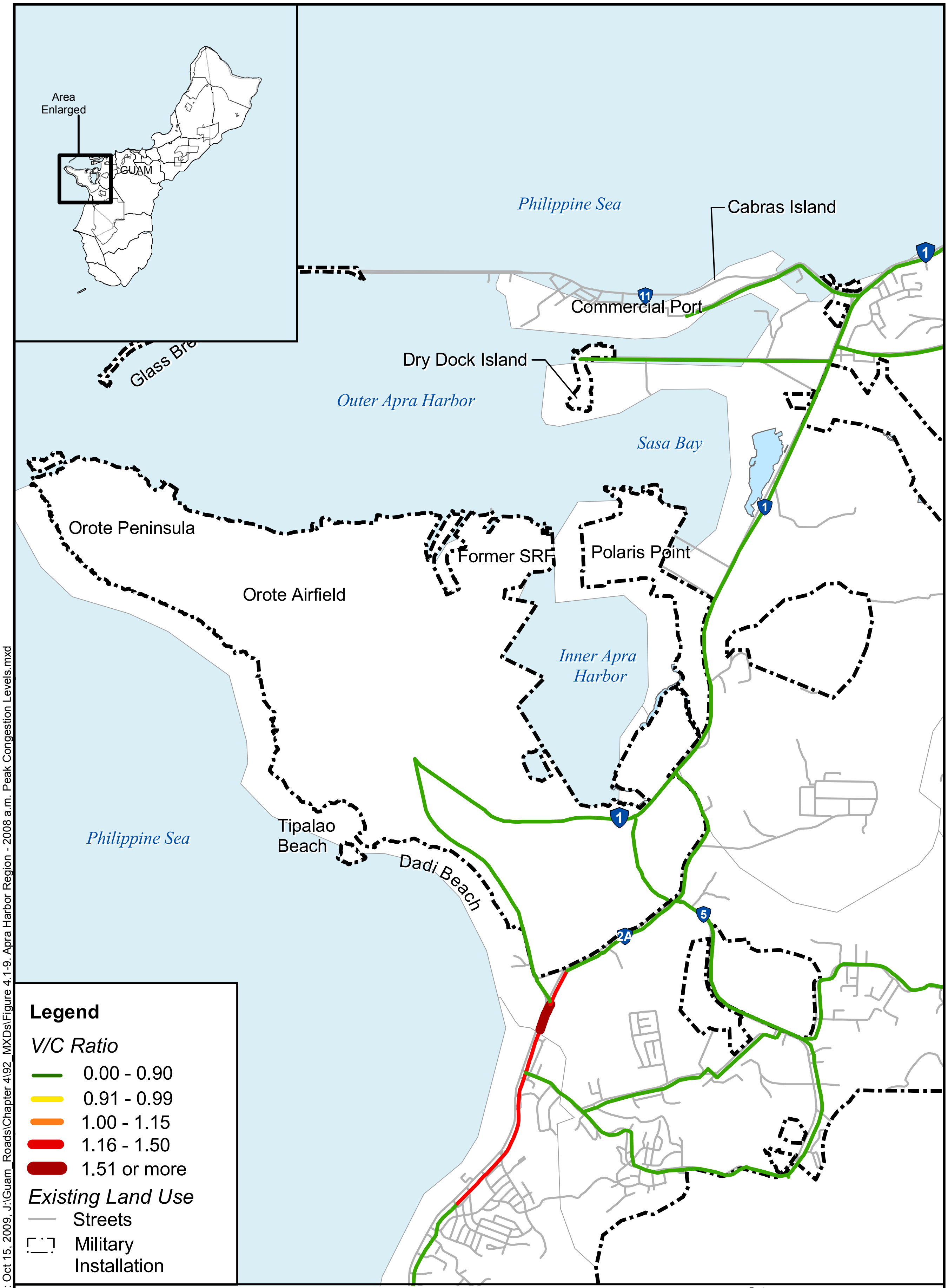

Figure 4.1-9
Apra Harbor Region - 2008 a.m. Peak Congestion Levels

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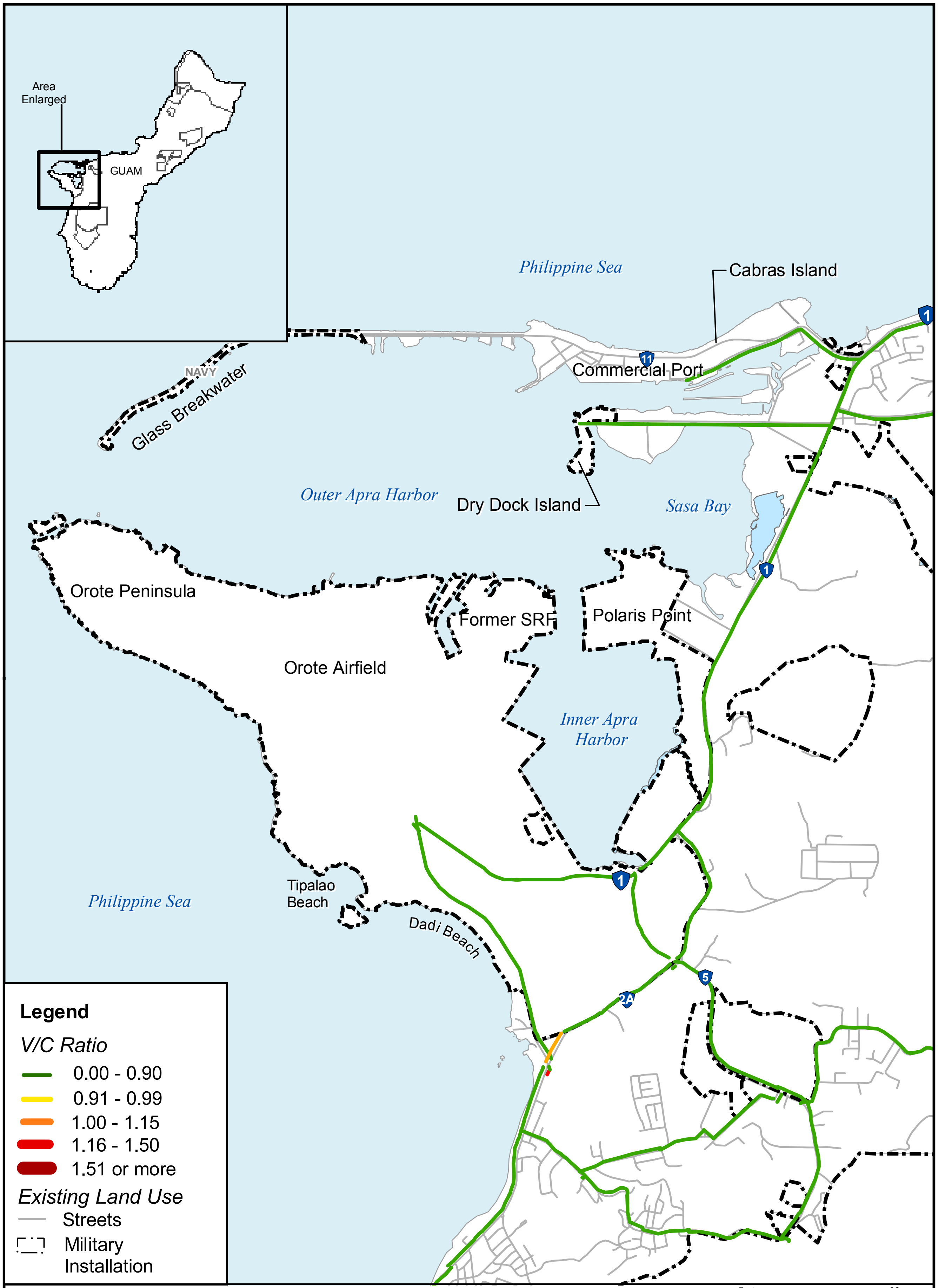

Figure 4.1-10
Apra Harbor Region - 2008 p.m. Peak Congestion Levels

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4192_MXDs\Figure 4.2-23. Apra Harbor Region - 2030 a.m. Peak Congestion Levels- Alternative 1-2.mxd

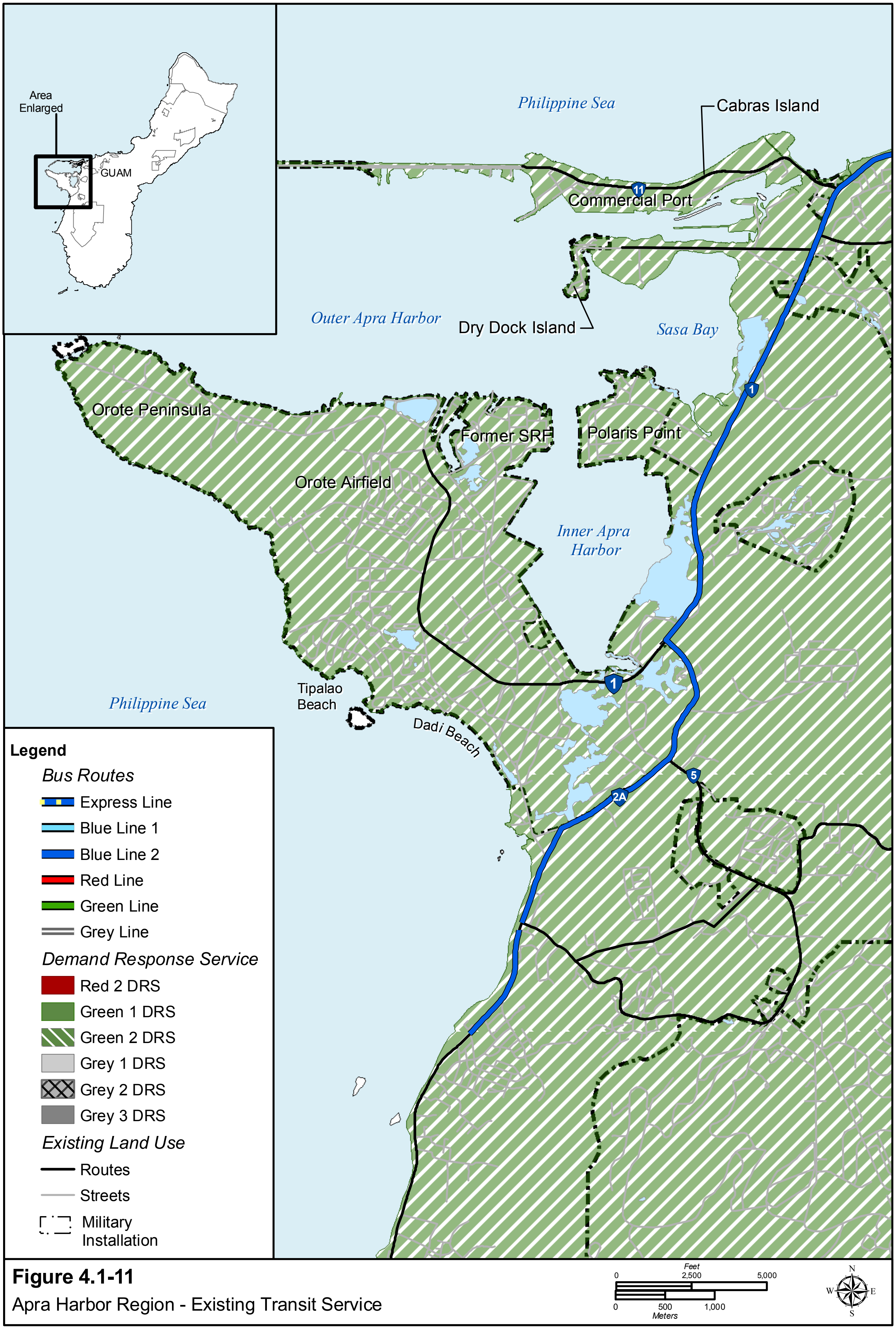

Figure 4.1-11

Apra Harbor Region - Existing Transit Service

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Table 4.1-17. Fixed Route and DRS Areas – Apra Harbor Region

Route	*Areas Served*	*Headway (hours)*	*Trips per Day, Monday-Saturday*	*Trips per Day, Sunday/Holiday*	*Scheduled Run Time Outbound (minutes)*	*Scheduled DR Time (minutes)*	*Scheduled Run Time Inbound (minutes)*
Fixed Route							
Blue Line 2	Hagatna – Agat (Shuttle)	2	8 OB,6 IB	6	41 to 52		44 to 54
DRS Area							
Green 2	Agat, Santa Rita, Umatac, and Merizo	NA	NA	NA	NA	NA	NA

Legend: DRS = Demand Response Service; IB = Inbound; NA = Not Applicable; OB=Outbound.
Source: Government of Guam, Department of Administration, Division of Public Transportation Services 2008.

The paratransit services partially located in the Apra Harbor Region are:

- Freedom 4 (southern area) serving Umatac, Agat, Piti, Asan, Maina, Hagatna Heights, and Hagatna
- Freedom 5 serving the entire island

The 12-month (2006-2007) ridership for the fixed route, DRS, and paratransit routes in the Apra Harbor Region can be found in Table 4.1-18. Note that there is overlap between several of the routes and service areas between the areas of interest for this project. Because the Freedom 5 serves the entire island, ridership is not included here.

Table 4.1-18. Monthly and Total Fiscal Year 2007 Guam Mass Transit Ridership (Passengers Boarding Each Route)

Service Type	*Route Name*	*12-Month Totals*
DRS	Green 2	9,669
Fixed Route	Blue Line 2	14,870
Paratransit	Freedom 4	8,892
	Totals	**33,431**

Legend: DRS = Demand Response Service.

Existing Pedestrian and Bicycle Facilities

The only sidewalks in the Apra Harbor Region are intermittent and are located on Route 11. There are approximately 2.27 mi (3.70 km) of sidewalk along Route 11 (Figure 4.1-12). In addition, there are existing shoulders on Route 1 up to the entrance of Naval Base Guam.

4.1.5 South

4.1.5.1 On Base Roadways

Naval Munitions Site

The NMS can be accessed through the gate at the intersection of Harmon Road and Route 12 in Santa Rita. Harmon Road and Lower Harmon Road provide access to the Fena Valley Reservoir within the NMS, which is the primary source of potable water for the Navy water system.

Based on the relatively low traffic demand on the NMS, all roadways and intersections should be operating at acceptable levels of service for both the a.m. and p.m. peak hours.

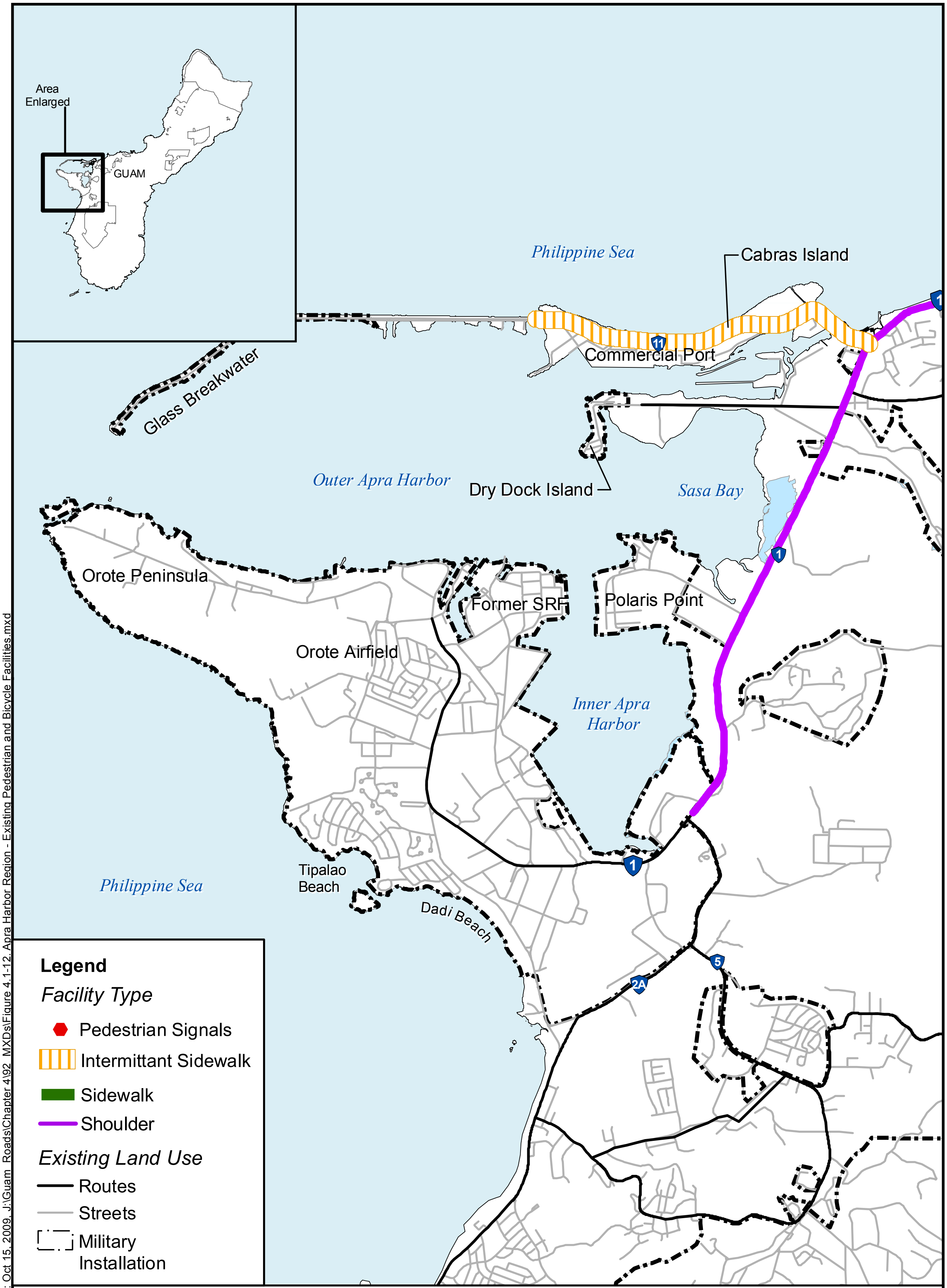

Figure 4.1-12
Apra Harbor Region - Existing Pedestrian and Bicycle Facilities

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4.1.5.2 Off Base Roadways

Existing Roadway Conditions

Route 5

Route 5 is located near Naval Base Guam in Santa Rita and intersects with Route 2A at its northern terminus. It loops around to join Route 12 at its southern terminus. The portion of Route 5 included in this study is the section between Route 2A and Route 17. The road is approximately 0.5-mi (0.8-km) long and is considered a minor arterial for the portion in this project. Route 5 has two lanes with an intermediate raised median and queuing left-turn lane at intersections and no shoulders, curb and gutter, or sidewalks. The lanes are generally 12.0 ft (3.6 m) wide.

Route 12

Route 12 is located in the southern part of the island and connects with Route 5 at its eastern terminus in Santa Rita and Route 2 at the western terminus in Agat. Route 12 is 2.7 mi (4.3 km) long and is classified as a major collector; however, the only portion included in this project is the intersection with Route 2. The road has two lanes, intermittent shoulders, and no curb and gutter or sidewalks. The lanes are generally 12.0 ft (3.6 m) wide.

The intersections and military access points included in the South Region are listed in Table 4.1-19.

Table 4.1-19. Intersections and Military Access Points – South Region

Intersections and Access Points - South
Signalized
Route 2/12
Unsignalized
Route 5/17
Route 17/4A
Route 4/4A
Military Access Points
Route 5 – Naval Munitions Site / Harmon Road

Existing Traffic Volumes and Capacity

A summary of existing ADT volumes (2008) for the South Region can be found in Table 4.1-20.

Table 4.1-20. Existing ADT Summary and Capacity – South Region

Roadway	*Existing ADT Summary*	*Existing v/c Ratio*
Route 5	Route 5 ranges from 7,200 to 12,000 vpd.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.80, which indicates that the roadway is not considered congested.
Route 12	Route 12 ranges from 1,000 to 4,100 vpd. The traffic increases toward the intersection with Route 2.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.80, which indicates that the roadway is not considered congested.

Legend: ADT = average daily traffic; v/c = volume to capacity; vpd = vehicles per day.

Figure 4.1-13 and Figure 4.1-14 show existing levels of traffic congestion in the South Region for the a.m. and p.m. peak hours, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E;

and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested.

Although there are numerous intersections with capacity issues, there are currently few roadways included in this study with an existing high v/c ratio. For both the morning and afternoon peaks, the roadways in this region are not considered congested.

Existing Intersection Operations

In the existing conditions, all intersections in the South Region operate at LOS C or better. Table 4.1-21 displays the LOS and delay results for the study intersections in the South Region.

Table 4.1-21. Existing Level of Service and Delay Results – South Region

	a.m. Peak Hour		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*				
Route 2/12	C	26.3	B	19.2
Unsignalized**				
Route 5/17	B	12.1	B	11.0
Route 4/4A	C	16.8	B	11.4
Route 17/4A	B	14.0	B	11.4
Military Access Points				
Route 5 – Naval Munitions Site/Harmon Road**	A	8.8	B	10.2

Legend: LOS = Level of Service.
Notes: *Signalized intersection LOS based on average delay for the overall intersection.
**Unsignalized intersection LOS based on approach delay on STOP-controlled approach.

For both the morning and afternoon peaks, the roadways in this region are not considered congested.

Existing Public Transportation

The discussion of existing conditions in this section would focus on the Guam Mass Transit System in the South Region. Figure 4.1-15 illustrates the fixed routes and DRS areas for the South Region. Note that all of the Monday through Friday fixed routes originate at Chamorro Village, which is located in Hagatna and is not shown on this map. The bus route partially included in the South Region is Blue Line 2. The DRS areas located in the South Region are Green 1 and Green 2. These routes provide service Monday through Saturday only, and all observe the normal 5:30 a.m. to 7:30 p.m. hours of service. DRS is available on call and normally provides transportation to the nearest fixed-route. Table 4.1-22 shows details about the fixed route and DRS areas in the South Region.

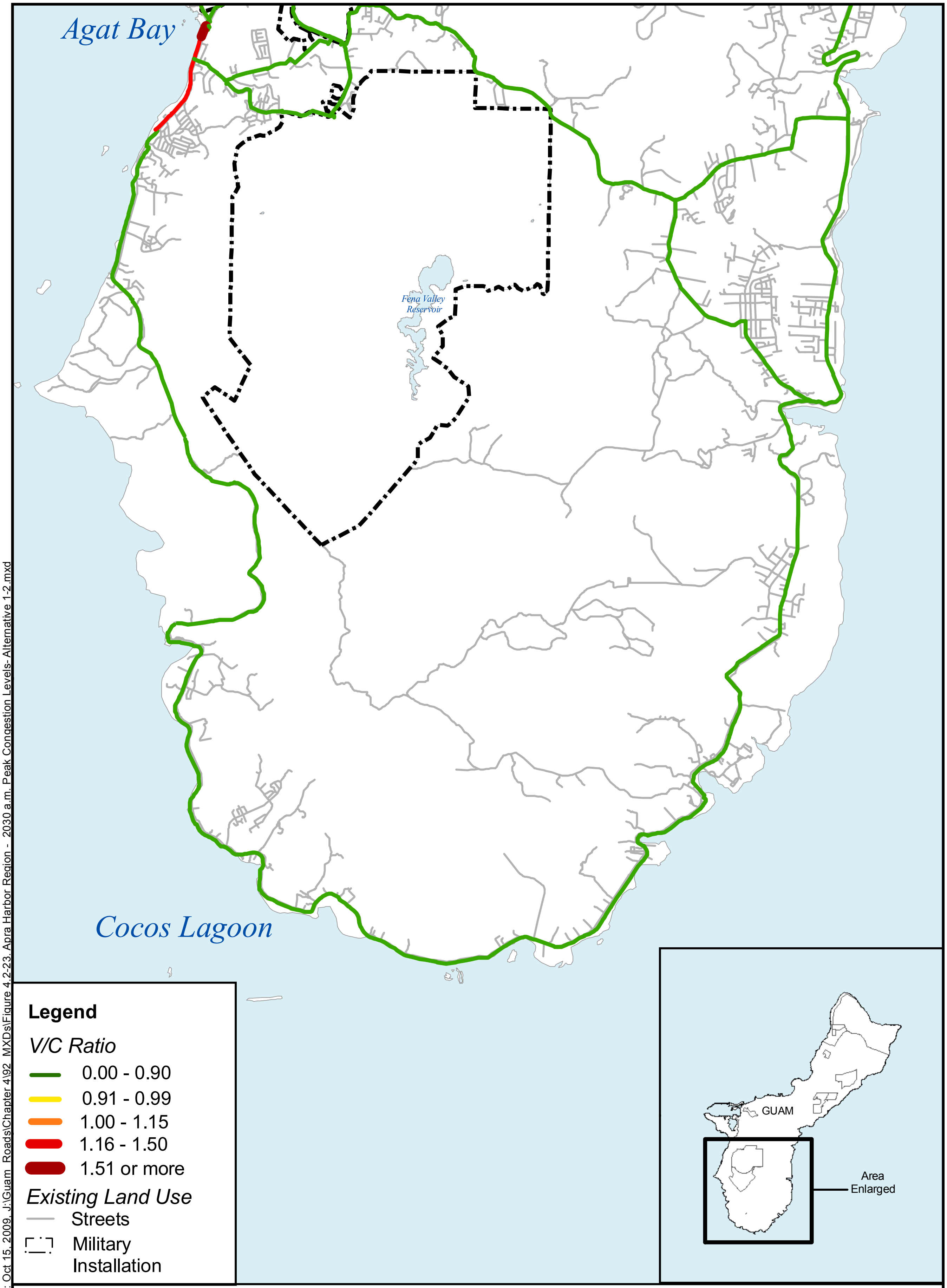

Figure 4.1-13

South Region - 2008 a.m. Peak Congestion Levels

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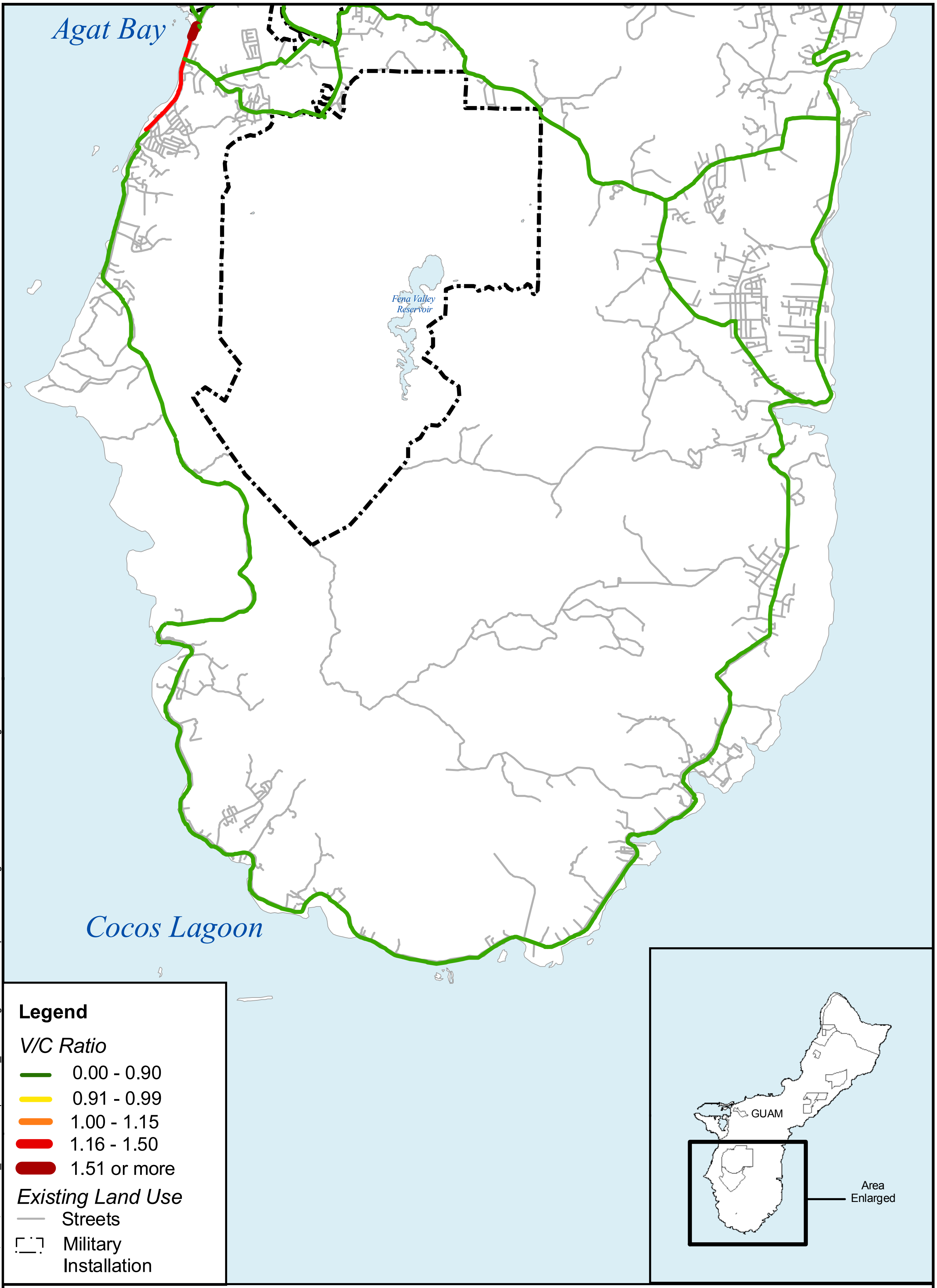

Figure 4.1-14

South Region - 2008 p.m. Peak Congestion Levels

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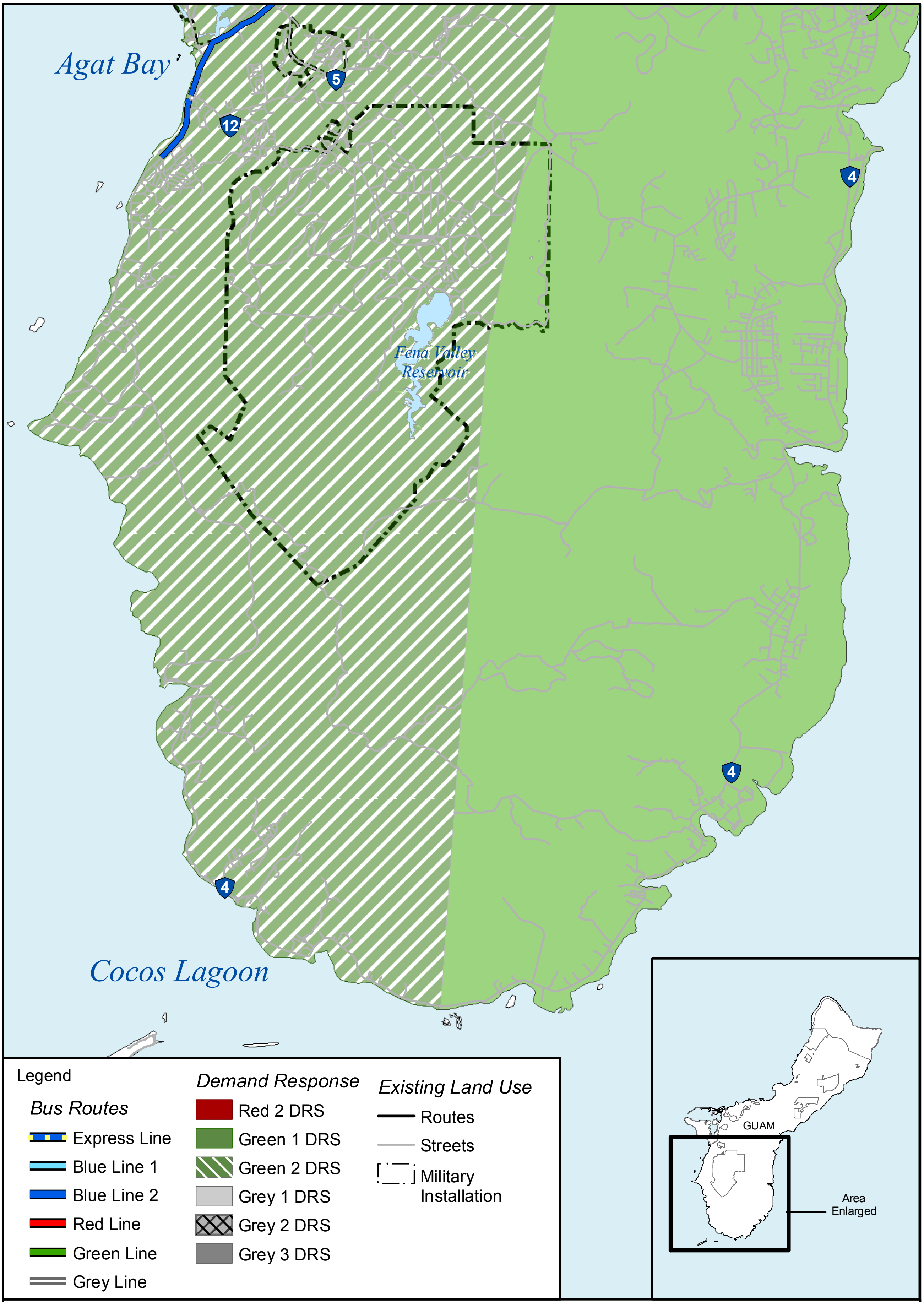

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Figure 4.1-15
South Region - Existing Transit Service

Table 4.1-22. Fixed Route and DRS Areas – South Region

Route	*Areas Served*	*Headway (hours)*	*Trips per Day, Monday-Saturday*	*Trips per Day, Sunday/Holiday*	*Scheduled Run Time Outbound (minutes)*	*Scheduled Time (minutes)*	*Scheduled Run Time Inbound (minutes)*
Fixed Route							
Blue Line 2	Hagatna —Agat (Shuttle)	2	8 OB, 6 IB	5 OB, 4 IB	35 to 37		32 to 35
Green Line 1*	Chamorro Village—Yona (Loop)	2	8	0	10	80	20
DRS Area							
Green Line 1	Hagatna, Yona, Talofofo, Malojloj, and Inarajan	NA	NA	NA	NA	NA	NA
Green Line 2	Agat, Santa Rita, Umatac, and Merizo	NA	NA	NA	NA	NA	NA

Legend: IB=Inbound; NA=Not Applicable; OB=Outbound.
Note: *Hours of service are 5:30 a.m. to 7:30 p.m. Monday through Saturday and 7:30 a.m. to 5:30 p.m. Sundays and Holidays.
Source: Government of Guam, Department of Administration, Division of Public Transportation Services 2008.

The paratransit service partially located in the South Region is:

- Freedom 3 (southern area) serving Inarajan, Malojloj, Talofofo, and Yona
- Freedom 4 (southern area) serving Umatac, Agat, Piti, Asan, Maina, Hagatna Heights, and Hagatna
- Freedom 5 serving the entire island

The 12-month (2006-2007) ridership for the fixed route, DRS, and paratransit routes in the South Region can be found in Table 4.1-23. Note that there is overlap between several of the routes and service areas between the regions for this project. Because the Freedom 5 serves the entire island, ridership is not included here.

Table 4.1-23. Monthly and Total Fiscal Year 2007 Guam Mass Transit Ridership (Passengers Boarding Each Route)

Service Type	*Route Name*	*12-Month Totals*
DRS	Green 1	13,050
	Green 2	9,669
Fixed Route	Blue Line 2	14,870
	Green Line 1	NA
Paratransit	Freedom 3	6,728
	Freedom 4	8,892
	Totals	53,209

Legend: DRS = Demand Response Service.

Existing Pedestrian and Bicycle Facilities

The southern portion of the island does not contain any pedestrian or bicycle facilities. In addition, there are no shoulders that can function as pedestrian or bicycle lanes. As stated earlier, no formal bike lanes or paths exist on Guam.

4.2 ENVIRONMENTAL CONSEQUENCES

4.2.1 Approach to Analysis

On Base Roadways

For Andersen AFB and Navy base, on base roadway analysis approach was based on the TransCAD traffic model volumes and available traffic study data. General baseline and operating conditions were taken from the Andersen Air Force Base Traffic and Safety Engineering Study (Andersen AFB 2008) for Andersen AFB and the Traffic Impact Study, BEQ Residential Complex, Naval Base, Guam (Duenas Bordallo & Associates, Inc. 2008) for Navy base. The TransCAD 2008 and 2030 traffic volumes at Andersen Air Force and Navy base gates were compared to determine the anticipated increase in traffic entering and exiting the base. This index provides a relative measure of traffic impact and is intended to be a gauge of the general level of traffic on the base. This index does not measure the traffic impact at critical intersections.

For Andersen South, Finegayan, Polaris Point and NMS, the current base land use was compared to the traffic anticipated to be generated by the proposed action. A qualitative analysis based on roadway capacities and project trips were compared to determine level of significance.

An on base traffic study is currently being prepared and once complete will be used to identify potential mitigation options for high traffic areas.

Off Base Roadways

This section describes the future condition of off base roadways as a result of roadway improvements needed to support the military relocation to Guam. The results are discussed for the four major alternatives of Volume 2: Alternative 1, Alternative 2, Alternative 3, and Alternative 8, all of which are described in detail in Chapter 2. However, the analysis also includes the alternatives associated with the aircraft carrier berthing action and the Army Air and Missile Defense Task Force (AMDTF) action because the traffic on the roadways must be analyzed as a whole in order to determine the full impacts of the proposed action. As described in the Affected Environment subsection of Volume 2, the island is divided up into four regions: North, Central, Apra Harbor, and South. The future conditions of the off base roadways are discussed in their respective regions, as listed above.

The traffic impacts of the alternatives were determined through an analysis of future traffic volumes and intersection operations. The alternatives that were modeled are as follows:

- 2014 Peak Construction/Full Military Expansion – Alternative 1
- 2014 Peak Construction/Full Military Expansion – Alternative 2
- 2014 Peak Construction/Full Military Expansion – Alternative 3
- 2014 Peak Construction/Full Military Expansion – Alternative 8
- 2014 – No-Action Alternative
- 2030 Full Military Expansion – Alternative 1
- 2030 Full Military Expansion – Alternative 2
- 2030 Full Military Expansion – Alternative 3
- 2030 Full Military Expansion – Alternative 8
- 2030 – No-Action Alternative

Forecasting of future traffic volumes involved a three-step process (trip generation, trip distribution and assignment). All modeling efforts used the 2008 TransCAD model, as discussed in the Affected

Environment section, along with several population and employment assumptions. The assumptions included:

- Population related to the military relocation would peak in 2014 with approximately 268,000 construction and military personnel and general population of Guam. By 2030, the population would slightly decrease to approximately 255,000 because of the loss in off-island construction personnel (see Figure 4.2-1).
- All military loading, housing location, and military workplace location information was provided by the Navy. Most of the military personnel are housed in the northwest area of the island (see Figure 4.2-1 and Table 4.2-1 and Figure 4.2-2).
- Off-island construction personnel associated with the military actions are housed in community housing close to the construction sites and bused to work during off-peak hours during the construction years.
- Transient personnel (aircraft carriers, Marines, Air Force) visit periodically, do not have access to personally owned vehicles, and would have designated shuttle service to on-island locations; therefore, traffic was assumed to be negligible and subsequently not included in model.
- Off-island indirect workers associated with the military actions would live in zones concentrated around the north and central parts of the island.
- New indirect and direct jobs that result from the military actions would be concentrated around the north and central parts of the island.
- Roadway construction workers were included in the model as “Other” indirect workers. The employment at these locations would attract workers during the trip distribution step.
- Construction materials being delivered to the construction sites were also modeled.
- Delivery of roadway construction materials in the model accounts for the impact of roadway work during the construction peak phase.
- Traffic congestion was measured by dividing the number of cars on the road (i.e., volume) by the number of cars the road was designed to carry (i.e., capacity). A v/c ratio greater than 1 indicates that the roads are carrying more vehicles than they were designed to handle—the roads are congested.

4.2.1.1 Methodology

<u>On Base Roadways</u>

For Andersen AFB and Navy base, a percent increase of traffic between 2030 with and without project was used to determine the level of significance. For the purpose of this analysis, a 5 percent (%) increase in total traffic was used as an indicator for potential problem areas.

For on base construction, Andersen South, Finegayan, Polaris Point and NMS, the current traffic demand on the roadway system was compared to the traffic anticipated to be generated by the proposed action. Typically, a two lane roadway has a capacity of approximately 5,000 vehicles per day (vpd). This capacity was compared to projected traffic of the project and current traffic demand to determine the potential for impacts.

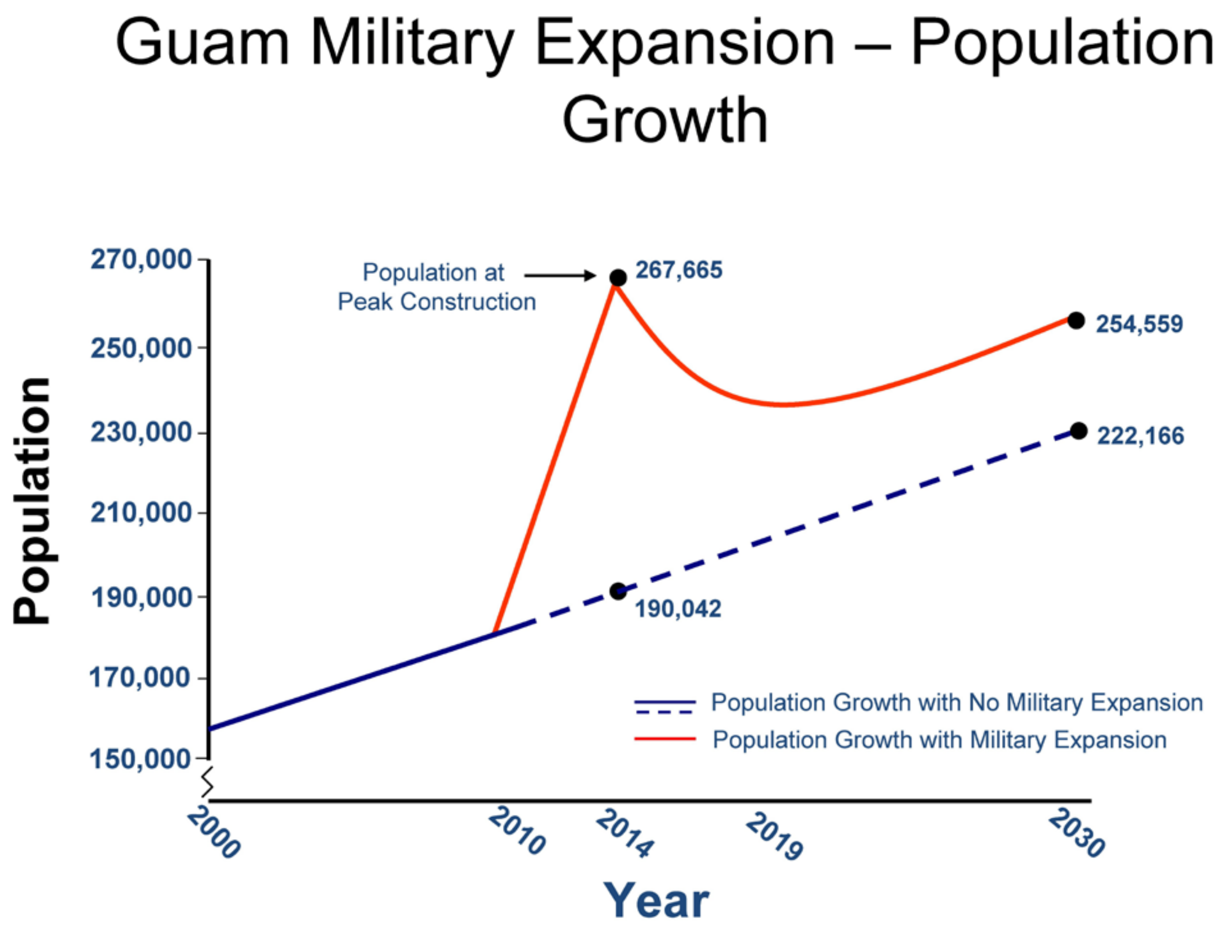

Figure 4.2-1. Island Population Growth

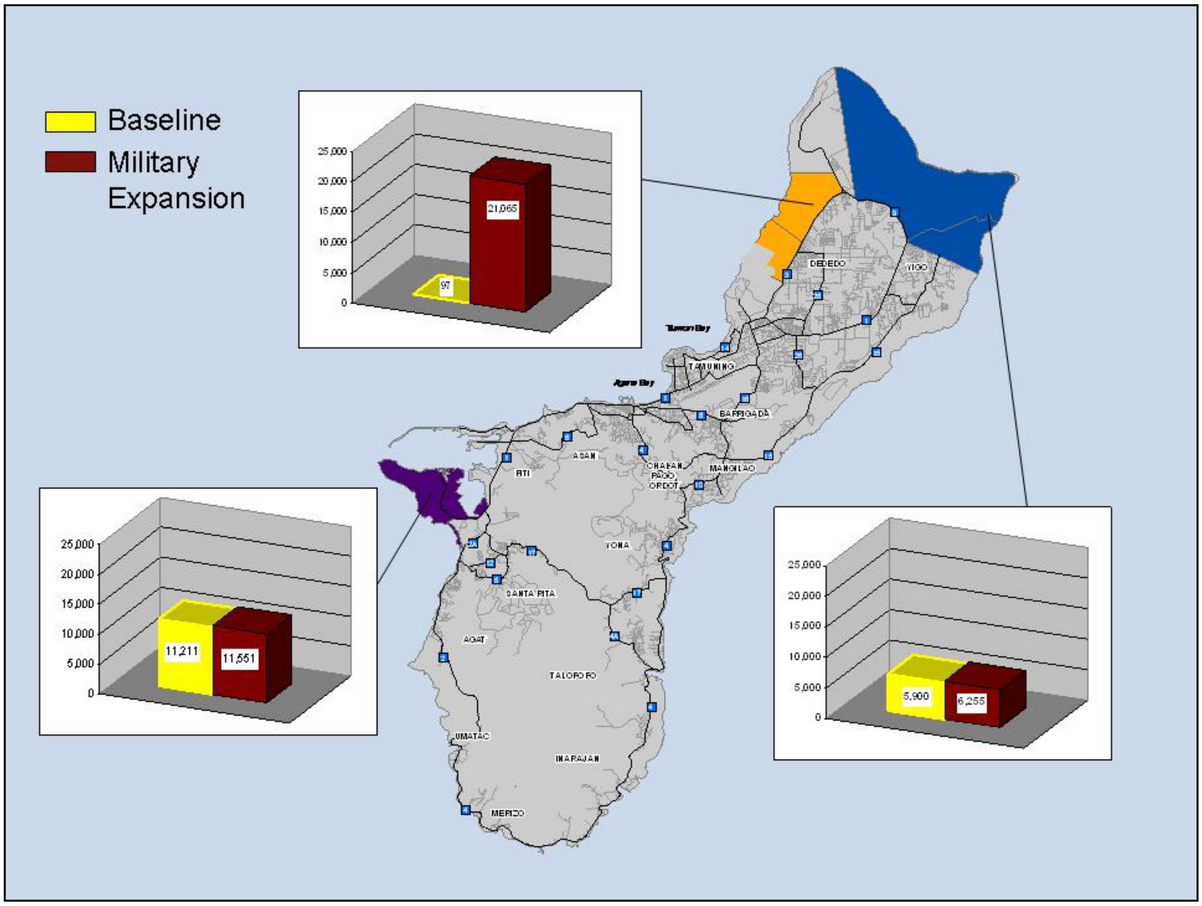

Figure 4.2-2. Military Base Population Growth

Off Base Roadways

As the first step, traffic volumes were modeled for each 2030 Alternative to understand the impacts of the military relocation on the existing roadway network, including already programmed roadway improvements. With current capacities, this initial modeling effort showed severe military-related congestion along several routes in the northern and central portions of the island. The results formed the roadway improvements needed to improve traffic congestion and improve safety of the system. The proposed projects, as described in Volume 6, Chapter 2, included roadway widening to improve the congestion levels and strengthening to improve structural capacity of roads. These projects are shown in Table 4.2-1.

Table 4.2-1. Roadway Widening Projects

Route	*Limits*	*Description*	*Alternatives 1 and 2*	*Alternative 3*	*Alternative 8*
Route 3	NCTS Finegayan to Route 28	Widen from 2 to 4 lanes, add median and shoulders.	X	X	X
Route 3	NCTS Finegayan to Route 9	Widen from 2 to 4 lanes, add median and shoulders.	X	X	X
Route 8	Route 33 (east) to Route 1	Widen from 4/6 lanes to 6 lanes, with a median.	X	X	X
Route 8A	Route 16 to Air Force Barrigada	Widen to provide median and shoulders.		X	
Route 9	Route 3 to Andersen AFB (ACE Gate)	Widen from 2 to 4 lanes, add median.	X	X	X
Route 9	Andersen AFB ACE Gate to Route 1 (Andersen AFB Main Gate)	Add median and shoulders.	X	X	X
Route 16	Route 10A to Navy Barrigada Residential Gate	Widen from 4 to 6 lanes, with a median.		X	
Route 25	Route 16 to Route 26	Widen from 2 to 4 lanes.	X	X	X
Route 26	Route 1 to Route 15	Widen from 2 to 4 lanes.	X	X	X
Route 28	Route 1 to Route 3	Add median and 4 shoulders.	X	X	X

Legend: ACE = Air Combat Element; AFB = Air Force Base; NCTS = Naval Computer and Telecommunications Station.

The existing roads are not structurally capable of handling heavy traffic due to the current condition of pavement. By improving the structural capacity of the roadways and widening selected roads to account for additional traffic, the safety and stability of the roadways would also be improved for other drivers, transit patrons, pedestrians, and bicyclists. As discussed in Chapter 2, the following roads are included in the proposed improvements for this project:

- Route 1
- Route 2a
- Route 3
- Route 5
- Route 8
- Route 8a
- Route 9
- Route 10
- Route 11
- Route 12
- Route 15
- Route 16
- Route 25
- Route 26
- Route 27
- Route 28
- Chalan Lujuna

The second step included re-modeling the 2030 traffic volumes for each 2030 Alternative with the additional projects listed in Table 4.2-1 with the exception of Routes 25 and 26, as these projects were included in the 2030 programmed roadway improvements. After incorporating the new capacities with the proposed roadway segment improvements, the results reveal decreased congestion on the routes in the north; however, some military-related congestion still exists in the Central Region.

The third step included modeling each 2014 Alternative with the full set of roadway widening improvements to obtain 2014 roadway volumes and resulting congestion levels. The final step in the off base roadway analysis was using peak-hour roadway volumes to forecast the 2014 and 2030 intersection turning movements. Geometric conditions and intersection turning movements were evaluated using Synchro to estimate intersection delay and levels of service. Intersection improvements were developed with the goal of providing LOS E or better in the 2030 condition. In some cases, achieving LOS E would have required inordinately costly and environmentally impactful roadway improvements. In most those cases, intersection improvements were recommended that would offset the traffic impacts associated with the military relocation, however intersections would still operate at LOS F. The intersection improvements were recommended at 27 intersections and were evaluated for both 2014 and 2030. LOS modeling and geometric requirements/design were completed for the access points based on the long-term steady-state condition in 2030. The 2014 analysis should be completed for the "preferred" alternative as part of a future traffic management plan during the peak construction period.

The results of this analysis are shown in the *Future Traffic Impacts* subsections of Sections 4.2.2 and 4.2.3 in this chapter.

Figure 4.2-3 through Figure 4.2-14 present the different congestion levels for each alternative. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested. The congestion levels for Alternative 2 are the same as that of Alternative 1; therefore, Figure 4.2-3 through Figure 4.2-6 are applicable to both Alternatives 1 and 2.

The turning movements calculated using the methods and assumptions described above were then used to forecast the LOS at the 42 intersections. The traffic volumes from the revised TransCAD model, including the roadway widening projects associated with each alternative, were used to analyze intersection operations. The future conditions for the 42 intersections were calculated using Synchro, which is described earlier in this chapter.

4.2.1.2 Determination of Significance

On Base Roadways

See On base Approach to Analysis and Methodology (Sections 4.2.1 and 4.2.1.1) of this Chapter.

Off Base Roadways

The desired threshold for acceptable operating conditions at intersections is LOS E or better. Intersections operating at LOS F would be considered unacceptable.

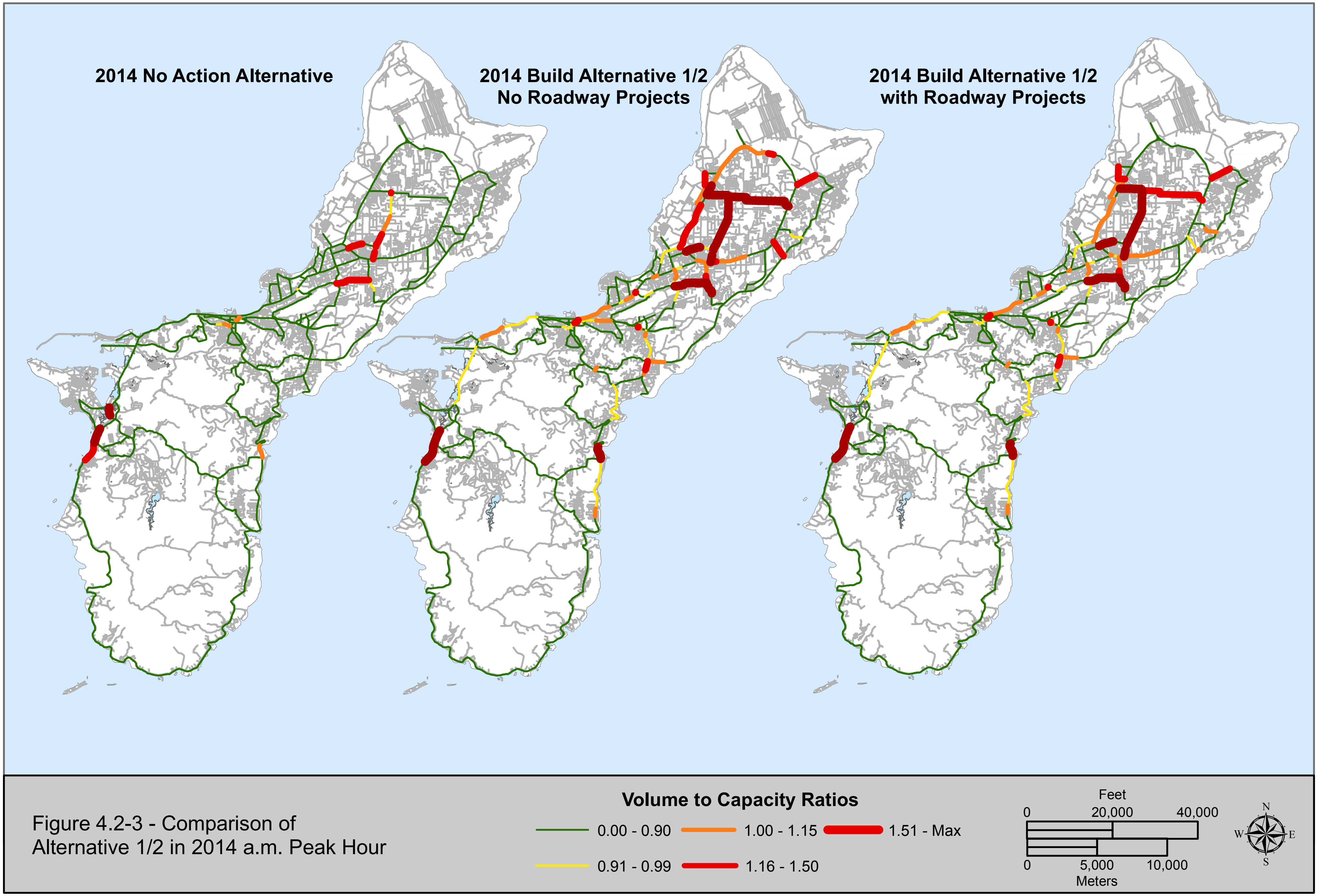

Figure 4.2-3 - Comparison of Alternative 1/2 in 2014 a.m. Peak Hour

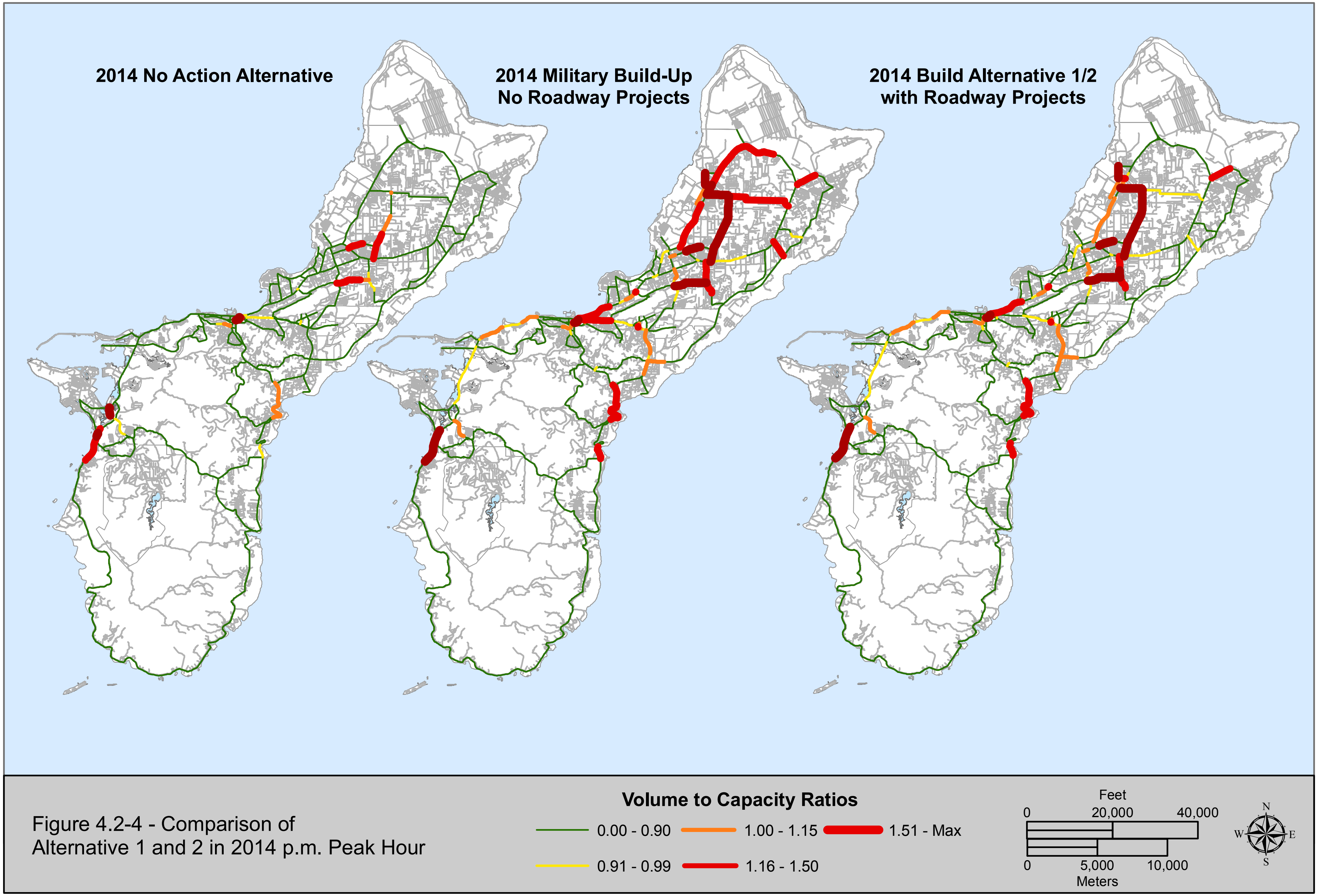

Figure 4.2-4 - Comparison of Alternative 1 and 2 in 2014 p.m. Peak Hour

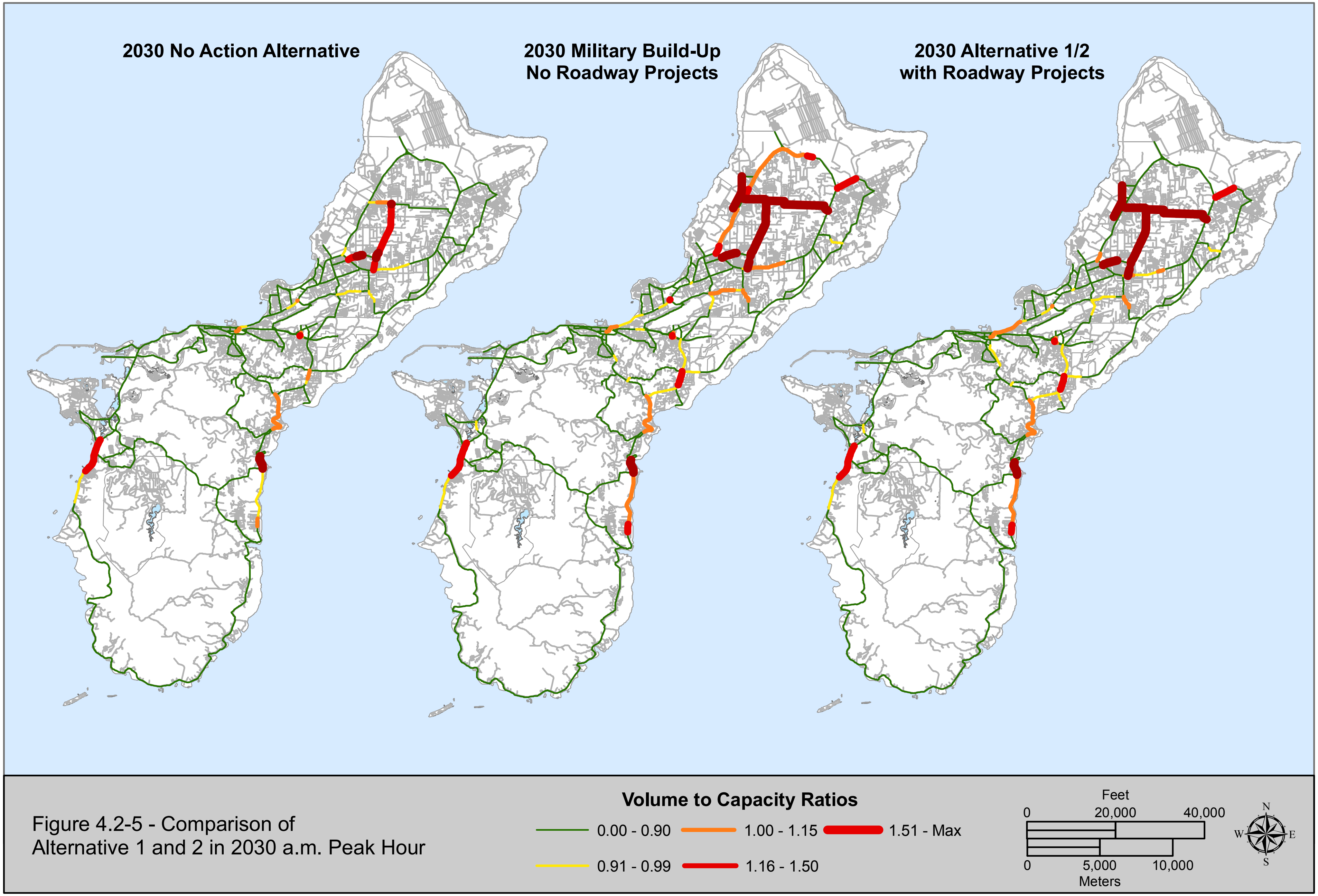

Figure 4.2-5 - Comparison of Alternative 1 and 2 in 2030 a.m. Peak Hour

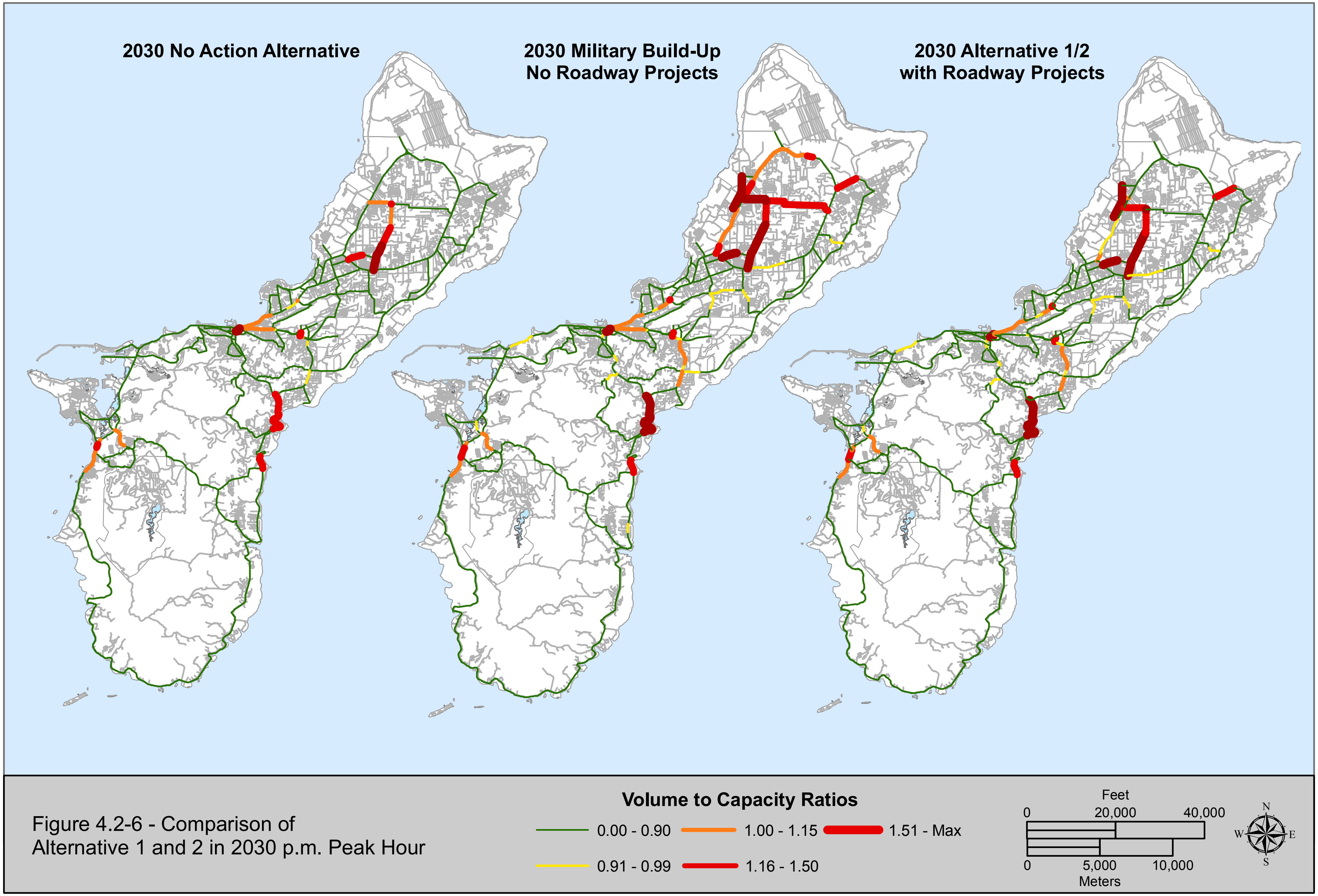

Figure 4.2-6 - Comparison of Alternative 1 and 2 in 2030 p.m. Peak Hour

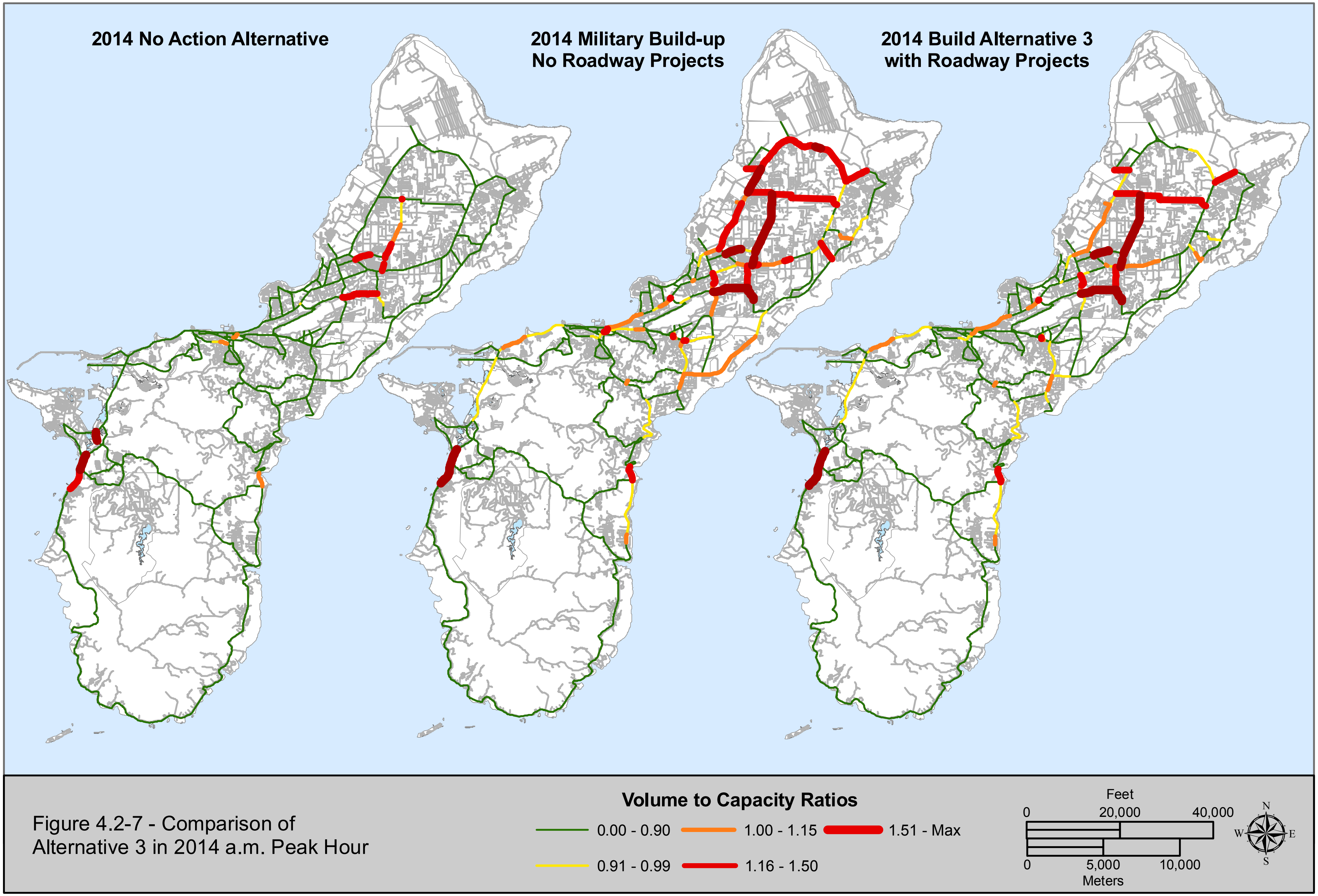

Figure 4.2-7 - Comparison of Alternative 3 in 2014 a.m. Peak Hour

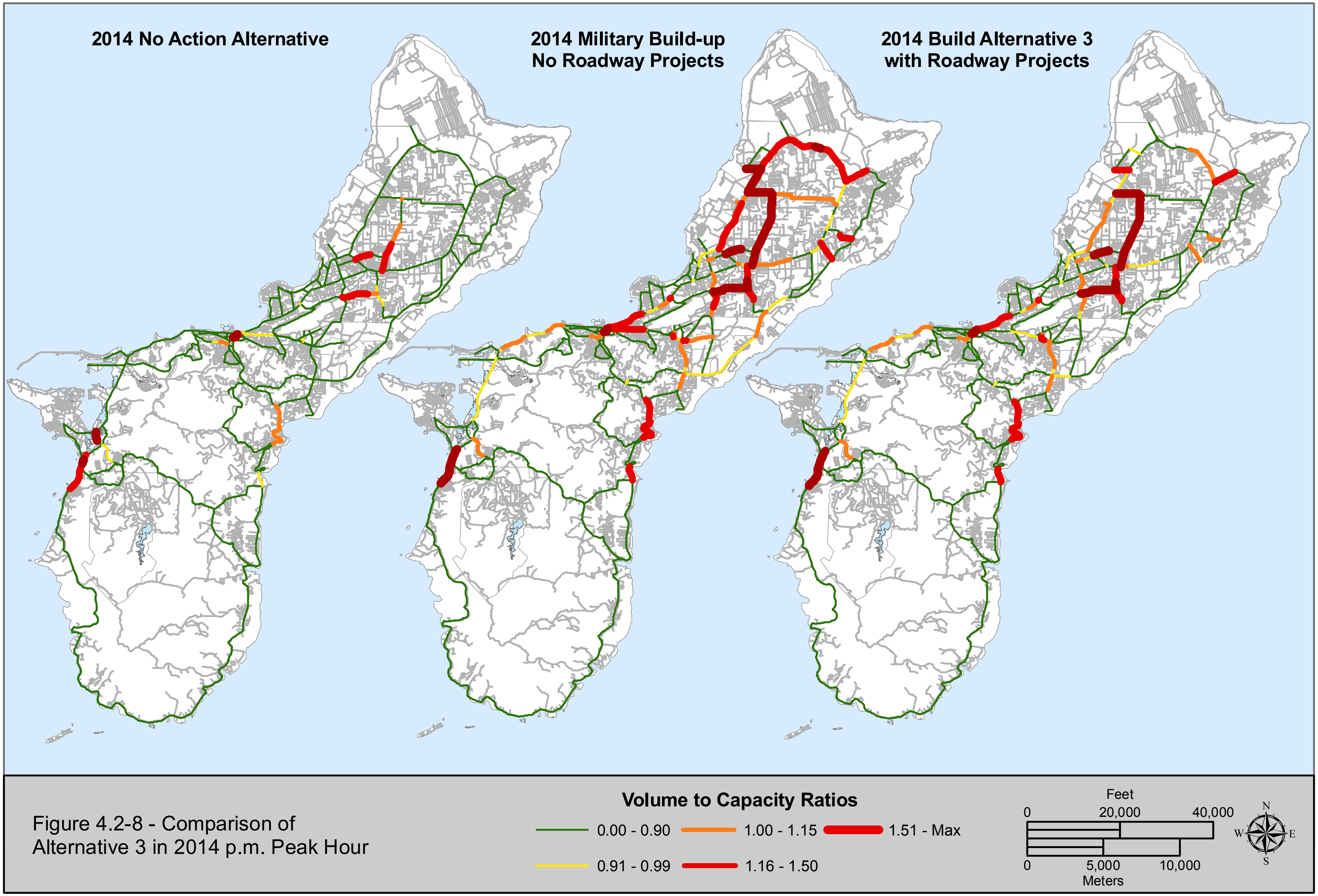

Figure 4.2-8 - Comparison of Alternative 3 in 2014 p.m. Peak Hour

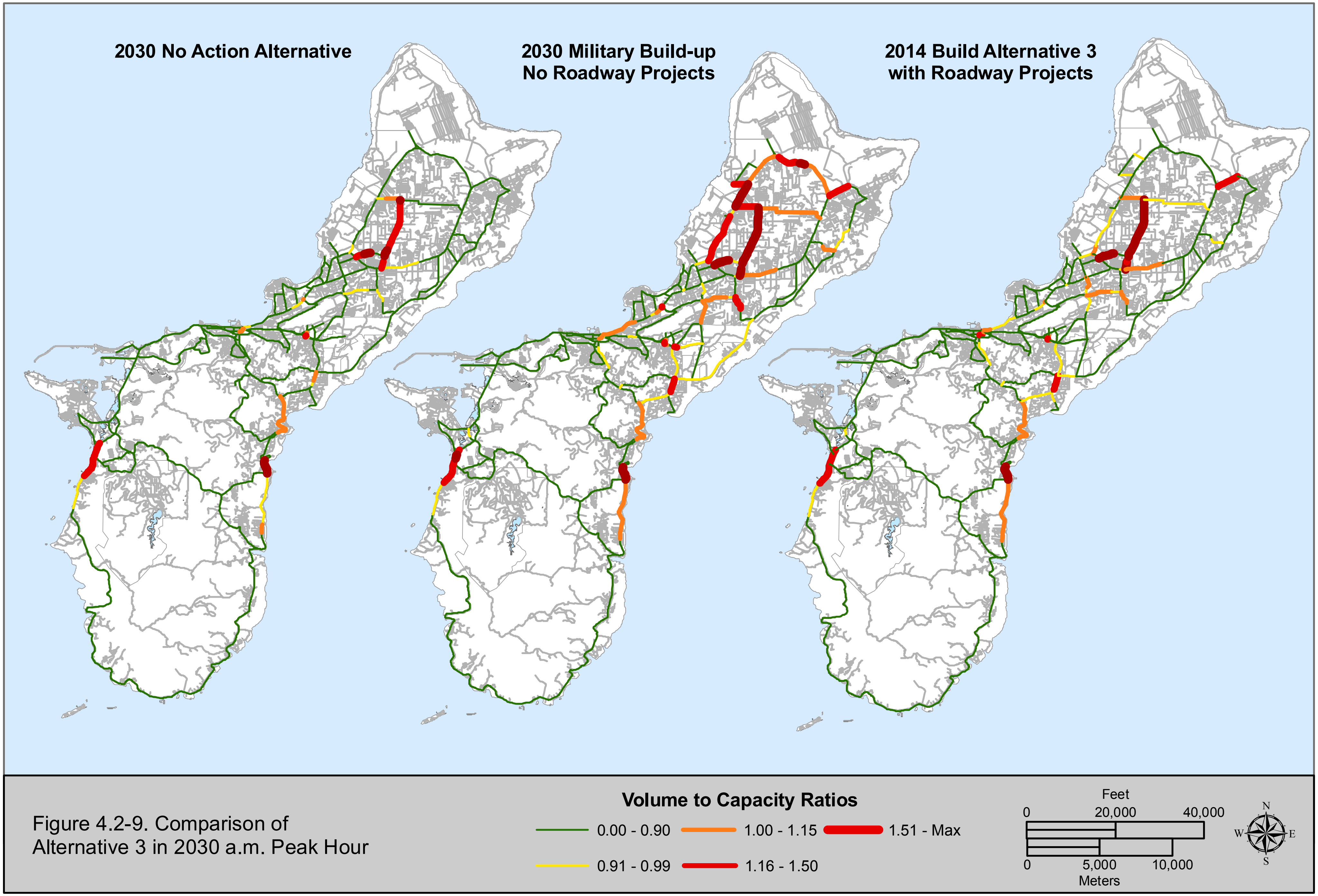

Figure 4.2-9. Comparison of Alternative 3 in 2030 a.m. Peak Hour

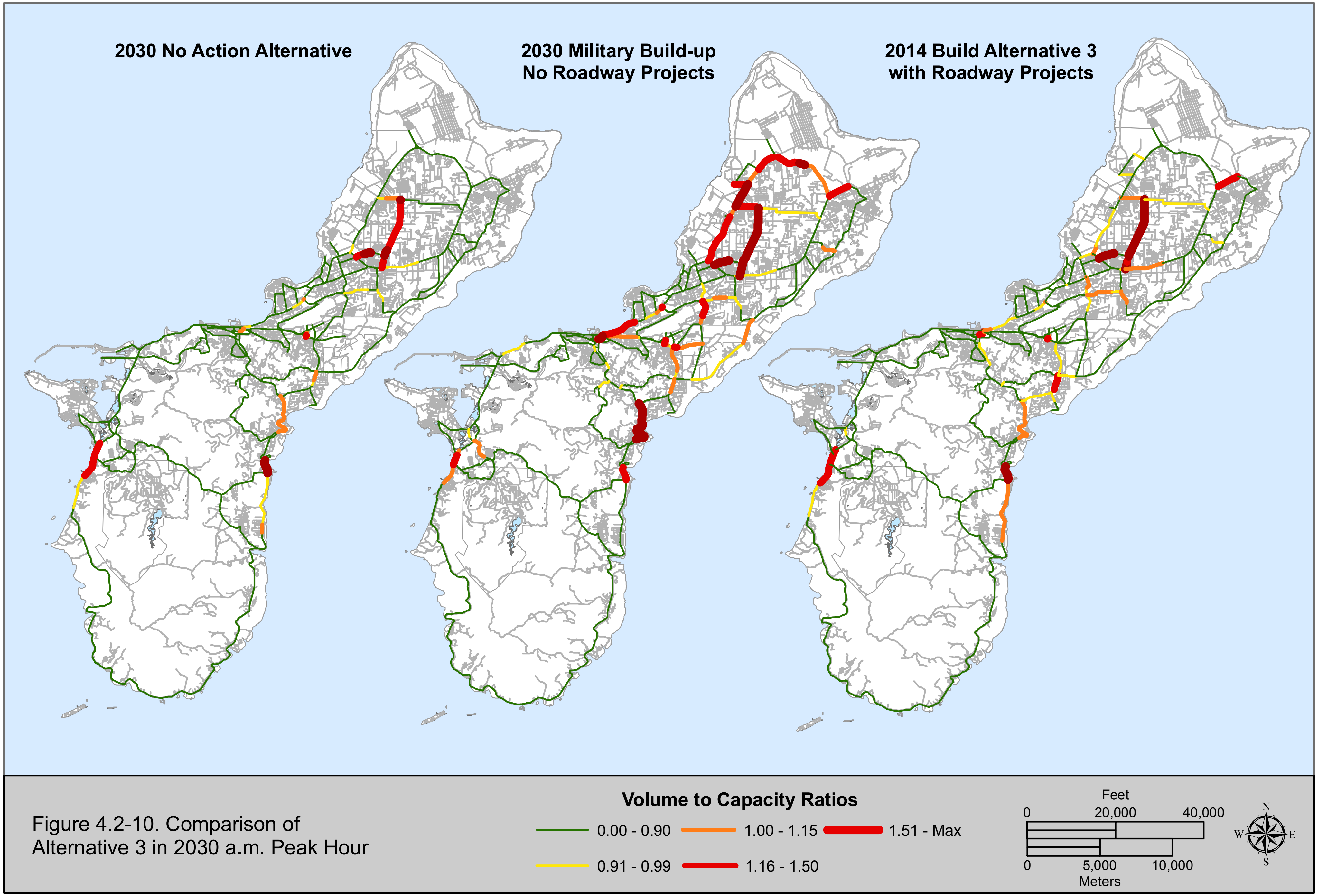

Figure 4.2-10. Comparison of Alternative 3 in 2030 a.m. Peak Hour

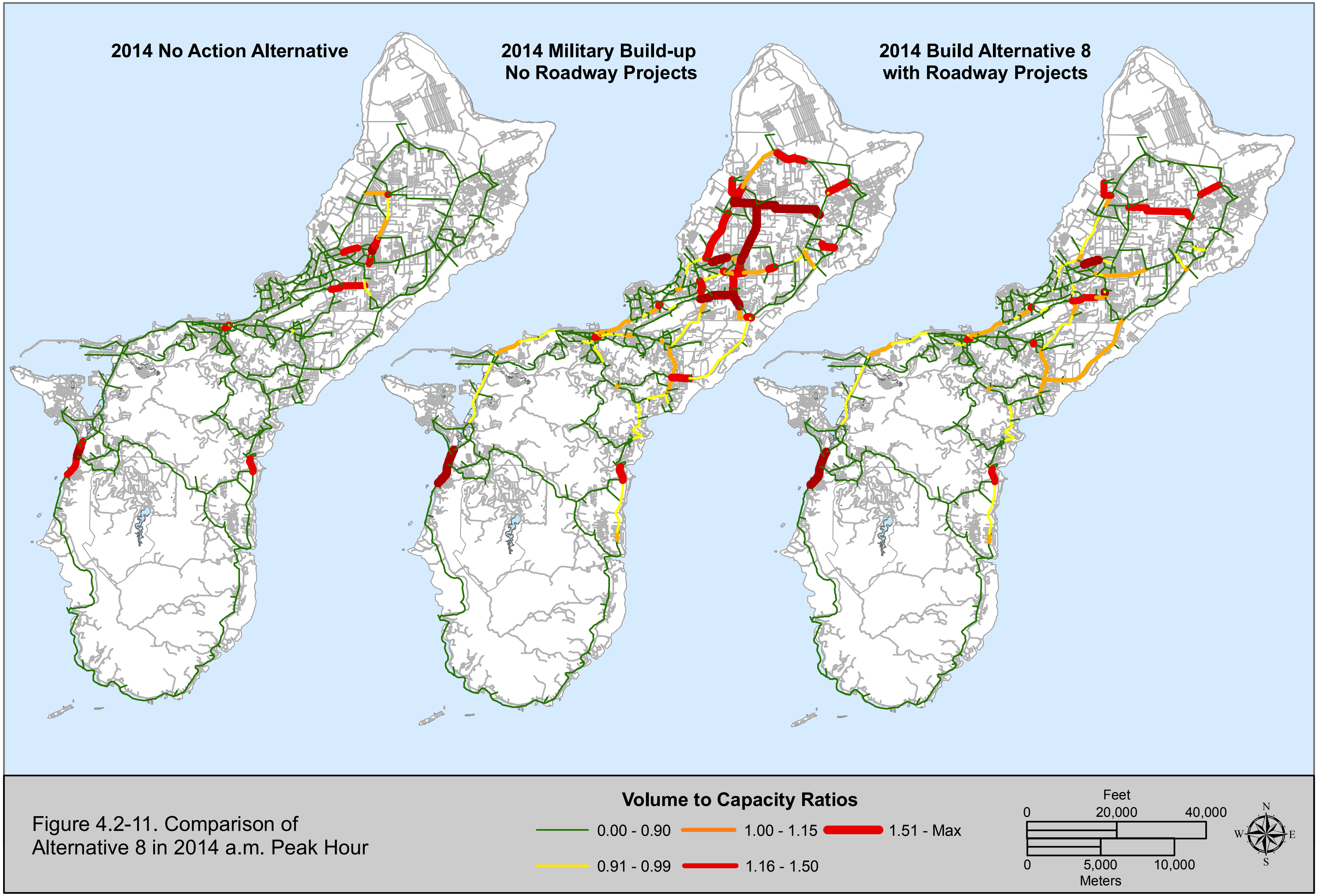

Figure 4.2-11. Comparison of Alternative 8 in 2014 a.m. Peak Hour

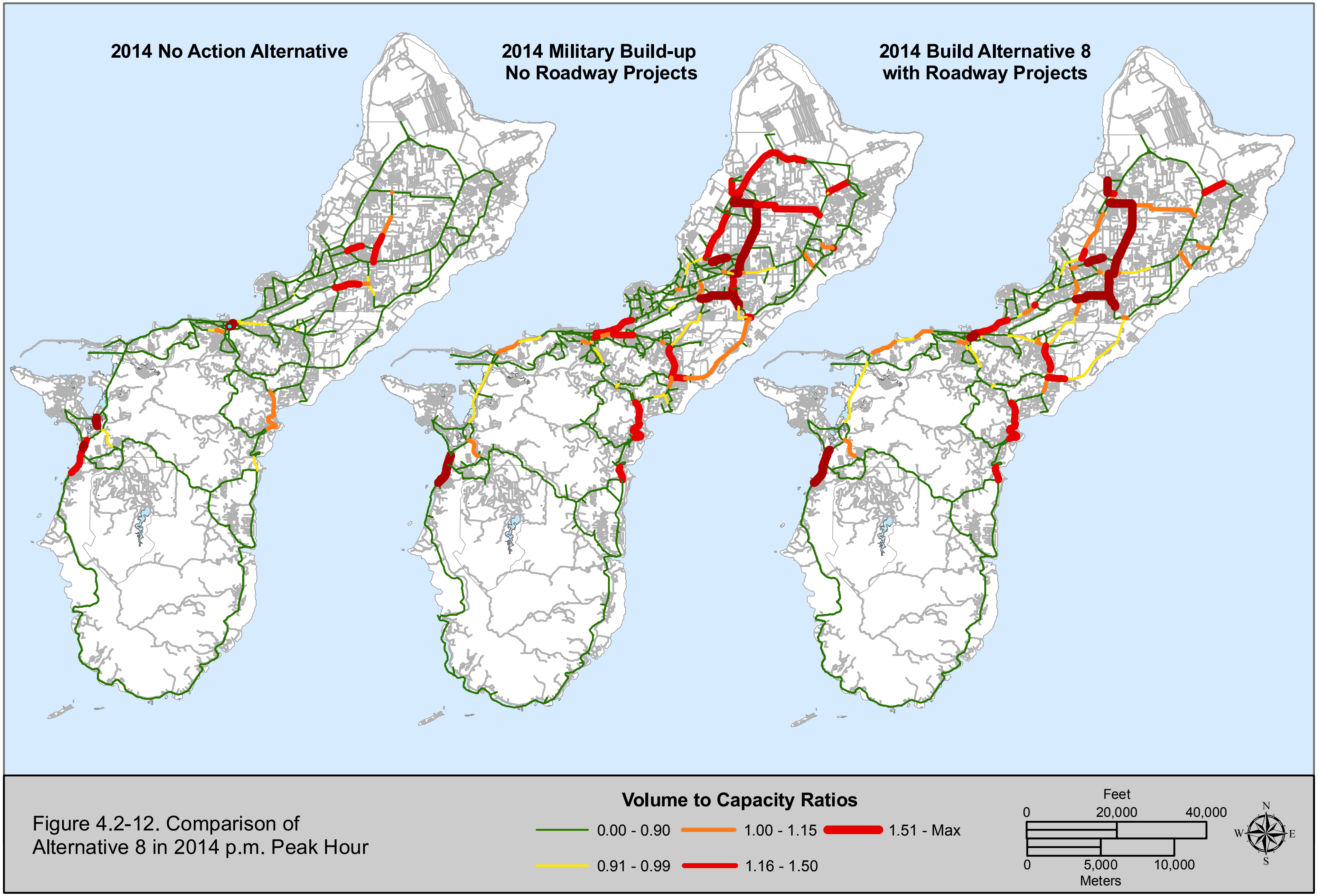

Figure 4.2-12. Comparison of Alternative 8 in 2014 p.m. Peak Hour

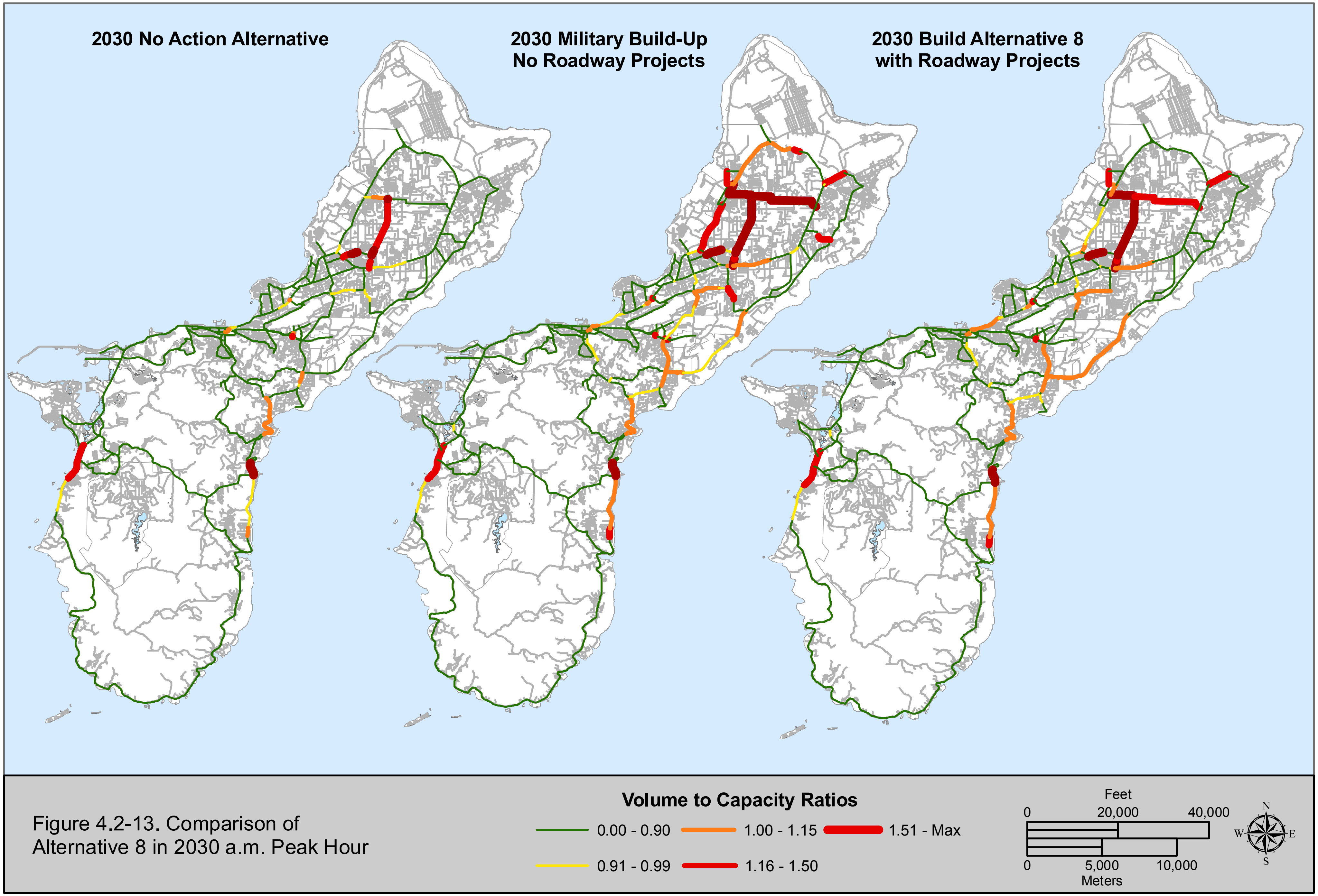

Figure 4.2-13. Comparison of Alternative 8 in 2030 a.m. Peak Hour

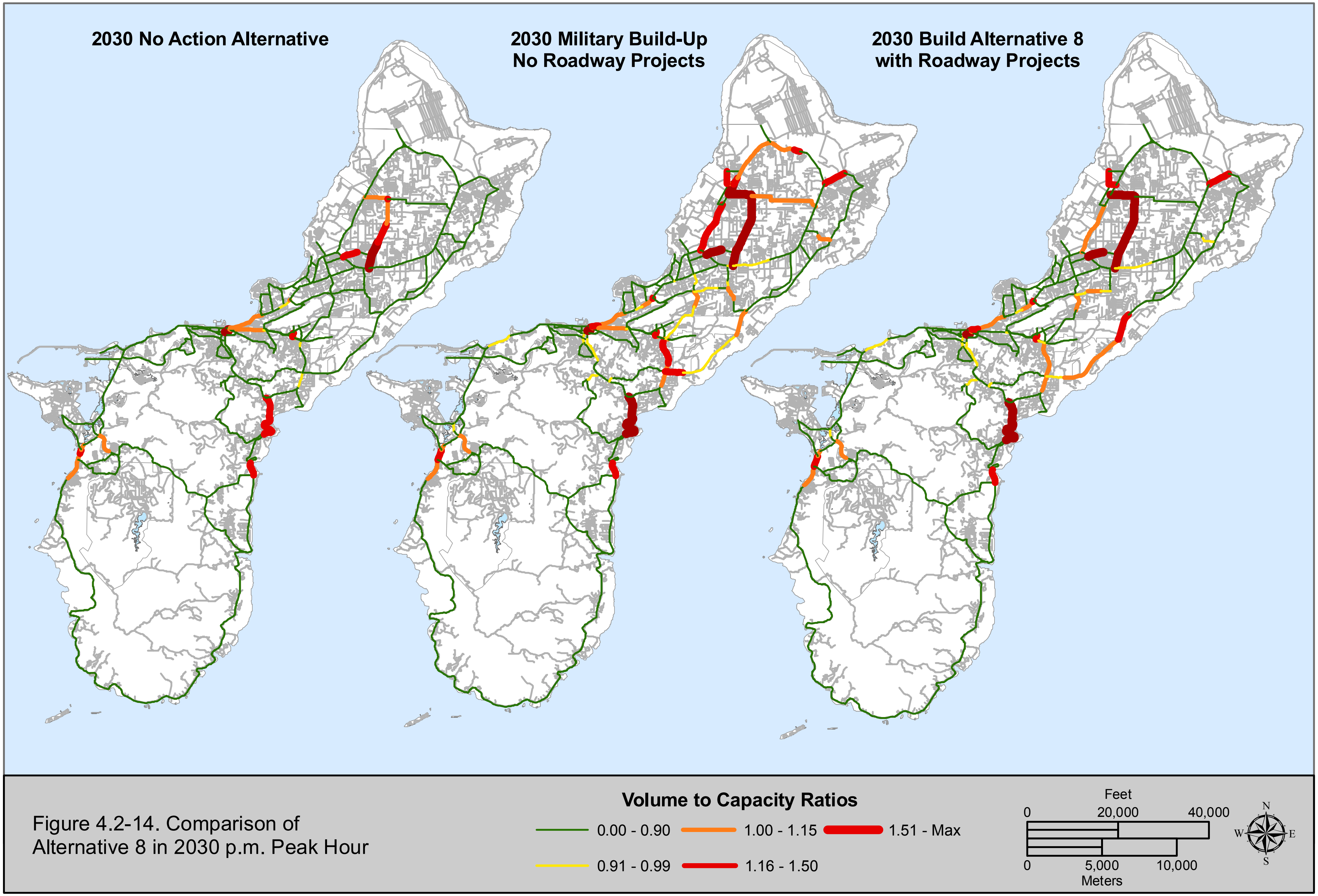
Figure 4.2-14. Comparison of Alternative 8 in 2030 p.m. Peak Hour

4.2.1.3 Issues Identified during Public Scoping Process

On Base Roadways

Although there were many traffic related comments received during the public scoping process, no on base traffic related comments were received.

Off Base Roadways

During the public scoping meeting, 33 comments were received regarding the increase in traffic and roadway conditions. Several comments were received indicating that studies must be conducted to identify needs, synchronize signals, upgrade roads to federal standards, and identify impacts to primary, secondary, and tertiary roadways. The Bureau of Planning and Statistics had several comments and questions regarding the impact of population growth on existing off base roadways, the capacity of the existing system, and the interface between the planning efforts with the Guam Highway Master Plan(s). In addition, there were comments received requesting the mitigation measures for traffic impacts be identified in this Environmental Impact Statement.

4.2.2 Roadway Alternatives Analysis

4.2.2.1 Alternative 1

North

On Base Roadways:

Andersen AFB

Construction. The proposed construction at Andersen AFB is the same for Alternative 1, 2, 3 and 8 and would include a new access road and a new access gate (North Gate) on Route 9. The access road would serve as the main access to the North Ramp area where the support facilities would be constructed.

New construction associated with the access road would include the following:

- Two new lanes would be constructed on Route 9 to allow for Wheel Base-33D Turnpike-Double Combination Trucks to turn into and out of the new base access road.
- The project includes a 12 ft (3.7 m) wide access road to intersect Route 9 approximately 10,561 ft (3,219 m) north of existing Andersen AFB Entry Control Point and extend into Andersen AFB approximately 6,561.66 ft (2,000 m) until it terminates at 5th Avenue. Roadway paving, street lighting, and drainage would be constructed for the entire length of the alignment. No curbs or sidewalks are proposed along the roadway. Improvements at the new intersection would include two dedicated turn lanes per American Association of State Highway and Transportation Officials Wheel Base-33D (i.e., Minimum Turning Path for Turnpike-Double Combination), and traffic signals with demand left turn signals and pavement detectors.
- A new traffic signal is proposed at the new gate access road and Route 9, subject to Government of Guam approval.

Marianas Boulevard has relatively low traffic with an existing ADT of 1064 trips near the proposed North Ramp area. Marianas Boulevard has a capacity of approximately 5,000 vpd. With the construction of a new North Gate, construction activities related to the North Ramp area would be isolated to roadways with relatively low traffic. Therefore, the construction activities at the North Ramp area would have less than significant impacts if the construction traffic is restricted to the North Gate and the new access road.

Operation. Andersen AFB has two existing access gates, Main and Back Gate, and a new North Gate that would be constructed prior to the Marine relocation. The North Gate would be the primary access for the North Ramp area.

In 2008, there were 1,637 morning peak hour trips, 1,816 afternoon peak hour trips, and 21,984 daily trips through the Main and Back Gates. These volumes are expected to increase by Year 2030 due to the increase in base population and the proposed action. In 2030, traffic is anticipated to increase by 457 trips (28%) in a.m. peak hour, 469 trips (26%) in p.m. peak hour and 5,144 trips (23%) daily. The Andersen Air Force Base Traffic and Safety Engineering Study (Andersen AFB 2008) conducted a base-wide road survey and recommended roadway improvements. It forecast a 25% increase in on base traffic volumes based on an expected 1,000 increase in base population from the current 4,000. This 25% growth rate agrees with the 2030 baseline growth rates shown on Table 4.2-2 from the 2008 TransCAD traffic model.

In 2030, under the proposed action, the morning peak hour traffic is forecasted to increase by 1,676 mostly inbound trips (80%), the afternoon peak hour traffic by 1,719 mostly outbound trips (75%), and daily traffic by 7,058 trips (28%). The peak hour growth rates being much higher than the daily growth rates would indicate that the traffic generated by the proposed actions would primarily be work oriented and made during the major commuter periods. The proposed project would increase traffic in excess of 5%, except for the a.m. outbound period.

Table 4.2-2. 2030 Baseline Growth Rates

Time Period	*2008 Volume*	*2030 Baseline*			*2030 w/Project*		
			2030 Base/2008			*2030 Proj/Base*	
		Volume	*Number Increase*	*Percentage Increase*	*Volume*	*Number Increase*	*Percentage Increase*
Andersen AFB: Alternatives 1, 2, 3 and 8							
a.m. Inbound	869	1227	358	41%	2,869	1642	134%
a.m. Outbound	768	867	99	13%	901	34	4%
a.m. Total	1,637	2,094	457	28%	3,770	1,676	80%
p.m. Inbound	864	993	129	15%	1,064	71	7%
p.m. Outbound	952	1,292	340	36%	2,940	1,648	128%
p.m. Total	1,816	2,285	469	26%	4,004	1,719	75%
Daily	21,984	27,128	5,144	23%	34,186	7,058	26%

Legend: AFB = Air Force Base.

Finegayan

Construction. In Alternative 1, NCTS Finegayan, the Former FAA parcel, South Finegayan, and Harmon Annex land would be utilized for constructing the Main Cantonment, family housing, and community support structures for the Marines. The alternative proposes three access gates. A new Commercial Gate would be constructed on Route 3 about 0.2 mi (0.32 km) due east from the present intersection of Van Meter Street and Courtney Street. A new Main Gate would be constructed close to the point where presently Bullard Avenue meets Route 3. The present access gate to South Finegayan at Coral Tree Drive and Route 3 intersection would be upgraded to form the Residential Gate for Alternative 1. New roads, intersections, curbs, pedestrian walkways, signage, lighting, and landscaped areas would be constructed to support the constructed facilities.

Due to the reconstruction of the roadway system at Finegayan temporary impacts to on base roads may occur. The impacts are not expected to be significant.

Operation. The new transportation roadway network on the Main Cantonment is intended to accommodate the proposed relocation of Marines from Okinawa to Guam. The new base would be designed to Navy planning criteria and the features would be designed and sized to accommodate the expected future conditions.

The traffic impact from operations at the Main Cantonment would be less than significant to existing motorists on Finegayan.

Off Base Roadways:

Future Traffic Impacts. Alternative 1 of the Army AMDTF proposed action involves collocation of facilities with the Marine Corps at NCTS Finegayan. Thus, effects of Army AMDTF Alternative 1 are captured in the following analysis. The impacts for Alternative 2 are the same as Alternative 1 and the results are referred to as "Alternatives 1 and 2" in this section.

A summary of future ADT volumes and the v/c ratio for 2014 and 2030 for Alternative 1 can be found in Table 4.2-3. Generally, there is a substantial increase in volumes on roadways from 2008 to 2014, and then a modest decrease in volumes on roadways from 2014 to 2030. See Table 4.2-3 for the 2008 volume summary. This can be attributed to the increase in construction traffic and coinciding military expansion during peak construction time, which is in 2014, and then a reduction in traffic once off-island construction workers leave the island. These changes are most noticeable on roadways with direct access to DoD land, such as the Main Cantonment area located on Route 3.

Figure 4.2-15 through Figure 4.2-18 show future levels of traffic congestion in the North Region for the a.m. and p.m. peak hours, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested. The roads serving the DoD lands are expected to be the most congested. During both the morning and afternoon peaks, the roads with the greatest congestion levels in the North Region are Routes 3 and 28, south of the Main Gate. Route 28 has the highest level of congestion (v/c ratio greater than 1.50). They both have an LOS F in both the a.m. and p.m. peak hours, which is considered severely congested. The results of the future operational analysis are shown in Table 4.2-4 for both the 2014 a.m. and p.m. and 2030 a.m. and p.m. conditions.

Table 4.2-3. Alternatives 1 and 2 Future ADT and Volume to Capacity Ratio Summary – North Region

Roadway	*2014*		*2030*	
	ADT Summary	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 1	Route 1 ranges from 24,000 to 44,000 vpd. Traffic decreases as Route 1 approaches Andersen AFB.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.90, which indicates that the roadway is not considered congested.	Route 1 ranges from 23,000 to 37,000 vpd. Traffic decreases as Route 1 approaches Andersen AFB.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.90, which indicates that the roadway is not considered congested.
Route 3	Route 3 ranges from 23,000 to 46,000 vpd. Traffic decreases north of the intersection with Route 28.	The portion of Route 3 south of the Residential Gate, as well as between Route 28 and the Main Gate, have a v/c ratio of 1.00-1.15 in the a.m. and p.m. peak. This portion of the roadway is considered congested. North of the Commercial Gate, Route 3 has a v/c ratio of 0.00-0.90 during peak hours, which indicates that this part of the roadway is not considered congested.	Route 3 ranges from 20,000 to 37,000 vpd. Traffic decreases north of the intersection with Route 28.	The portion of Route 3 south of the Residential Gate has a v/c ratio of 0.91-0.99 in both the a.m. and p.m. peak hours. Aside from a stretch between Route 28 and the Main Gate, Route 3 north of the Residential Gate has a v/c ratio of 0.00-0.90 during peak hours. The roadway is not considered congested.
Route 9	Route 9 ranges from 12,000 to 20,000 vpd. There is a decrease in traffic east of the two residential developments on Route 9.	The western portion of Route 9 has a v/c ratio of 0.00-0.90 in both the a.m. and p.m. peak hours. The eastern portion has a v/c ratio of 0.91-0.99 in both the a.m. and p.m. peak hours. The roadway is not considered congested.	Route 9 ranges from 10,000 to 16,000 vpd. There is a decrease in traffic east of the two residential developments on Route 9.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.90, which indicates that the roadway is not considered congested.
Route 15	Route 15 has 6,900 vpd in the North.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.90, which indicates that the roadway is not considered congested.	Route 15 has 7,600 vpd in the North.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.90, which indicates that the roadway is not considered congested.
Route 28	Route 28 ranges from 21,000 to 22,000 vpd. Traffic increases closer to the intersection with Route 1.	Route 28 has a v/c ratio greater than 1.51 in both the a.m. and p.m. peak hours, which indicates the roadway is considered congested.	Route 28 ranges from 16,000 to 17,000 vpd. Traffic increases closer to the intersection with Route 1.	In the a.m. peak, Route 28 has a v/c ratio greater than 1.15. In the p.m. peak, Route 28 has a v/c ratio of 1.15-1.50. The roadway is considered congested during peak hours.

Legend: ADT = average daily traffic; AFB = Air Force Base; v/c = volume to capacity; vpd = vehicles per day.

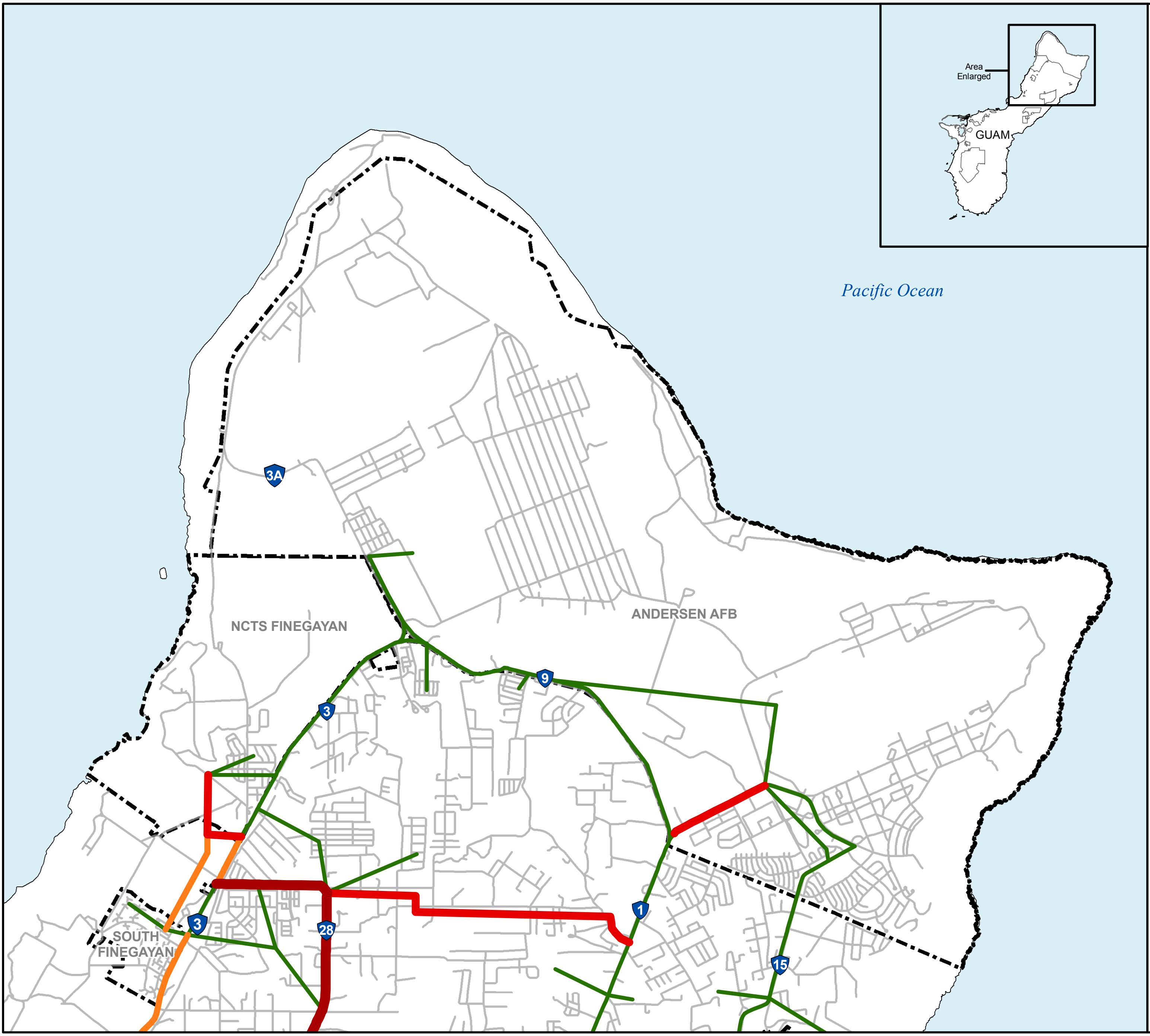

Figure 4.2-15

North Region–
2014 a.m. Peak
Congestion Levels –
Alternative 1 and 2

Legend

Volume to Capacity Ratios

🟩 0.00 - 0.90
🟨 0.91 - 0.99
🟧 1.00 - 1.15
🟥 1.16 - 1.50
🟥 1.51 or more

Existing Land Use

— Streets
⌐ ┘ Military Installation

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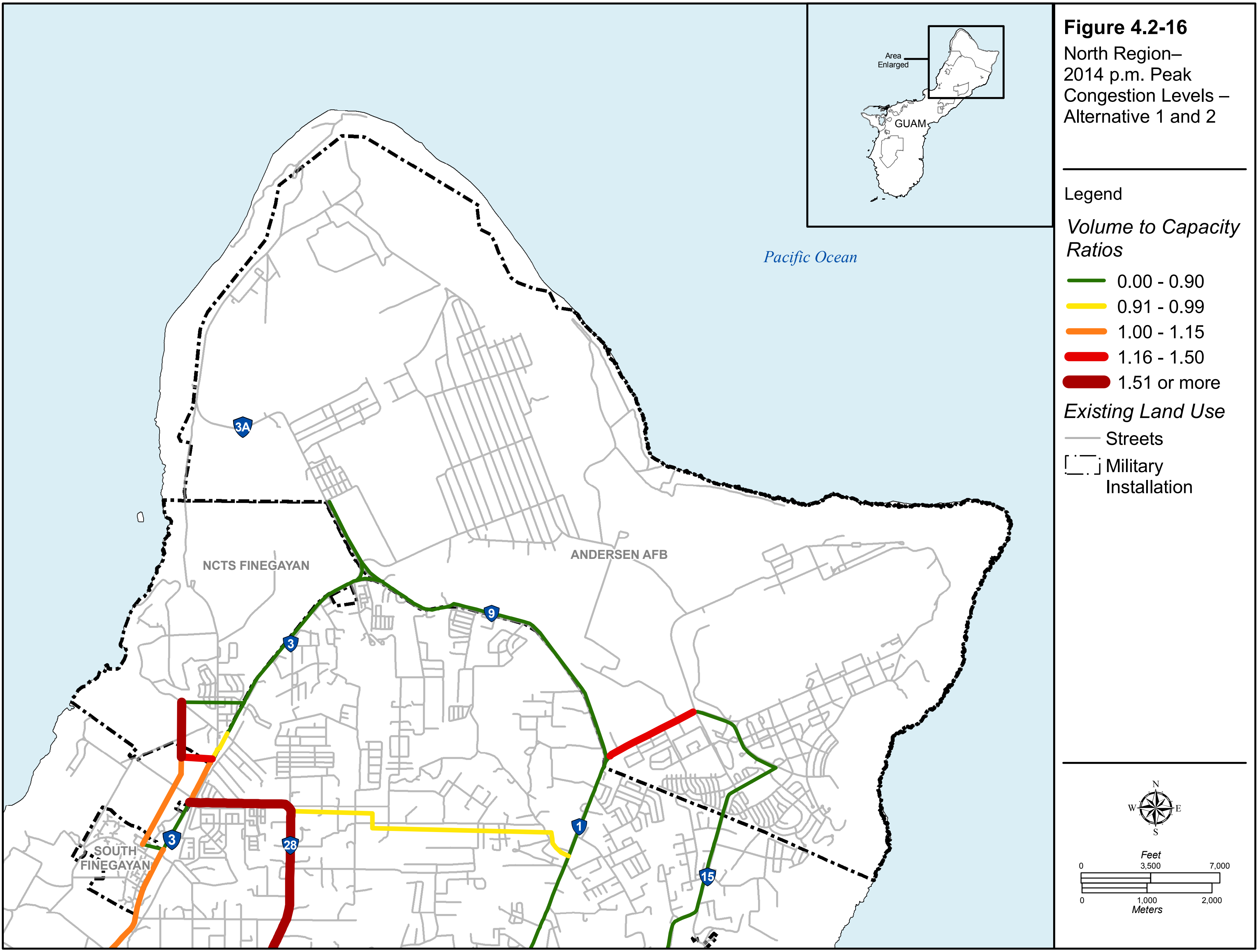

Figure 4.2-16
North Region–
2014 p.m. Peak
Congestion Levels –
Alternative 1 and 2

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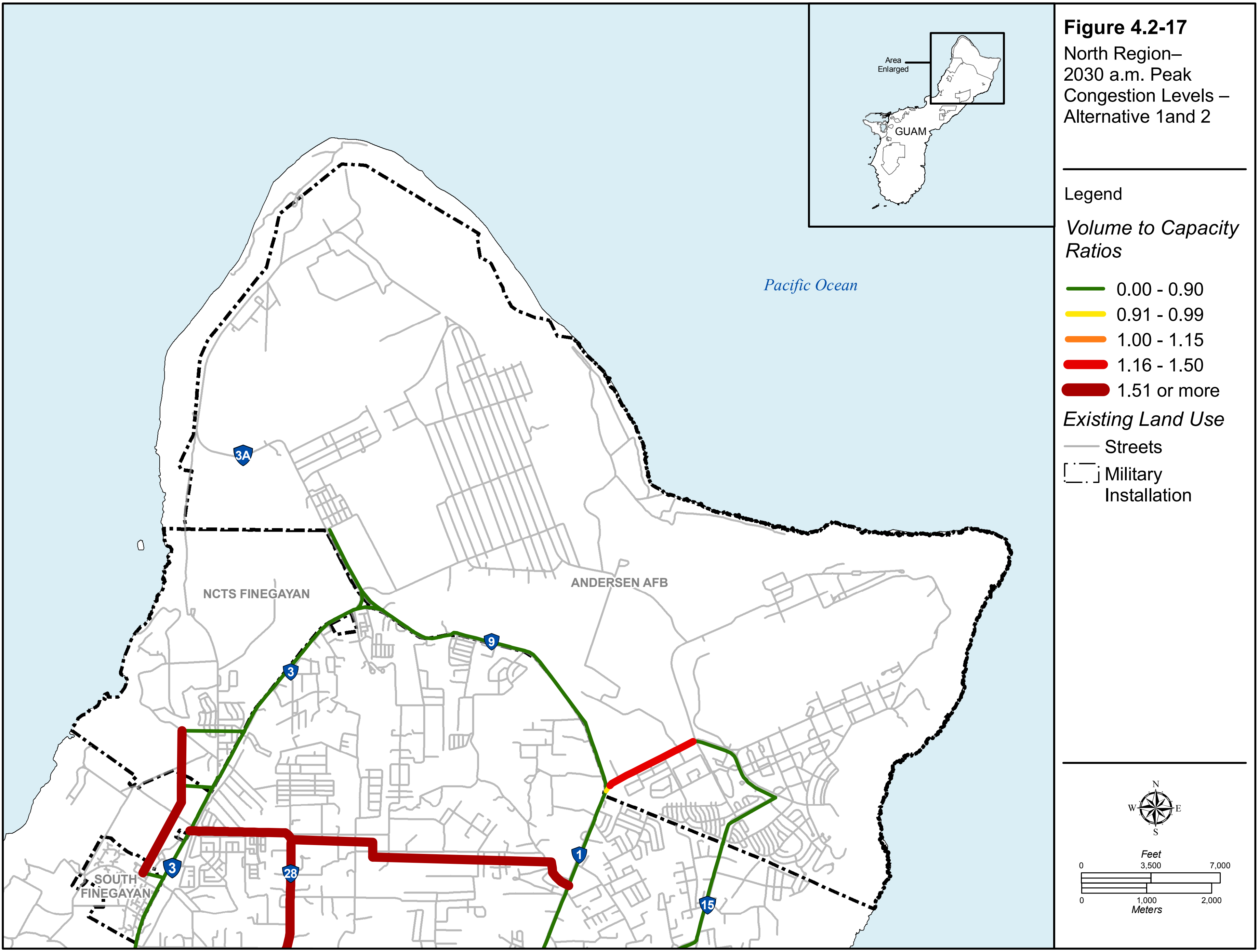

Figure 4.2-17
North Region–
2030 a.m. Peak
Congestion Levels –
Alternative 1and 2

Printing Date: March 11, 2010

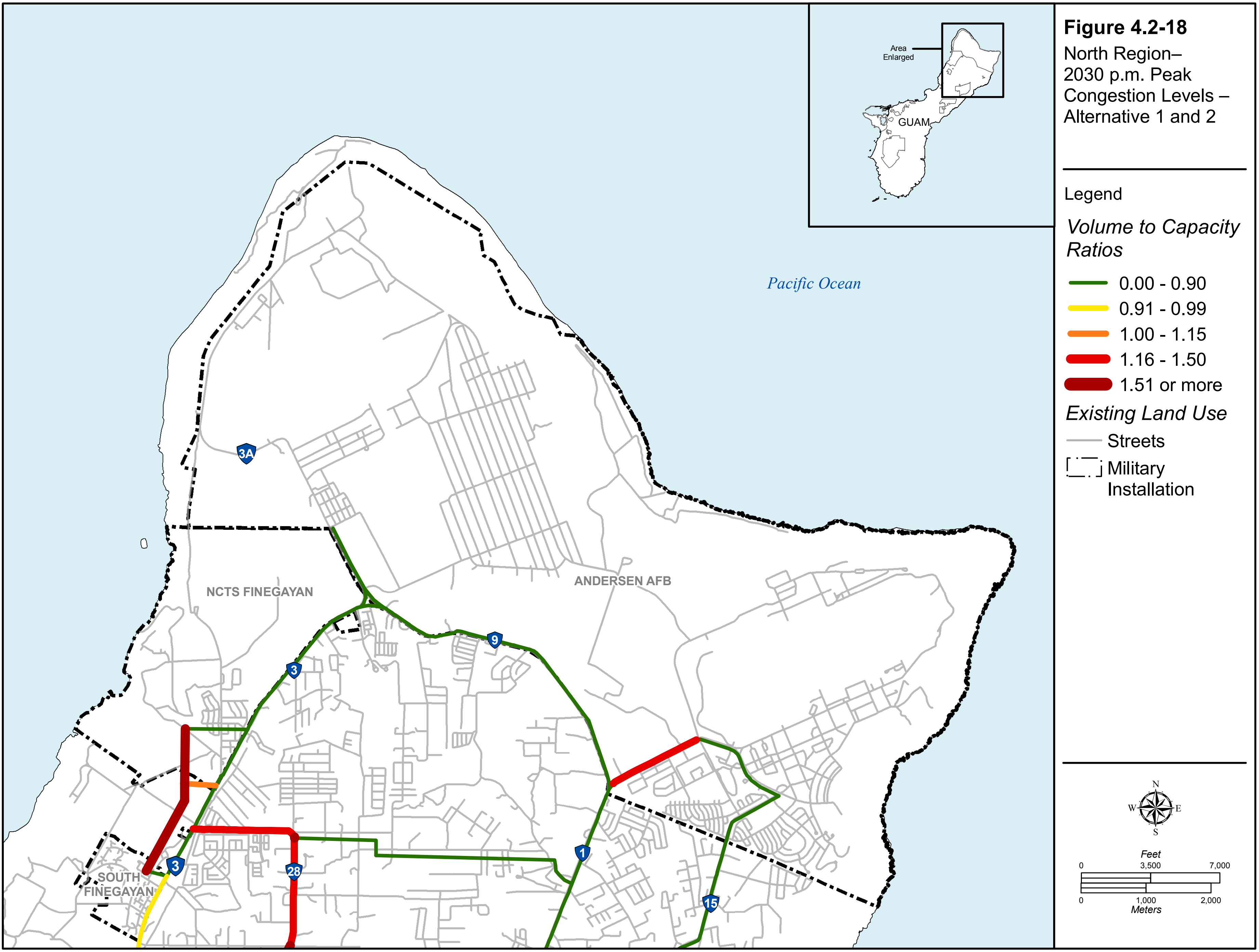

Figure 4.2-18
North Region–
2030 p.m. Peak
Congestion Levels –
Alternative 1 and 2

Printing Date: March 11, 2010

For most of the intersections, the LOS in both 2014 and 2030 was below the minimum acceptable LOS E. It is important to note that in many cases, the proposed intersection improvements do not improve the LOS level; however, they do decrease the amount of delay a driver would experience at an intersection. As stated previously, each LOS has a range of seconds of delay. Anything greater than 80.0 seconds of delay at signalized intersections or 50.0 seconds of delay at unsignalized intersections is considered LOS F. There is no upper end for delay for LOS F, which is why an intersection could greatly decrease in the amount of delay while still being LOS F. For the North Region, there are three intersections for which the traffic is worse in 2014 than in 2030 in both the a.m. and p.m. peak hours. This can be attributed to an increase in traffic associated with construction activity and military personnel in 2014.

As shown in Table 4.2-4, there are four intersections and one military access point with LOS F for at least one peak hour, which is considered unacceptable; however, none of the intersections are operating at LOS F in both the a.m. and p.m. for 2030. The worst intersection in the North Region is Route 15/29, which is operating at LOS F with heavy delays in the a.m. peak hour in 2014.

Table 4.2-4. Alternatives 1 and 2 Future Level of Service and Delay Results – North Region

	2014				*2030*			
	a.m. Peak Hour		*p.m. Peak Hour*		*a.m. Peak Hour*		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*								
Route 1/9	C	27.6	D	39.8	C	22.5	D	52.2
Route 1/29	F	256.2	F	138.7	E	65.5	E	67.7
Route 3/28	F	85.1	F	227.1	C	26.0	D	36.9
Route 15/29**	F	NA	F	838.9	C	27.7	C	25.4
Unsignalized**								
Route 3/3A/9	C	19.7	F	74.3	B	11.6	F	79.0
Military Access Points*								
Route 3 – Main Cantonment/Commercial Gate**	—	—	—	—	B	12.5	C	28.3
Route 3 - Main Cantonment/Main Gate**	—	—	—	—	C	33.5	E	58.6
Route 3 – South Finegayan/Residential Gate**	—	—	—	—	C	26.7	B	18.5
Route 9 – Andersen AFB/ Andersen AFB North Gate***	—	—	—	—	F	NA****	F	NA****

Legend: AFB = Air Force Base; LOS = Level of Service; NA = Not Applicable.
Notes: *Signalized intersection LOS based on average delay for the overall intersection.
**Intersection is proposed to be signalized in future build conditions.
***Unsignalized intersection LOS based on approach delay on STOP-controlled approach.
****Delay exceeded maximum calculated value.

Public Transportation Impacts. Impacts to the public transportation system relate to the delays caused by increased levels of congestion on roadways and at intersections. This would affect the demand response and paratransit services, increasing passenger wait times and missed transfers. While there is no existing fixed-route service in the North Region, planning efforts have proposed new routes along Routes 1 and 3. Implementation of new transit services should take into consideration the impacts of the military relocation.

Pedestrian and Bicycle Impacts. There are no impacts to pedestrian and bicycle facilities in the North Region. Along Route 1, future traffic volumes and congestion should not negatively affect the experience or safety of the pedestrian or cyclist using the shoulder as a running or biking lane. Any future planning for pedestrian and bicycle facilities needs to consider the impacts of the military relocation.

Central

On Base Roadways:

Andersen South

Construction. Proposed construction at Andersen South is independent of Alternatives 1, 2, 3, and 8. The proposed construction is geared towards constructing the Military Operations in Urban Terrain complex for providing maneuver training to the relocated Marines. The proposed construction includes:

- Construction of a new road segment to connect existing roads into a complete convoy course loop.
- Two access gates are proposed for the new base that would upgrade existing gates at the base. The proposed Main Gate would be located at the present intersection of Turner Street and Route 1. The proposed Secondary Gate would be located at the present intersection of Rissi Street and Route 15.
- The construction of the roadway improvements on Andersen South would have a less than significant impact to traffic because base operations have been abandoned with exception of training.
- Based on the relatively low traffic demand on Andersen South, traffic impact would be less than significant for construction activities.

Operation. Convoy operations, Military Operations in Urban Terrain-related maneuver training, and general maneuver and air-ground operations would vary from small unit to company-level exercises. This would occur 5 days per week, 45 weeks per year, and during both day and night. The upward estimate is that approximately 250 to 300 Marines would participate in maneuver training at Andersen South each week, for a total annual throughput of 11,250 to 13,500 Marines. The convoy operations would typically consist of 2 to 7 vehicles.

The two lane roadways on Andersen South have a capacity of approximately 5,000 vpd and can accommodate the anticipated increase in traffic. Therefore, traffic impact would be less than significant for operational impacts.

Barrigada

Construction. In Alternative 1, Barrigada is not utilized.

Operation. In Alternative 1, Barrigada is not utilized.

Off Base Roadways:

Future Traffic Impacts. A summary of future ADT volumes and the v/c ratio for 2014 and 2030 for Alternative 1 can be found in Table 4.2-5. Generally, there is a substantial increase in volumes on roadways from 2008 to 2014, and then a modest decrease in volumes on roadways from 2014 to 2030. See Table 4.1-8 for the 2008 volume summary. This can be attributed to the increase in construction traffic and coinciding military expansion during peak construction time, which is in 2014, and then a reduction in traffic once off-island construction workers leave the island.

Table 4.2-5. Alternative 1 and 2 Future ADT and Volume to Capacity Ratio Summary – Central Region

Roadway	*2014*		*2030*	
	ADT Summary	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 1	Route 1 ranges from 59,000 to 100,000 vpd. Traffic decreases significantly south of the intersection with Route 4.	The v/c ratio is generally less than 1.00 in both the a.m. and p.m. condition; however, there are small segments near the intersections with 14A, and 30 that have a v/c ratio of more than 1, which indicates the roadway is congested in Tamuning.	Route 1 ranges from 51,000 to 95,000 vpd. Traffic decreases significantly south of the intersection with Route 4.	The v/c ratio is generally less than 1.00 in both the a.m. and p.m. condition; however, there are small segments near the intersections with 14A, and 30 that have a v/c ratio of more than 1, which indicates the roadway is considered congested in Tamuning.
Route 3	Route 3 ranges from 46,000 to 68,000 vpd. Traffic increases toward the Route 1 intersection.	The v/c ratio in both the a.m. and p.m. peak is 1.00-1.15. This indicates the roadway is considered congested.	Route 3 ranges from 37,000 to 54,000 vpd. Traffic increases toward the Route 1 intersection.	The v/c ratio is between 1.00-1.15, indicating that the roadway is considered congested at this location.
Route 8/8A	Route 8 ranges from 51,000 to 65,000 vpd. There is a decrease in traffic west of the intersection with Sunset Boulevard. Route 8A has 3,500 vpd.	During peak hours, the v/c ratio is 0.00-0.90 east of Tiyan Parkway, 0.91-0.99 west of Tiyan Parkway, and 0.00-0.90 west of Route 16. The roadway is not considered congested.	Route 8 ranges from 50,000 to 59,000 vpd. There is a decrease in traffic west of the intersection with Sunset Boulevard. Route 8A has 3,400 vpd.	During the a.m. peak, the v/c ratio is 0.00-0.90. During the p.m. peak, the v/c ratio is 0.00-0.90 east of Tiyan Parkway, 0.91-0.99 west of Tiyan Parkway, and 0.00-0.90 west of Route 16. The roadway is not considered congested.
Route 10	Route 10 ranges from 56,000 to 58,000 vpd between Routes 8 and 15.	In the a.m. peak, a small segment south of the intersection with Route 15 has a v/c ratio between 1.15-1.50. During the p.m. peak, Route 10 has a v/c ratio of 1.00-1.15 north of Route 32 to Route 8. The roadway is primarily congested during the p.m. peak.	Route 10 ranges from 54,000 to 56,000 vpd between Routes 8 and 15.	In the a.m. peak, Route 10 has a v/c ratio of 1.00-1.15 north of Route 32 to Route 15. During the p.m. peak, Route 10 has a v/c ratio of 1.00-1.15 north of Route 32 to Route 8. The roadway is primarily congested during the p.m. peak.

Roadway	*2014*		*2030*	
	ADT Summary	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 15	Route 15 ranges from 13,000 to 24,000 vpd. There is an increase in traffic south of the intersection with Route 26.	North of Route 26 and west of Route 10, Route 15 has a v/c ratio of 0.00-0.90 during peak hours. The middle section of Route 15 has a v/c ratio of 0.91-0.99, with a v/c ratio of 1.00-1.15 at Route 10. The roadway is only congested near the intersection with Route 10.	Route 15 ranges from 7,500 to 13,000 vpd. There is an increase in traffic south of the intersection with Route 26.	The v/c ratio is less than 1.00 during peak hours. The roadway is not considered congested.
Route 16	Route 16 ranges from 59,000 to 91,000 vpd. There is a decrease in traffic south of the residential developments south of Route 25.	The v/c ratio is less than 1.00 in the a.m. and p.m., except at the intersection with Route 27 where the v/c ratio is 1.00-1.15. The roadway is considered congested at this location.	Route 16 ranges from 40,000 to 77,000 vpd. There is a decrease in traffic south of the residential developments south of Route 25.	The v/c ratio is less than 1.00 during peak hours. The roadway is not considered congested.
Route 25	Route 25 ranges from 24,000 to 28,000 vpd.	Route 25 has a v/c ratio greater than 1.50, indicating that the roadway is considered congested.	Route 25 ranges from 29,000 to 33,000 vpd.	The v/c ratio is less than 1.00 during peak hours. The roadway is not considered congested.
Route 26	Route 26 ranges from 10,000 to 25,000 vpd. There is a decrease in traffic south of the large residential development just north of the intersection with Route 15.	Route 26 primarily has a v/c ratio greater than 1.00 during both the a.m. and p.m. peak. The roadway is considered congested.	Route 26 ranges from 10,000 to 30,000 vpd. There is a decrease in traffic south of the large residential development just north of the intersection with Route 15.	The v/c ratio is less than 1.00 during peak hours, except for south of Route 25, where the v/c ratio is 1.00-1.15 in the a.m. peak. The roadway is considered congested at this location.
Route 27	Route 27 ranges from 58,000 to 61,000 vpd between Routes 16 and 1.	The v/c ratio is 0.00-0.90 during peak hours, except for the portion between Routes 16 and 1, which has a v/c ratio of 0.81-0.99 during the a.m. peak. This roadway is not considered congested.	Route 27 ranges from 49,000 to 51,000 vpd between Routes 16 and 1.	The v/c ratio is 0.00-0.90 during peak hours, indicating the roadway is not considered congested.
Route 28	Route 28 ranges from 21,000 to 26,000 vpd. Traffic generally decreases south of the Route 27A intersection.	The v/c ratio is greater than 1.50 in both the a.m. and p.m. peak, indicating the roadway is congested.	Route 28 ranges from 19,000 to 23,000 vpd. Traffic generally decreases south of the Route 27A intersection.	The v/c ratio is greater than 1.50 in both the a.m. and p.m. peak, indicating the roadway is considered congested.

Roadway	*2014*		*2030*	
	ADT Summary	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Chalan Lujuna	Chalan Lujuna has 22,000 vpd.	The v/c ratio is 0.91-0.99, indicating it is not considered congested.	Chalan Lujuna ranges from 6,300 to 7,100 vpd.	The v/c ratio is 0.00-0.90 during peak hours, indicating the roadway is not considered congested.

Legend: ADT = average daily traffic; v/c = volume to capacity; vpd = vehicles per day.

Figure 4.2-19 through Figure 4.2-22 show future levels of traffic congestion in the Central Region for the a.m. and p.m. peak hours, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have a LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have a LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have a LOS of F, with red being the most severely congested.

There are a few areas of congestion in the Central Region, primarily on roads that serve the DoD lands to the north. During both the morning and afternoon peaks, the roads with the greatest congestion levels in the Central Region are parts of Route 1 and 10 and Route 28. All have a LOS F in both the a.m. and p.m. peak hours, which is considered congested. Route 28 has the highest level of congestion (v/c ratio greater than 1.50) north of the Route 1 intersection in the morning.

As shown in Table 4.2-6, 24 out of 28 intersections have LOS F for at least one peak hour, which is considered unacceptable. The following intersections are operating at LOS F in the a.m. and p.m. peak hours in both 2014 and 2030:

- Route 1/28
- Route 1/27
- Route 1/14A
- Route 1/10A
- Route 1/14 (ITC)
- Route 1/30
- Route 1/8
- Route 4/7A
- Route 8/10
- Route 10/15
- Route 16/27
- Route 16/10A

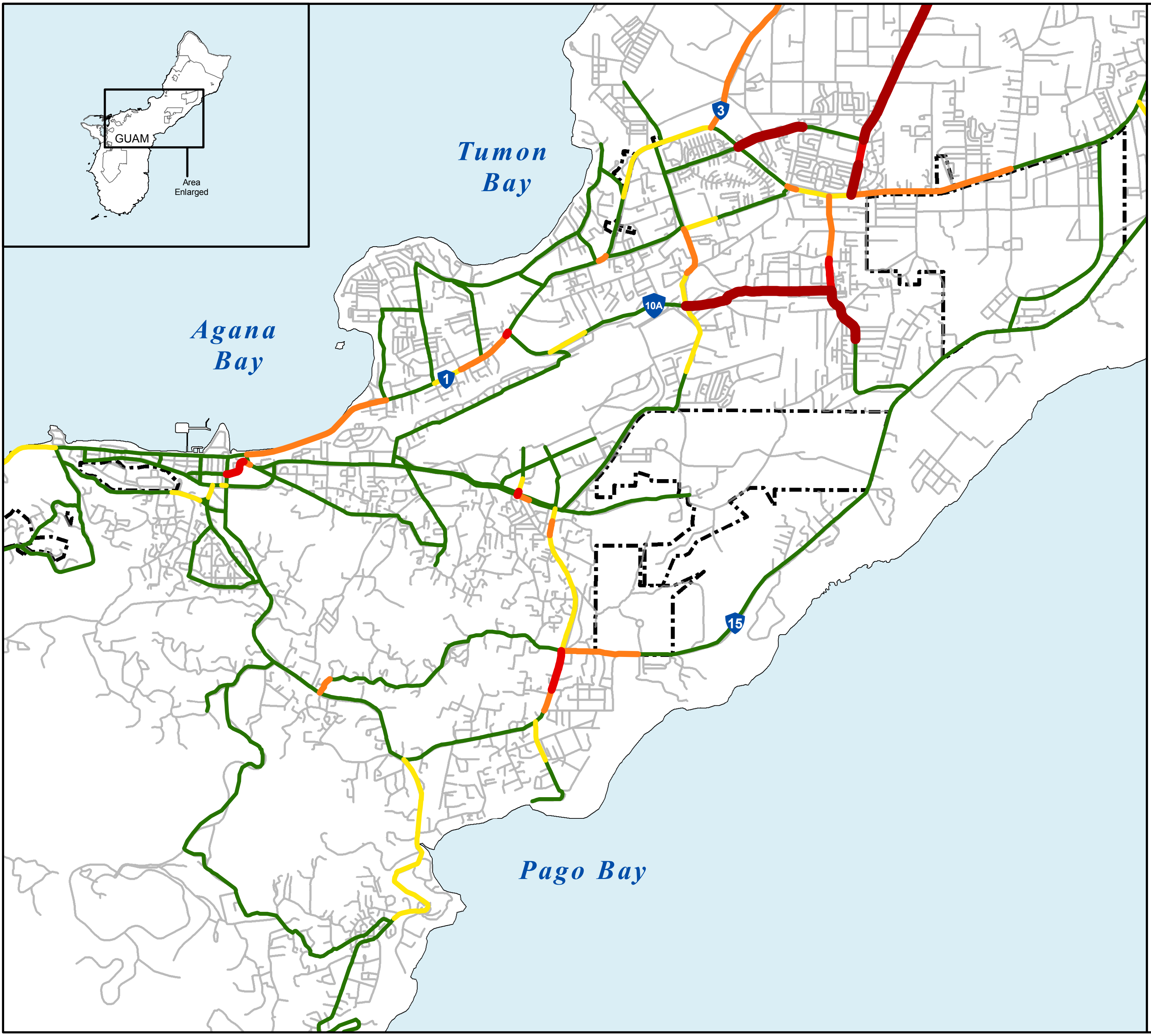

Figure 4.2-19
Central Region–2014 a.m. Peak Congestion Levels – Alternative 1 and 2

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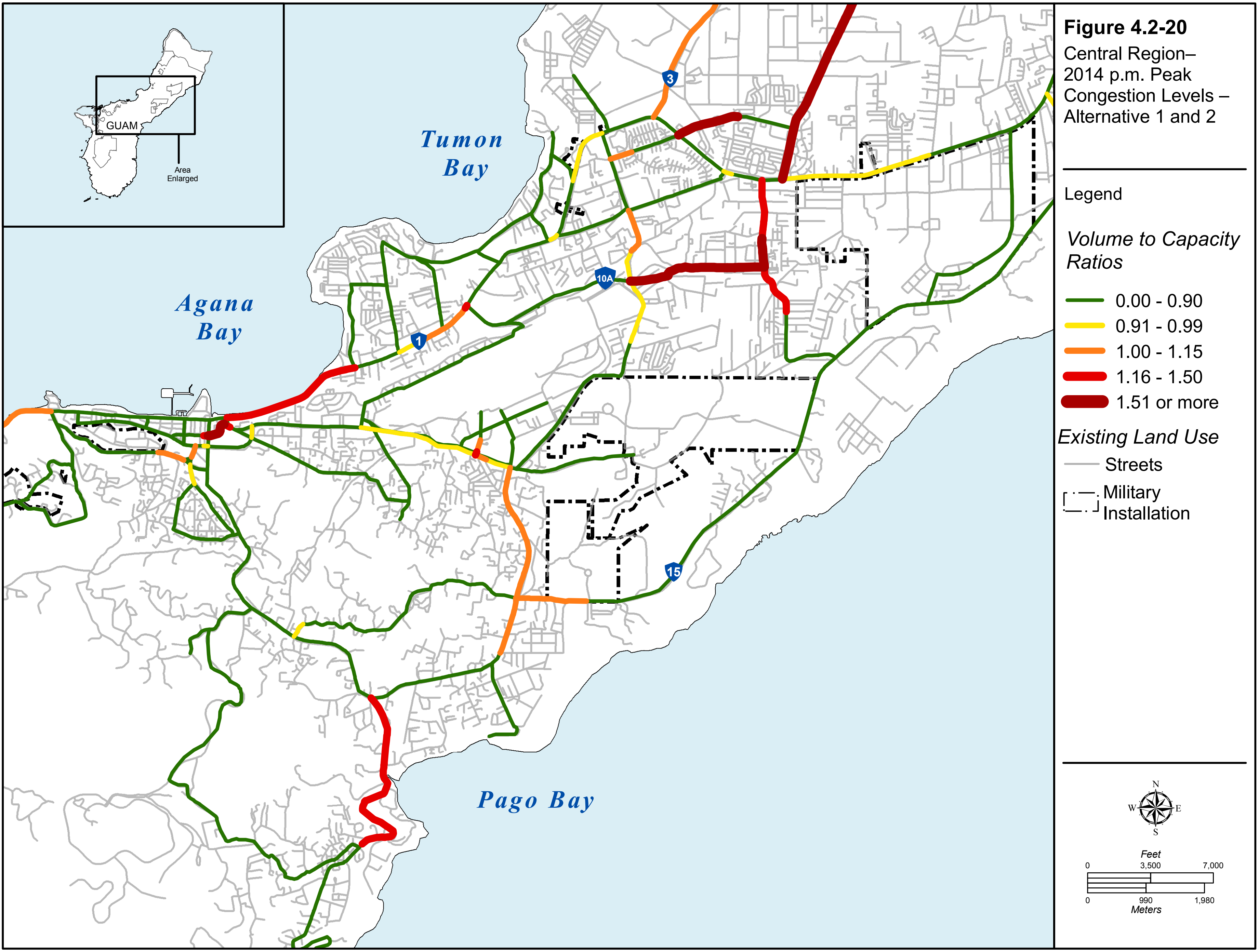

Figure 4.2-20
Central Region–2014 p.m. Peak Congestion Levels – Alternative 1 and 2

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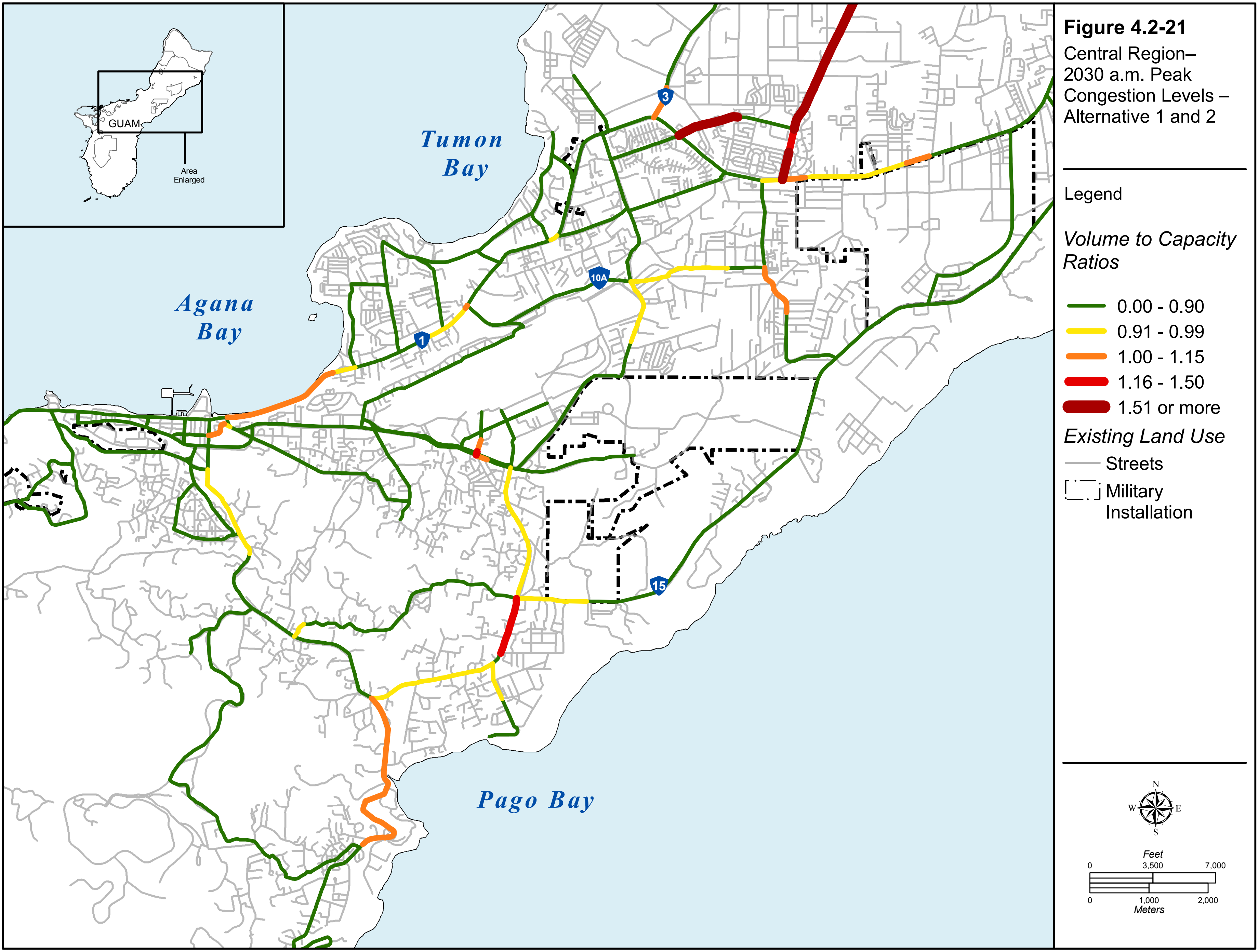


Figure 4.2-21
Central Region–2030 a.m. Peak Congestion Levels – Alternative 1 and 2

Printing Date: March 11, 2010

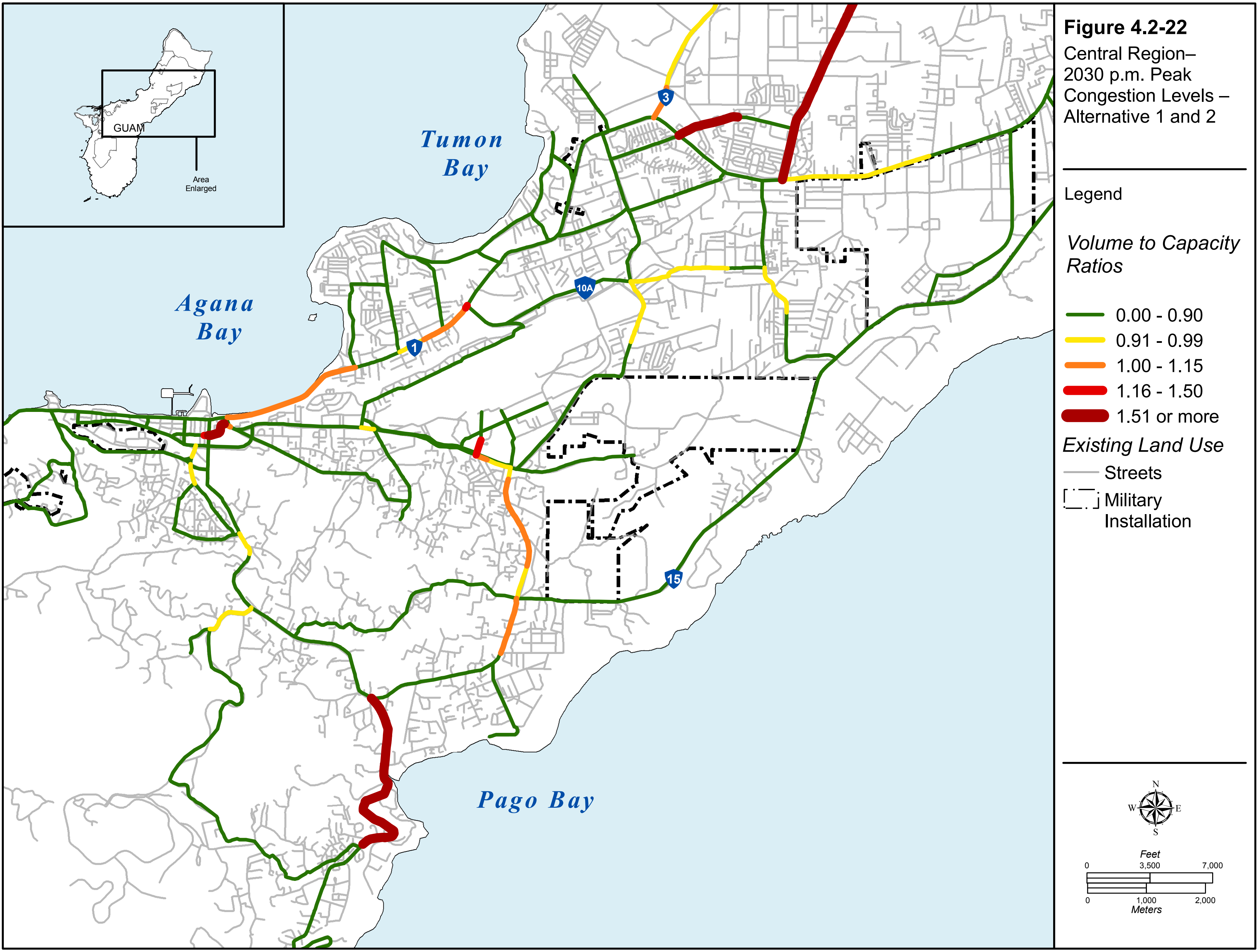


Figure 4.2-22
Central Region–2030 p.m. Peak Congestion Levels – Alternative 1 and 2

Printing Date: March 11, 2010

Table 4.2-6. Alternatives 1 and 2 Future Level of Service and Delay Results – Central Region

	2014				*2030*			
	a.m. Peak Hour		*p.m. Peak Hour*		*a.m. Peak Hour*		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*								
Route 1/28	F	360.8	F	331.8	F	216.8	F	104.5
Route 1/26	F	109.8	F	278.1	E	75.8	F	156.6
Route 1/27	F	1830.9	F	928.9	F	137.4	F	374.3
Route 1/27A	E	77.8	F	204.7	D	44.4	E	75.7
Route 1/3	F	495.1	F	523.8	D	48.5	D	50.6
Route 1/16	F	126.4	F	336.2	E	65.3	F	87.5
Route 1/14 (North San Vitores)	F	176.5	F	134.8	E	68.0	F	82.0
Route 1/14A	F	313.6	F	326.8	F	112.2	F	131.5
Route 1/10A	F	241.5	F	376.7	F	118.1	F	102.0
Route 1/14B	F	168.4	F	159.1	F	83.9	E	78.2
Route 1/14 (ITC)	F	234.7	F	428.6	F	182.5	F	275.1
Route 1/30	F	488.1	F	568.6	F	134.7	F	267.2
Route 1/8	F	216.2	F	143.5	F	97.6	F	127.5
Route 1/4	C	24.3	D	44.6	C	32.4	F	140.2
Route 1/6 (Adelup)	D	36.2	F	108.9	D	40.6	E	61.8
Route 4/7A	F	270.5	F	989.8	F	607.3	F	534.1
Route 4/10	F	190.2	F	165.1	F	199.5	E	65.1
Route 4/17	C	35.0	D	42.6	D	39.6	E	57.7
Route 8/33	E	64.8	F	145.2	D	54.6	F	81.7
Route 8/10	F	273.7	F	315.0	F	96.9	F	172.7
Route 10/15	F	166.4	F	144.7	F	196.9	F	152.3
Route 16/27A	C	26.3	D	51.9	C	27.4	C	34.2
Route 16/27	F	389.3	F	601.5	F	345.0	F	288.7
Route 16/10A	F	260.1	F	566.1	F	123.1	F	123.5
Route 26/25**	F	94.9	E	70.1	C	31.2	D	41.0
Route 26/15**	F	2554.1	F	3440.9	C	27.9	C	32.1
Route 28/27A**	C	31.8	F	402.8	D	35.6	D	36.6
Unsignalized***								
Route 7/7A	F	167.7	F	285.7	D	29.2	F	105.1
Military Access Points								
Route 1 - South Andersen Main Gate/(Turner Street)*	—	—	—	—	C	32.4	E	79.1
Route 15 - South Andersen/Second Gate*	—	—	—	—	C	22.1	C	22.6
Route 16 - Navy Barrigada/Residential Gate	—	—	—	—	NA	NA	NA	NA
Route 8A - Navy Barrigada/(Residential Gate)	—	—	—	—	NA	NA	NA	NA
Route 15 - Barrigada Air Force/(Fadian Point Drive)***	—	—	—	—	NA	NA	NA	NA

Legend: ITC = International Trade Center; NA = Not Applicable.
Notes: *Signalized intersection LOS based on average delay for the overall intersection.
**Intersection is proposed to be signalized in future build conditions.
***Unsignalized intersection LOS based on approach delay on STOP-controlled approach.

Public Transportation Impacts. Impacts to the public transportation system relate to the delays caused by increased levels of congestion on roadways and at intersections. In the Central Region, this would affect the fixed-route service along Routes 1 and 10, as well as the demand response and paratransit services. Delays on the roadways increase passenger travel times, with longer headways and missed transfers. This would also affect the fixed-route services proposed for Routes 16 and 26. Implementation of new transit services should take into consideration the impacts of the military relocation.

Pedestrian and Bicycle Impacts. There are limited impacts to the pedestrian and bicycle facilities in the Central Region. Along Routes 1 and 10, future traffic volumes and congestion should not negatively affect the experience or safety of the pedestrian using the existing sidewalk; however, it could impact a cyclist wanting to use the outside lane when unable to use the sidewalk. Future improvements to Routes 8 and 26 would also impact the intermittent sidewalk along these roadways and provide an opportunity to fully complete the facility. In addition, any future planning for pedestrian and bicycle facilities needs to consider the impacts of the military relocation.

Apra Harbor

On Base Roadways:

Naval Base Guam

Construction. The proposed construction at Naval Base Guam is independent of Alternatives 1, 2, 3, and 8. Construction of necessary facilities to support the Marine Expeditionary Unit are proposed for the Apra inner harbor. Marine and roadway traffic volumes associated with transport of dredge materials during construction are described in Volume 4, Chapter 14. Due to the expected increase of construction traffic, the impact of the construction of the facilities would be significant but mitigable. An on base traffic study is currently being prepared and once complete will be used to identify potential mitigation options for high traffic areas.

Operation. The Marine Expeditionary Unit training would bring approximately 2,000 additional military personnel to Guam as a transient population. They would not be provided family housing or be using on or off base amenities (except during periods of leave and liberty). Personnel, cargo, and equipment arriving at Apra Harbor would travel in trucks, buses, and High Mobility Multipurpose Wheeled Vehicles on civilian roads to bivouac/expeditionary camp sites at Andersen South or other training venues. It is anticipated that these transport events would occur during evening hours or other non-peak travel hours. Approximately 15 trucks would travel as a group, with distance and time between convoys to minimize interruptions to civilian traffic flow. The number of trips will vary with the mission.

In 2008, the Naval Base Guam had approximately 1,343 morning peak hour trips, 1,540 afternoon peak hour trips, and 19,286 daily trips through its Main Gate. These volumes are expected to increase by 2030 with expected increases in base activities. In 2030, under the no-action alternative, the morning peak hour traffic is forecasted to increase by 232 trips (17%), the afternoon peak hour traffic by 303 trips (20%), and daily traffic by 4,182 trips (22%).

Traffic generated by the proposed actions at Naval Base Guam is summarized on Table 4.2-7. For 2030, under the proposed action, the morning peak hour traffic is forecasted to increase by 213 (14%), the afternoon peak hour traffic by 225 trips (12%), and daily traffic by 3010 trips (13%).

Off Base Roadways:

Future Traffic Impacts. A summary of future ADT volumes and the v/c ratio for 2014 and 2030 for Alternative 1 can be found in Table 4.2-8. Generally, there is a substantial increase in volumes on roadways from 2008 to 2014, and then a modest decrease in volumes on roadways from 2014 to 2030. See Table 4.1-15 for the 2008 volume summary. This can be attributed to the increase in construction traffic and coinciding military expansion during peak construction time, which is in 2014, and then a reduction in traffic once off-island construction workers leave the island. The magnitude of decrease is especially noticeable on Route 11, which decreases from approximately 14,000 vpd to 8,900 vpd. This can be attributed to the high volume of construction traffic.

Table 4.2-7. Traffic Generated by the Proposed Actions at the Naval Base Guam

		2030 BASELINE			*2030 W/PROJECT*		
			2030 BASE/2008			*2030 PROJ/BASE*	
Time Period	*2008 Volume*	*Volume*	*Number Increase*	*Percentage Increase*	*Volume*	*Number Increase*	*Percentage Increase*
Naval Base Guam: Alternative 1, 2, 3 & 8							
a.m. Inbound	883	999	116	13%	1066	67	7%
a.m. Outbound	460	576	116	25%	722	146	25%
a.m. Total	1343	1575	232	17%	1788	213	14%
p.m. Inbound	603	754	151	25%	880	126	17%
p.m. Outbound	937	1089	152	16%	1188	99	9%
p.m. Total	1540	1843	303	20%	2068	225	12%
Daily	19286	23468	4182	22%	26478	3010	13%

Table 4.2-8. Alternatives 1 and 2 Future ADT and Volume to Capacity Ratio Summary – Apra Harbor Region

	2014		*2030*	
Roadway	*ADT Summary*	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 1	Route 1 ranges from 23,000 to 47,000 vpd. The traffic decreases into the entrance into Naval Base Guam, which is at the Route 1/2A intersection.	The v/c ratio is less than 1. The roadway is not considered congested.	Route 1 ranges from 24,000 to 56,000 vpd. The traffic decreases into the entrance into Naval Base Guam, which is at the Route 1/2A intersection.	The v/c ratio is less than 1, indicating the roadway is not considered congested.
Route 2A	Route 2A has 36,000 vpd. The traffic decreases after the intersection with Route 5.	The v/c ratio is 0.00-0.90, indicating the roadway is not considered congested.	Route 2A has 35,000 vpd. The traffic decreases after the intersection with Route 5.	The v/c ratio is 0.00-0.90, indicating the roadway is not considered congested.
Route 11	Route 11 has 14,000 vpd.	The v/c ratio is 0.00-0.90, indicating the roadway is not considered congested.	Route 11 has 8,900 vpd.	The v/c ratio is 0.00-0.90, indicating the roadway is not considered congested.

Legend: ADT = average daily traffic; v/c = volume to capacity; vpd = vehicles per day.

Figure 4.2-23 through Figure 4.2-26 show future levels of traffic congestion in the Apra Harbor Region for the a.m. and p.m. peak hours, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, or C; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of D or E; and the orange and red roads that have a v/c ratio above 0.99 have an LOS of F, with red being the most severely congested.

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4192_MXDs\Figure 4.2-23. Apra Harbor Region - 2014 a.m. Peak Congestion Levels- Alternative 1-2.mxd

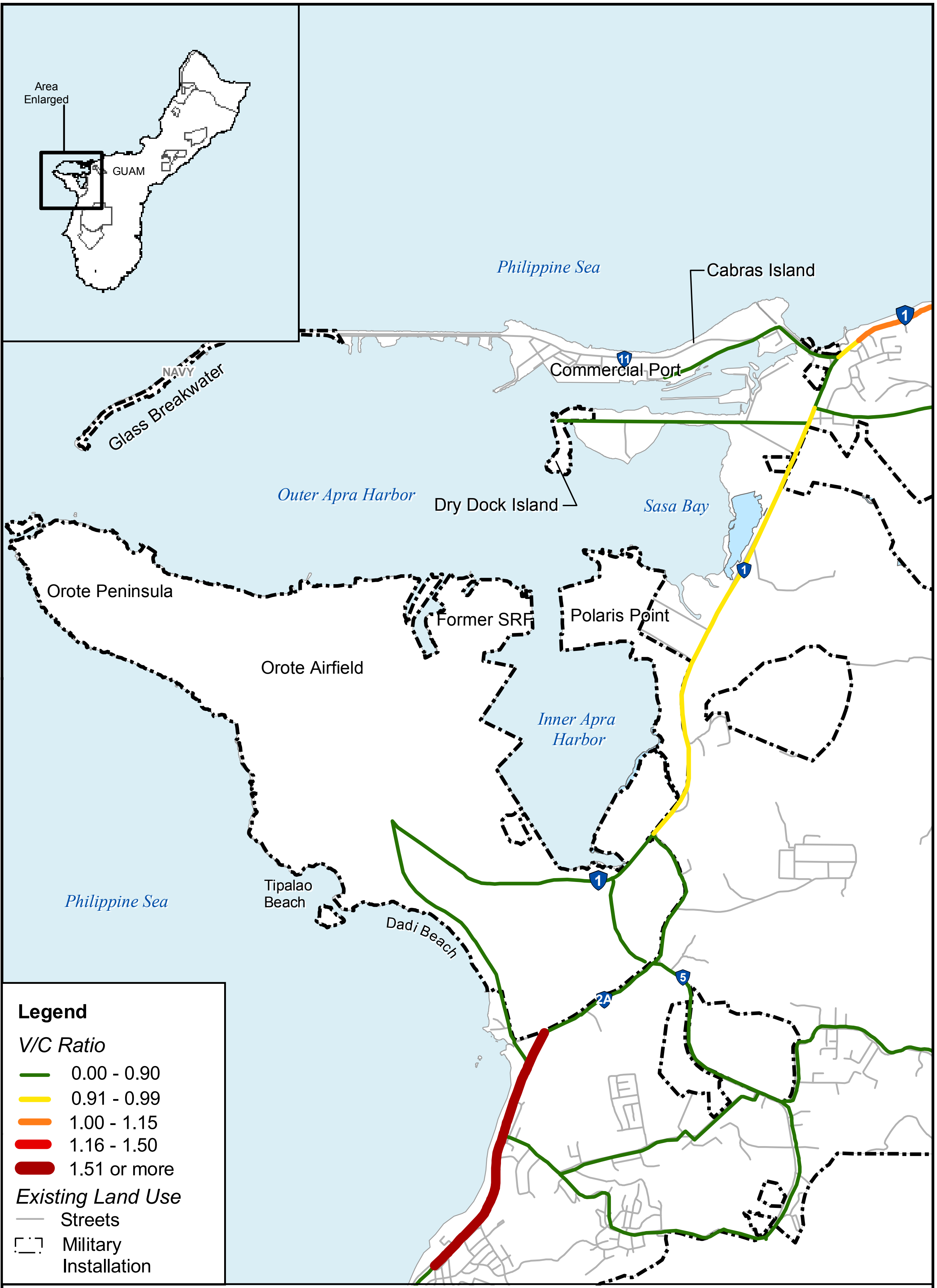


Figure 4.2-23
Apra Harbor Region - 2014 a.m. Peak Congestion Levels- Alternative 1 and 2

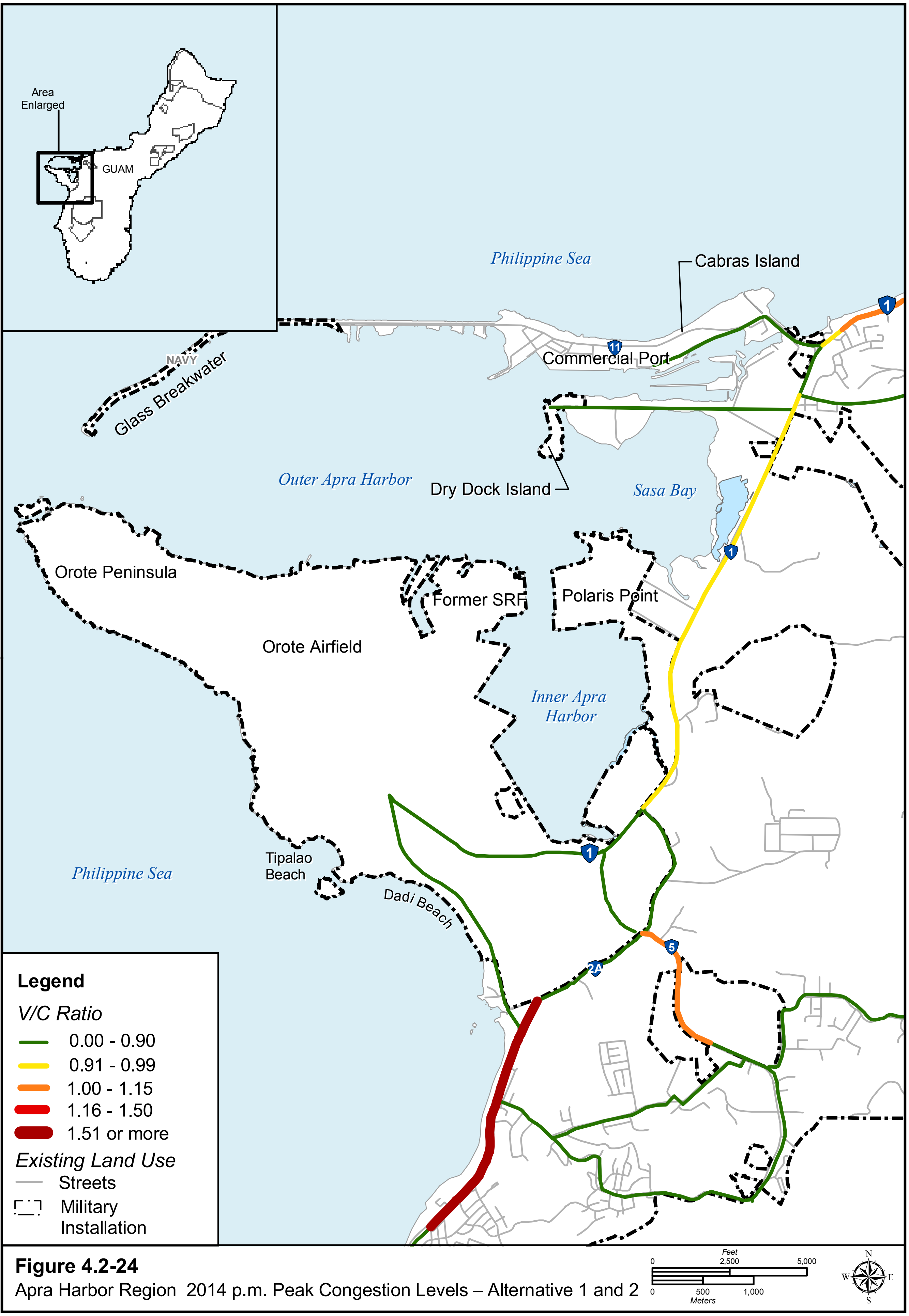


Figure 4.2-24
Apra Harbor Region 2014 p.m. Peak Congestion Levels – Alternative 1 and 2

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4192_MXDs\Figure 4.2-24. Apra Harbor Region - 2014 p.m. Peak Congestion Levels- Alternative 1-2.mxd

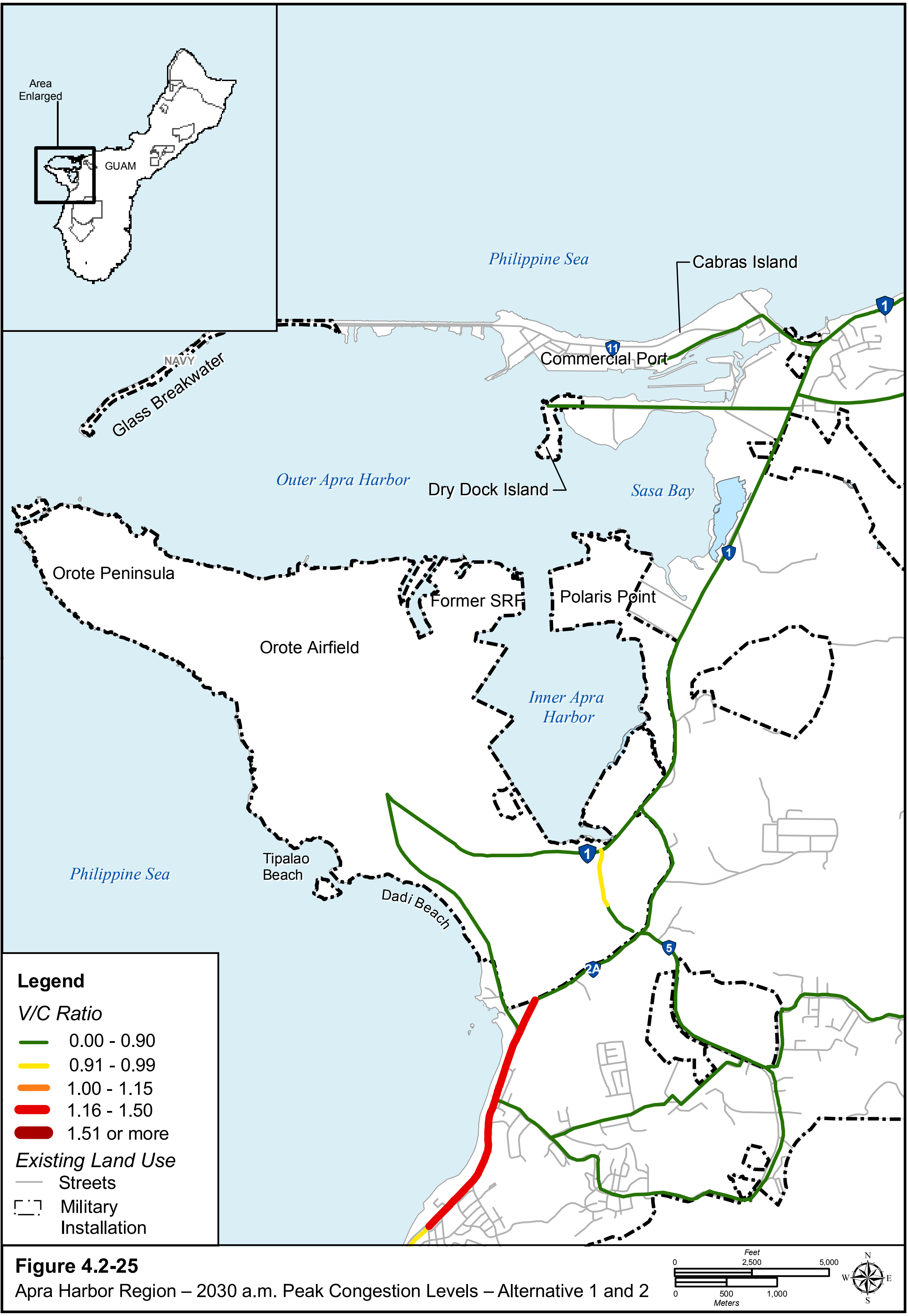


Figure 4.2-25
Apra Harbor Region – 2030 a.m. Peak Congestion Levels – Alternative 1 and 2

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-25. Apra Harbor Region - 2030 a.m. Peak Congestion Levels - Alternative 1-2.mxd

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-26. Apra Harbor Region - 2030 p.m. Peak Congestion Levels - Alternative 1-2.mxd

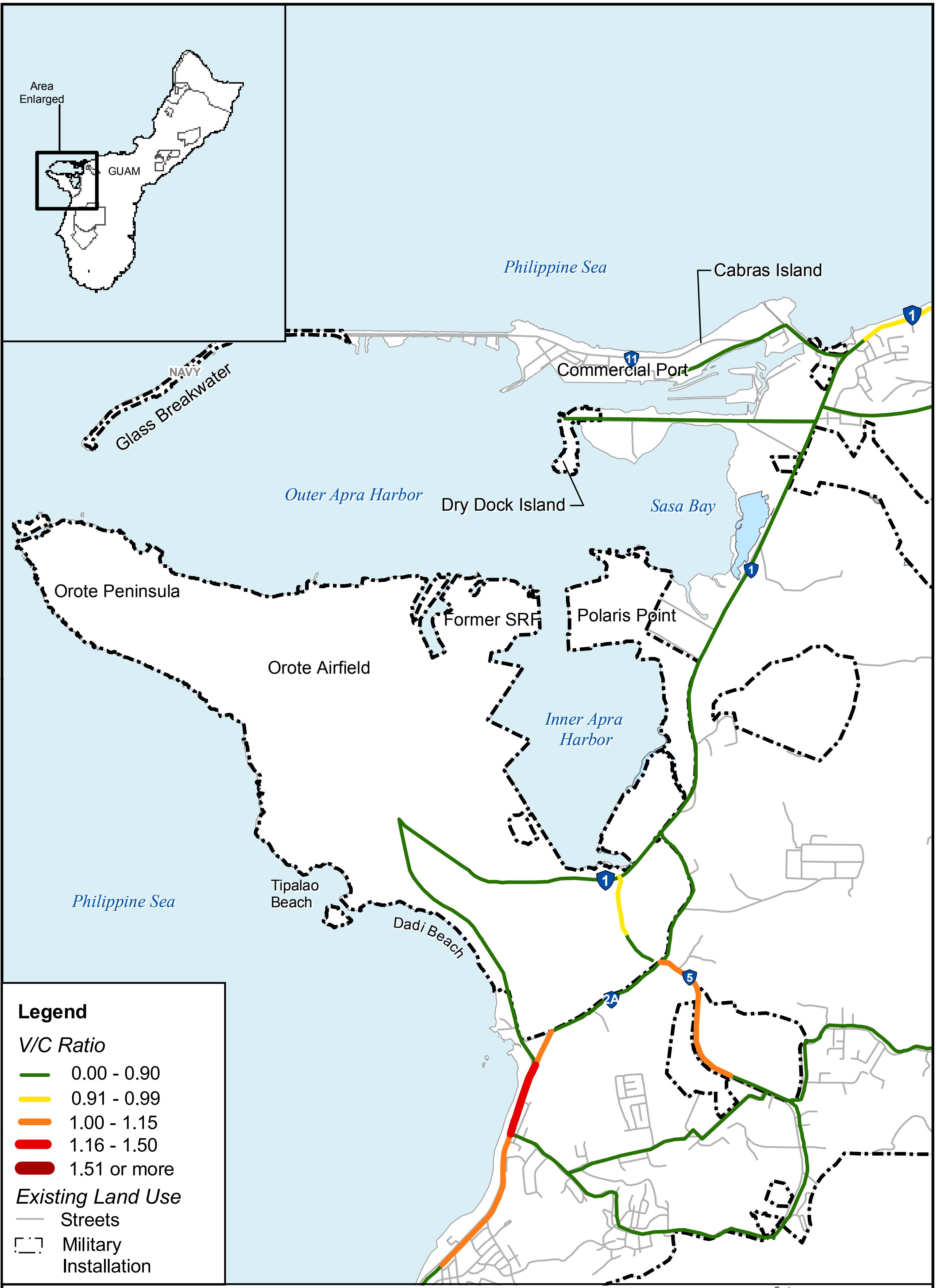


Figure 4.2-26

Apra Harbor Region – 2030 p.m. Peak Congestion Levels – Alternative 1 and 2

The proposed aircraft carrier berthing project would occur in the Apra Harbor Region. While in port, it is estimated that an average of four buses per hour would travel between Naval Base Guam and Tumon Bay. Under Alternative 1 (Polaris Point), an additional 2 buses per hour would travel between Polaris Point and Naval Base Guam. An identical number (unknown) of taxis and car rentals would be used for each alternative. Thus, for the two aircraft carrier berthing alternatives, the amount of vehicle activity would be virtually identical. However, the existing traffic conditions at the off base roadways that provide access to Polaris Point (Alternative 1) are better than the existing roadway conditions at the off base roadways that provide access to Former Ship Repair Facility (Alternative 2). Traffic associated with Alternative 1 (Polaris Point) would have access to the Guam roadway system at the existing signalized access point at Route 1/Polaris Point access road intersection. In the future, this signalized intersection operates at LOS A during weekday morning and afternoon peak hours and has adequate capacity for infrequent traffic events such as berthing of ships. Therefore, for Alternative 1 (Polaris Point), any additional traffic (e.g., rental cars, buses, and taxis) during berthing operations at peak hours would impact the LOS A condition on Route 1/Route 2A.

In the future condition, Route 1/Route 2A is anticipated to operate at LOS E both in the a.m. and p.m. peak hour without the aircraft carrier berthing project, provided the associated intersection improvement project is implemented (funded). Therefore, for Alternative 2 (Former Ship Repair Facility), any additional traffic (e.g., rental cars, buses, and taxis) during berthing operations for Alternative 2 during peak hours would impact the LOS E condition on Route 1/Route 2A. Without the intersection improvement project, LOS F is expected during afternoon peak hours.

As shown in Table 4.2-9, Route 1/2A would operate at LOS F in the a.m. peak hour for 2014, which is considered unacceptable. The intersection would operate more efficiently in terms of delay in 2030, with LOS E in the a.m. This change can be attributed to a decrease in construction traffic in 2030. Route 5/2A is operating at LOS F in the p.m. peak hour for 2030, which is considered unacceptable.

Table 4.2-9. Alternatives 1 and 2 Future Level of Service and Delay Results – Apra Harbor Region

	2014				*2030*			
	a.m. Peak Hour		*p.m. Peak Hour*		*a.m. Peak Hour*		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*								
Route 1/11	C	25.4	E	67.1	C	20.7	D	43.5
Route 1/Polaris Point	A	3.8	A	4.3	A	8.2	A	7.4
Route 1/6 (west)	D	53.2	C	23.6	B	18.4	C	22.0
Route 1/2A	F	94.1	F	82.1	E	66.8	E	57.2
Route 5/2A	E	79.4	D	36.9	F	96.3	C	26.2

Notes: *Signalized intersection LOS based on average delay for the overall intersection.
Legend: LOS = Level of Service.

Public Transportation Impacts. Impacts to the public transportation system in the Apra Harbor Region should be minimal and would relate to the delays caused by increased levels of congestion on Route 5 or at intersections near DoD lands. This would possibly affect the fixed-route service along Route 1, as well as any demand response and paratransit services. Implementation of new transit services should take into consideration the impacts of the military relocation.

Pedestrian and Bicycle Impacts. There are no impacts to the pedestrian and bicycle facilities in the Apra Harbor Region. Along Route 1, future traffic volumes and congestion should not negatively affect the experience or safety of the pedestrian and cyclist using the shoulder as a running or biking lane. Any future planning for pedestrian and bicycle facilities needs to consider the impacts of the military relocation.

South

On Base Roadways:

Naval Munitions Site

Construction. Under the proposed action there will be no major construction at the NMS associated with maneuver training operations. The existing hiking trail at the southern end of NMS would be utilized to avoid the Explosive Safety Quantity Distance arcs generated by the ammunitions storage area that overlap the existing access to NMS (the proposed maneuver area itself would not be within the safety arcs).

Alternative A: A new access road would be constructed that is 0.4 mi (0.6 km) long, would cover 0.8 acres at a 16 ft (5 m) width, and include no stream crossings.

Alternative B: Under this alternative, the road would be the same length but would not be improved. It would be used by foot traffic. Alternative B is the preferred alternative.

Operation.

The training operations would utilize an existing hiking trail that is located away from the existing roadways in the NMS. Therefore, the training operations would have no impact to existing traffic in the NMS.

Off Base Roadways:

Future Traffic Impacts. A summary of future ADT volumes and the v/c ratio for 2014 and 2030 for Alternative 1 can be found in Table 4.2-10. Route 12 decreases in volume from 2014 to 2030. See Table 4.1-20 for the 2008 volume summary. This can be attributed to the increase in construction traffic and coinciding military expansion during peak construction time, which is in 2014, and then a reduction in traffic once off-island construction workers leave the island.

Table 4.2-10. Alternatives 1 and 2 Future ADT and Volume to Capacity Ratio Summary – South Region

Roadway	*2014*		*2030*	
	ADT Summary	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 5	Route 5 ranges from 9,800 to 17,000 vpd. Traffic decreases as Route 5 approaches the intersection with Route 17.	The v/c ratio is 0.91-0.99 in the a.m. peak and 1.00-1.15 in the p.m. peak. The roadway is congested during the p.m. peak hours.	Route 5 ranges from 11,000 to 18,000 vpd. Traffic decreases as Route 5 approaches the intersection with Route 17.	The v/c ratio is 0.91-0.99 in the a.m. peak and 1.00-1.15 in the p.m. peak. The roadway is congested during the p.m. peak hours.
Route 12	Route 12 ranges from 1,800 to 5,600 vpd. The traffic increases toward the intersection with Route 2.	The v/c ratio is 0.00-0.90 during both the a.m. and p.m. peak, indicating the roadway is not considered congested.	Route 12 ranges from 2,300 to 6,000 vpd. The traffic increases toward the intersection with Route 2.	The v/c ratio is 0.00-0.90 during both the a.m. and p.m. peak, indicating the roadway is not considered congested.

Legend: ADT = average daily traffic; v/c = volume to capacity; vpd = vehicles per day.

Figure 4.2-27 through Figure 4.2-30 show future levels of traffic congestion in the South Region for the a.m. and p.m. peak hours, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested.

The roads in the South Region do not exhibit high levels of congestion. During the afternoon peak in 2030, Route 5 between Naval Base Guam and the NMS has an LOS F.

As shown in Table 4.2-11, two intersections have LOS F for at least one peak hour, which is considered unacceptable: Route 2/12, Route 5/17, and Route 4/4A. Route 4/4A and Route 5/17 have fairly free-flowing conditions in 2014 and become significantly more congested in 2030.

Table 4.2-11. Alternatives 1 and 2 Future Level of Service and Delay Results – South Region

	2014				*2030*			
	a.m. Peak Hour		*p.m. Peak Hour*		*a.m. Peak Hour*		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*								
Route 2/12	F	135.0	C	26.0	C	27.8	C	27.1
Unsignalized**								
Route 5/17	C	13.1	D	29.3	F	56.8	F	149.6
Route 4/4A	C	23.9	C	17.1	E	49.7	F	484.3
Route 17/4A	B	12.9	B	14.0	B	13.6	C	18.7
Military Access Points								
Route 5 - Naval Munitions Site/Harmon Road.**	—	—	—	—	A	9.5	A	10.6

Legend: LOS = Level of Service.
Notes: *Signalized intersection LOS based on average delay for the overall intersection.
**Unsignalized intersection LOS based on approach delay on STOP-controlled approach.

Public Transportation Impacts. Impacts to the demand response and paratransit that service the South Region are minimal. Implementation of new transit services should take into consideration the impacts of the military relocation.

Pedestrian and Bicycle Impacts. There are no impacts to pedestrian and bicycle facilities in the South Region. Any future planning for pedestrian and bicycle facilities needs to consider the impacts of the military relocation.

Proposed Mitigation Measures

On Base Roadways:

Due to increase of traffic from the proposed action, impacts to on base traffic would exist. The impacts would be more severe at Andersen AFB and Naval Base Guam. The traffic impact is less than significant at Andersen South, Barrigada, and NMS. Proposed mitigation measures for Andersen AFB and Naval Base Guam may include road widening, restriping, traffic signal, and other traffic control devices to help improve traffic operations. An on base traffic study is currently being prepared and once complete will be used to identify potential mitigation options for high traffic areas.

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-27. South Region - 2014 a.m. Peak Congestion Levels- Alternative 1-2.mxd

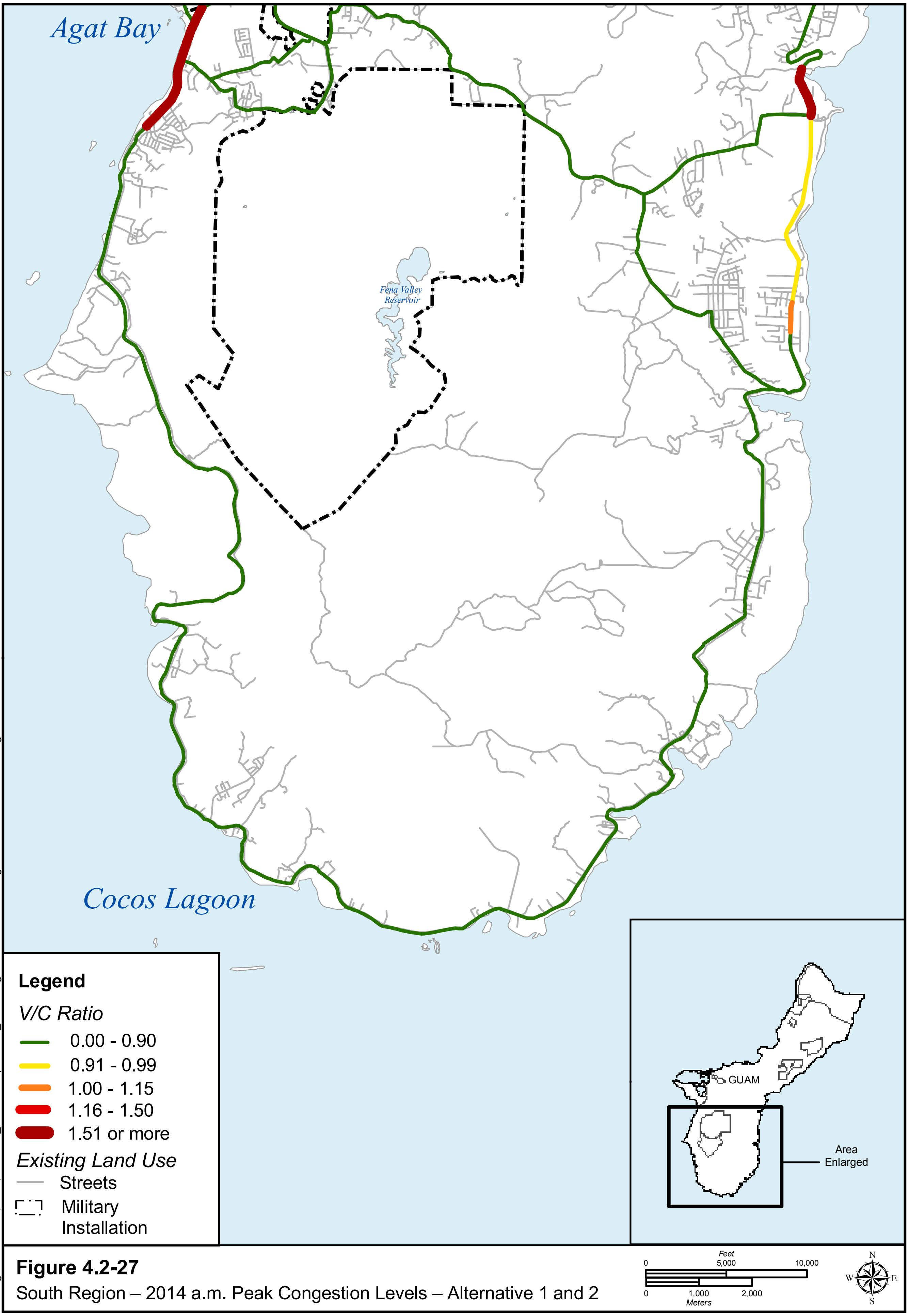


Figure 4.2-27

South Region – 2014 a.m. Peak Congestion Levels – Alternative 1 and 2

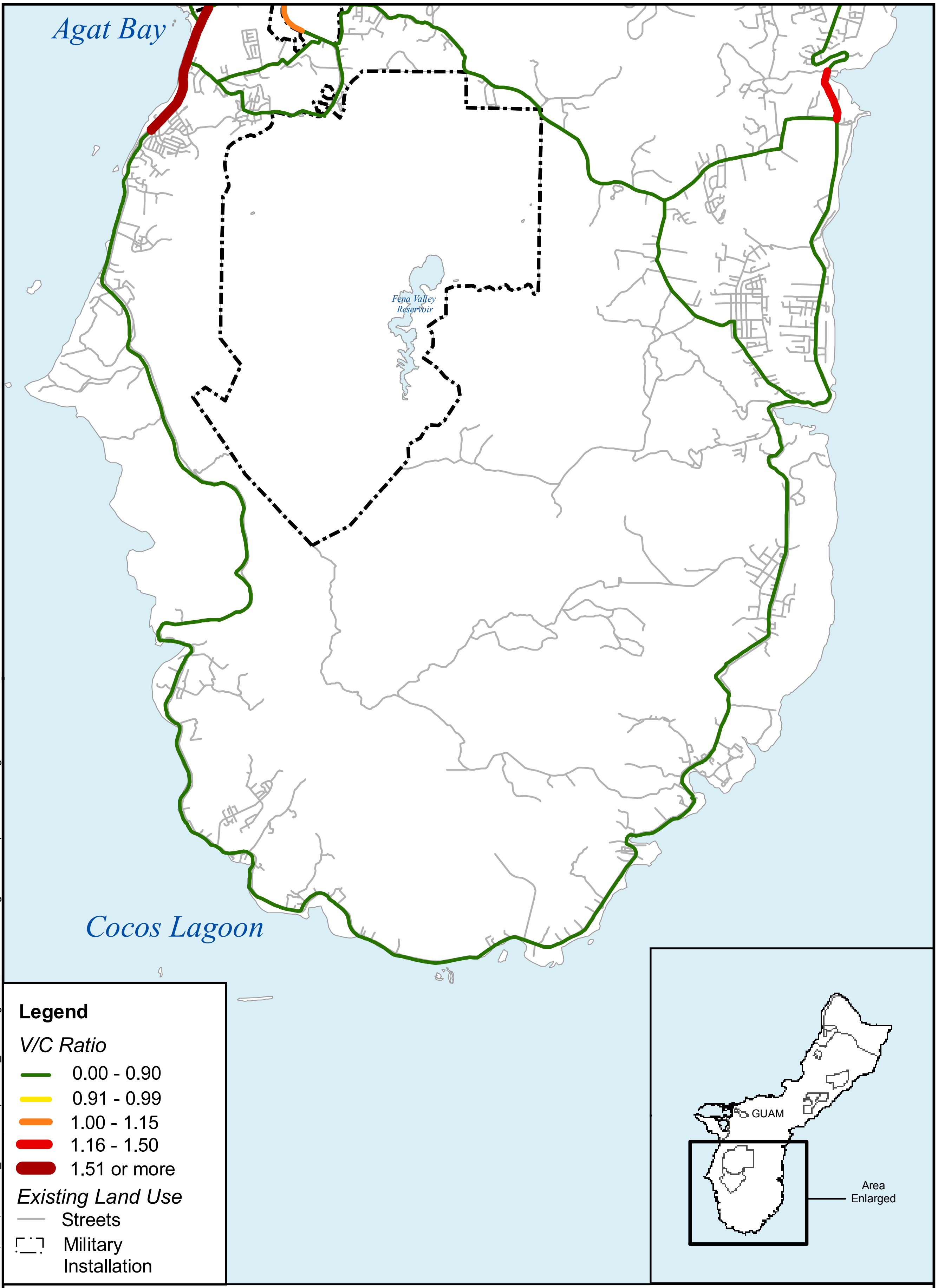


Figure 4.2-28

South Region – 2014 p.m. Peak Congestion Levels – Alternative 1 and 2

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-28. South Region - 2014 p.m. Peak Congestion Levels- Alternative 1-2.mxd

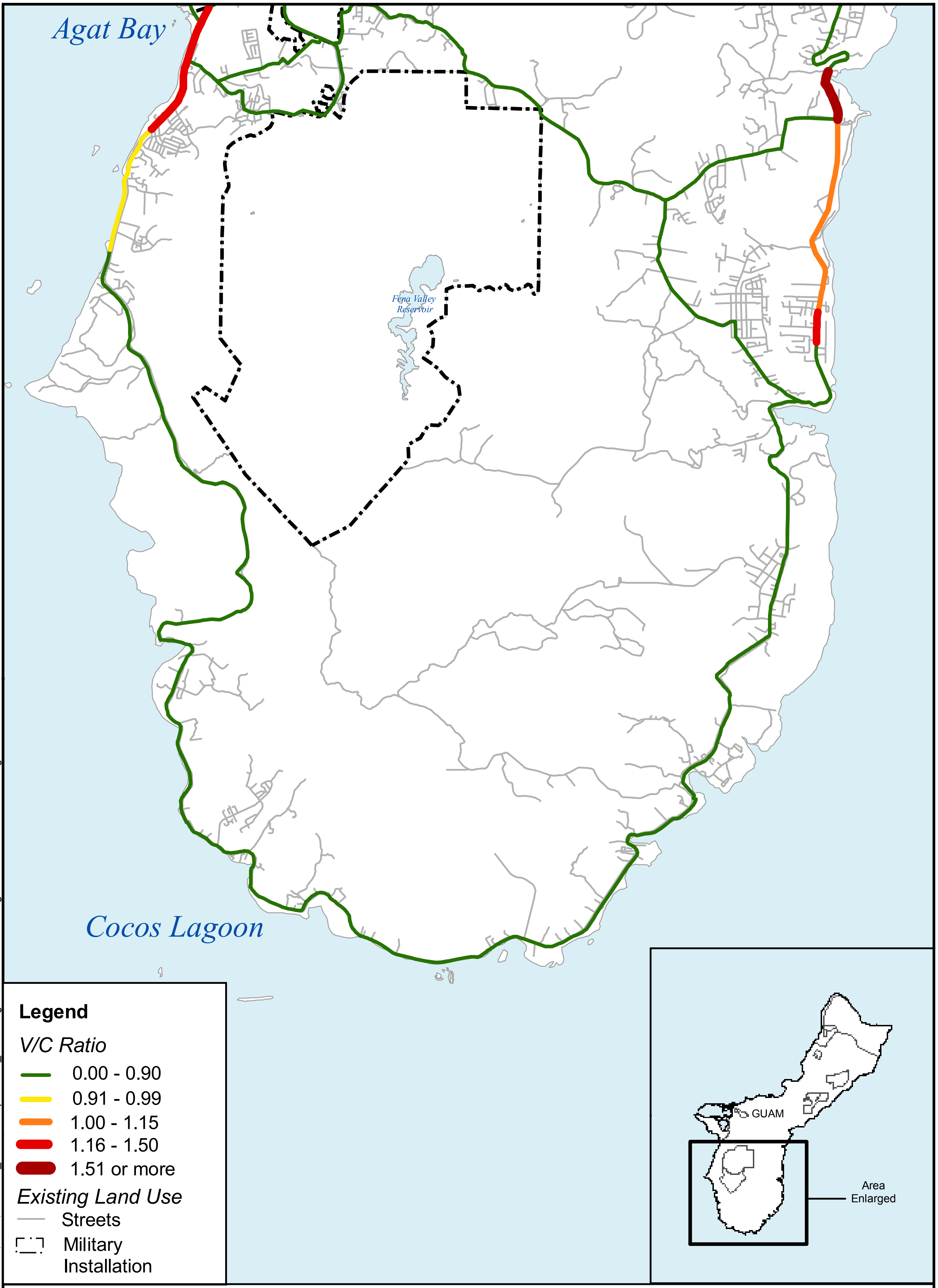


Figure 4.2-29

South Region – 2030 a.m. Peak Congestion Levels – Alternative 1 and 2

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-29. South Region - 2030 a.m. Peak Congestion Levels- Alternative 1-2.mxd

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-30. South Region - 2030 p.m. Peak Congestion Levels- Alternative 1-2.mxd

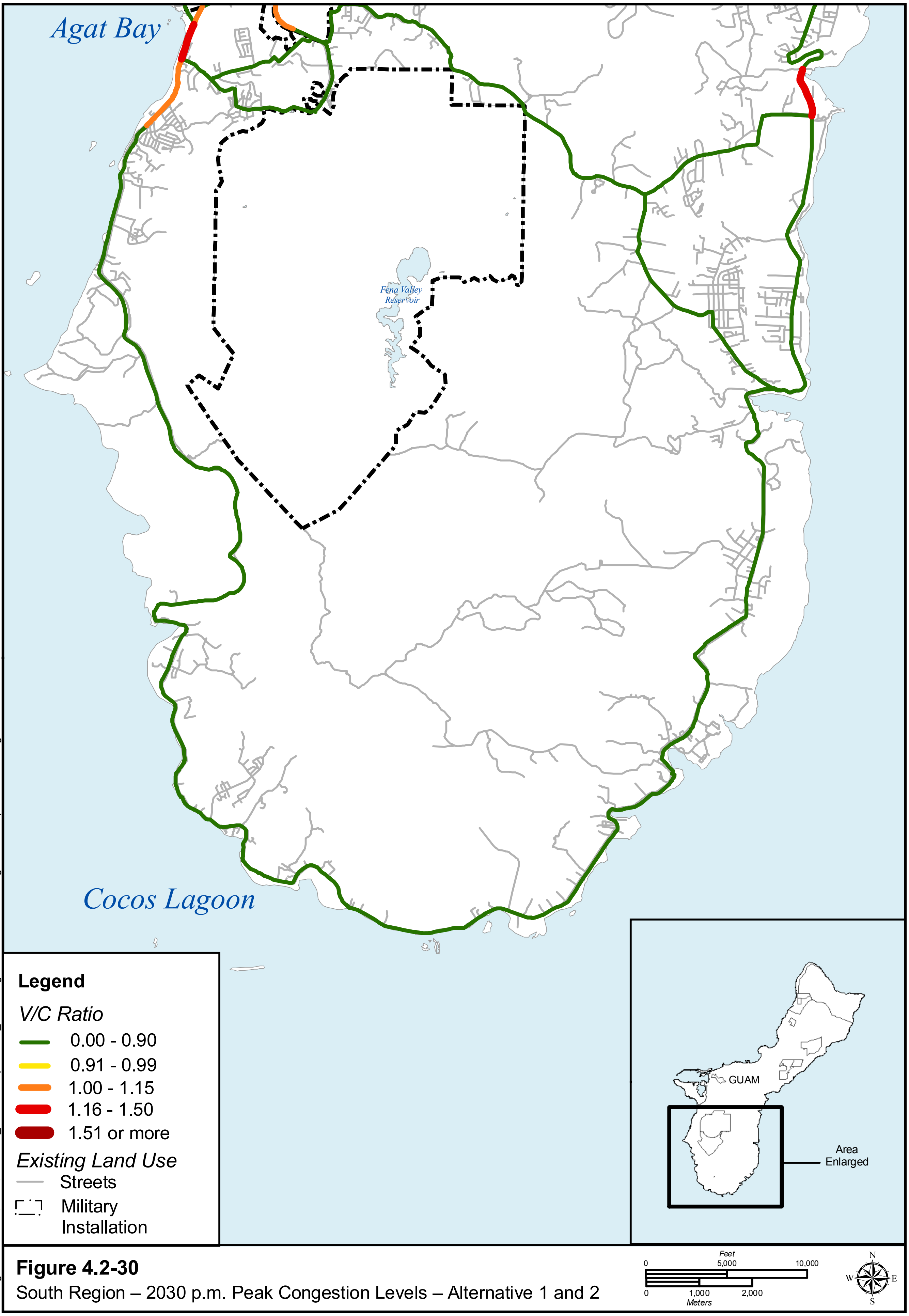


Figure 4.2-30

South Region – 2030 p.m. Peak Congestion Levels – Alternative 1 and 2

Off Base Roadways:

Mitigation for the impacts described for Alternative 1 would be under the control of Federal Highway Administration and could include the creation of a Traffic Management Plan that may incorporate the following:

- Travel demand management
- Encourage moped and motorcycle use
- Develop transportation demand measures to discourage single-occupant vehicle use
- Stagger work hours
- Provide corporate shuttles for local circulation
- Better delivery system for purchases
- Flextime – compressed work weeks
- Promote trip reduction planning
- Traffic management would follow the Manual on Uniform Traffic Control Devices, as deemed necessary and applicable
- The Manual on Uniform Traffic Control Devices provides several examples on dealing with traffic through many different types of roadway construction activities
- Whenever possible, construction would be phased to allow two lanes of traffic to remain open
- If two lanes of traffic are not permissible, traffic would be reduced to one lane
- Should it be required for all lanes of traffic to be closed, a detour route would be clearly signed
- Appropriate measures would be taken to maintain access to businesses
- Should construction require a business access to be closed, the business owner would be given reasonable notice of the construction activities and the estimated duration of closure
- Pedestrian routes would remain open and clear of any debris
- Should a pedestrian route be closed, a detour route would be clearly signed and maintained throughout construction to ensure pedestrian safety
- All emergency services would be given sufficient notice of construction activities and relative detour routes as to not affect their response times

4.2.2.2 Alternative 2 (Preferred Alternative)

North

On Base Roadways:

Andersen AFB

Construction. The impacts for Alternative 2 are the same as Alternative 1.

Operation. The impacts for Alternative 2 are the same as Alternative 1.

Finegayan

Construction. The impacts for Alternative 2 are the same as Alternative 1.

Operation. The impacts for Alternative 2 are the same as Alternative 1.

Off Base Roadways:

The impacts for Alternative 2 are the same as Alternative 1.

Central

On Base Roadways:

Andersen South

Construction. The impacts for Alternative 2 are the same as Alternative 1.

Operation. The impacts for Alternative 2 are the same as Alternative 1.

Barrigada

Construction. The impacts for Alternative 2 are the same as Alternative 1.

Operation. The impacts for Alternative 2 are the same as Alternative 1.

Off Base Roadways:

The impacts for Alternative 2 are the same as Alternative 1.

Apra Harbor

On Base Roadways:

Naval Base Guam

Construction. The impacts for Alternative 2 are the same as Alternative 1.

Operation. The impacts for Alternative 2 are the same as Alternative 1.

Off Base Roadways:

The impacts for Alternative 2 are the same as Alternative 1.

South

On Base Roadways:

Naval Munitions Site

Construction. The impacts for Alternative 2 are the same as Alternative 1.

Operation. The impacts for Alternative 2 are the same as Alternative 1.

Off Base Roadways:

The impacts for Alternative 2 are the same as Alternative 1.

Proposed Mitigation Measures

On Base Roadways:

The proposed mitigation measures would be the same as for Alternative 1.

Off Base Roadways:

The proposed mitigation measures would be the same as for Alternative 1.

4.2.2.3 Alternative 3

<u>North</u>

On Base Roadways:

Andersen AFB

Construction. The impacts for Alternative 3 are the same as Alternative 1.

Operation. The impacts for Alternative 3 are the same as Alternative 1.

Finegayan

Construction. The construction in Finegayan remains similar to that explained in Alternatives 1 and 2. In this alternative, the Former FAA parcel, and Harmon Annex are not utilized. The alternative includes utilizing Navy Barrigada and Air Force Barrigada for constructing the family housing and community support facilities that would not be constructed on the Former FAA parcel and Harmon Annex. The Commercial Gate, Main Gate, and Residential Gate remain at the same location. Facilities that would be constructed remain the same as explained in Alternatives 1 and 2 earlier.

The impacts for Alternative 3 would be similar to Alternative 1.

Operation. As there is no inter-connectivity between NCTS Finegayan and South Finegayan in Alternative 3; the traffic between these two neighboring bases would have to pass through Route 3. This would result in higher traffic congestion on Route 3 and impacts are discussed in the Off Base Roadway sections of this chapter.

The impacts for Alternative 3 to on base roadways are the same as Alternative 1.

Off Base Roadways:

Future Traffic Impacts. Alternative 3 of the Army AMDTF proposed action involves collocation of facilities with the Marine Corps at NCTS Finegayan, Navy Barrigada, and Air Force Barrigada. Alternative 2 of the Army AMDTF is similar in that Army facilities would be located at Navy Barrigada. Thus, effects of Army AMDTF Alternatives 2 and 3 are captured in the following analysis.

A summary of future ADT volumes and the v/c ratio for 2014 and 2030 for Alternative 3 is presented in Table 4.2-12. Generally, there is a substantial increase in volumes on roadways from 2008 to 2014, and then a modest decrease in volumes on roadways from 2014 to 2030. See Table 4.1-3 for the 2008 volume summary. This can be attributed to the increase in construction traffic and coinciding military expansion during peak construction time, which is in 2014, and then a reduction in traffic once off-island construction workers leave the island. Overall, there would be increased traffic as compared to Alternative 1 due to traffic from off base housing.

Figure 4.2-31 through Figure 4.2-34 show future levels of traffic congestion in the North Region for the a.m. and p.m. peak hours, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested.

The road indirectly serving the DoD lands is the most congested. During both the morning and afternoon peaks, the road with the greatest congestion levels in the North Region is Route 28 with LOS F.

Table 4.2-12. Alternative 3 Future ADT and Volume to Capacity Ratio Summary – North Region

	2014		*2030*	
Roadway	*ADT Summary*	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 1	Route 1 ranges from 32,000 to 41,000 vpd. Traffic decreases as Route 1 approaches Andersen AFB.	The v/c ratio is 0.00-0.90 during the a.m. and p.m. peak hours, indicating the roadway is not considered congested.	Route 1 ranges from 24,000 to 40,000 vpd. Traffic decreases as Route 1 approaches Andersen AFB.	The v/c ratio is 0.00-0.90 during the a.m. and p.m. peak hours, indicating the roadway is not considered congested.
Route 3	Route 3 ranges from 23,000 to 68,000 vpd. Traffic decreases north of the intersection with Route 28.	During the a.m. and p.m. peak, Route 3 south of the Residential Gate has a v/c ratio of 1.00-1.15. North of the Residential Gate, the v/c ratio is less than 1. The roadway is considered congested south of the military installation.	Route 3 ranges from 13,000 to 53,000 vpd. Traffic decreases north of the intersection with Route 28.	During peak hours, Route 3 has a v/c ratio of less than 1 and is not considered congested.
Route 9	Route 9 ranges from 12,000 to 20,000 vpd. There is a decrease in traffic east of the two residential developments on Route 9.	The western portion has a v/c ratio of 0.00-0.90 during peak hours; however, the eastern portion has a v/c ratio of 0.81-0.99 during the a.m. peak and 1.00-1.15 during the p.m. peak. This section is congested during the p.m. peak.	Route 9 ranges from 9,200 to 16,000 vpd. There is a decrease in traffic east of the two residential developments on Route 9.	The western portion of Route 9 has a v/c ratio of 0.00-0.90 during peak hours, while the eastern portion has a v/c ratio of 0.91-0.99. The roadway is not considered congested.
Route 15	Route 15 has 6,900 vpd in the North Region.	The v/c ratio is 0.00-0.90 during the a.m. and p.m. peak hours, indicating the roadway is not considered congested.	Route 15 has 7,600 vpd in the North Region.	The v/c ratio is 0.00-0.90 during the a.m. and p.m. peak hours, indicating the roadway is not considered congested
Route 28	Route 28 ranges from 21,000 to 26,000 vpd. Traffic increases closer to the intersection with Route 1.	The north/south portion of Route 28 has a v/c ratio greater than 1.50 during peak hours. The east/west portion has a v/c of 1.16-1.50 during the a.m. and greater than 1.50 during the p.m. The roadway is considered congested.	Route 28 ranges from 16,000 to 18,000 vpd. Traffic increases closer to the intersection with Route 1.	The north/south portion of Route 28 has a v/c ratio greater than 1.50 during peak hours. The east/west portion has a v/c of 1.00-1.15 during the a.m. and 1.16-1.50 during the p.m. The roadway is considered congested.

Legend: ADT = average daily traffic; AFB = Air Force Base; v/c = volume to capacity; vpd = vehicles per day.

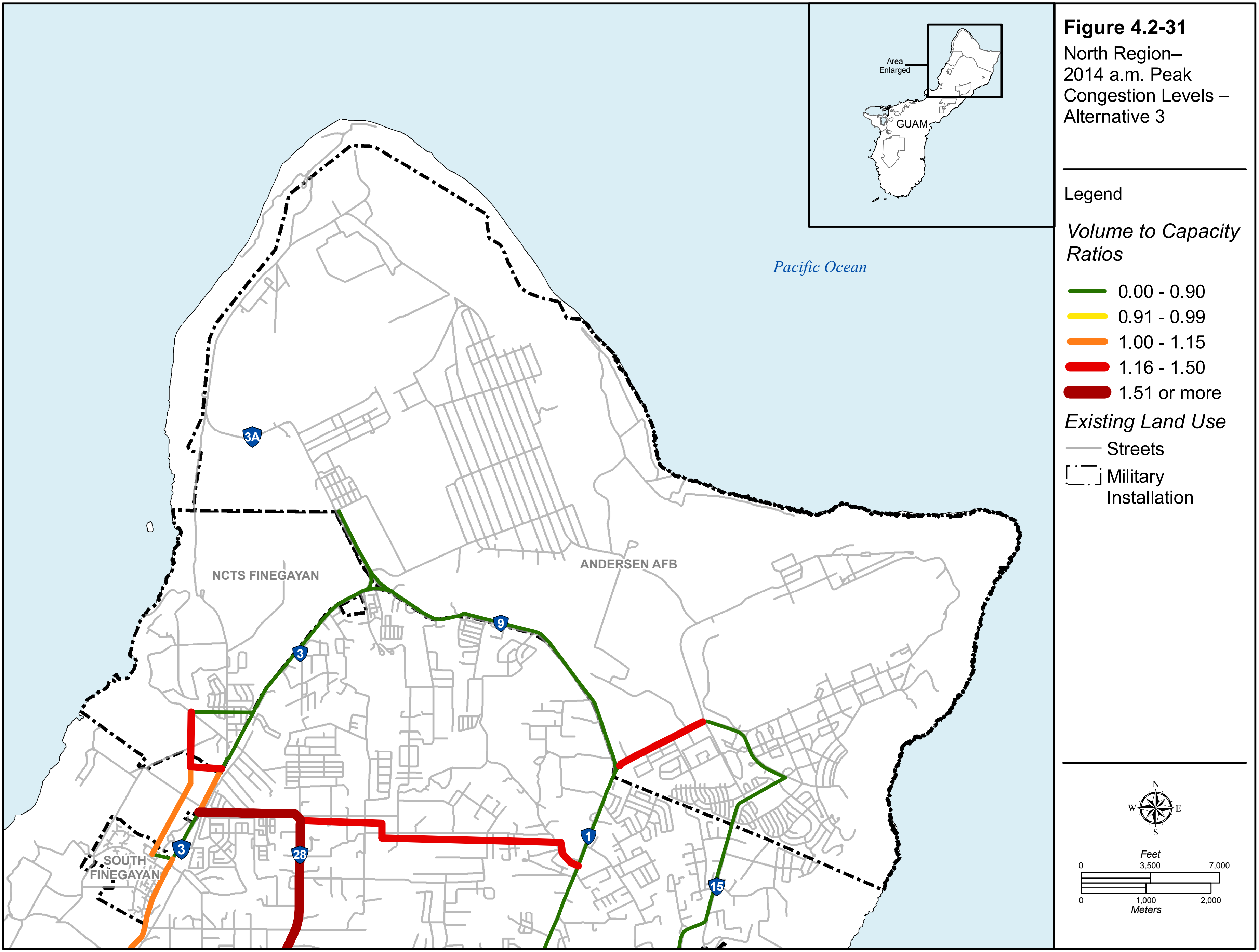


Figure 4.2-31
North Region– 2014 a.m. Peak Congestion Levels – Alternative 3

Printing Date: March 11, 2010

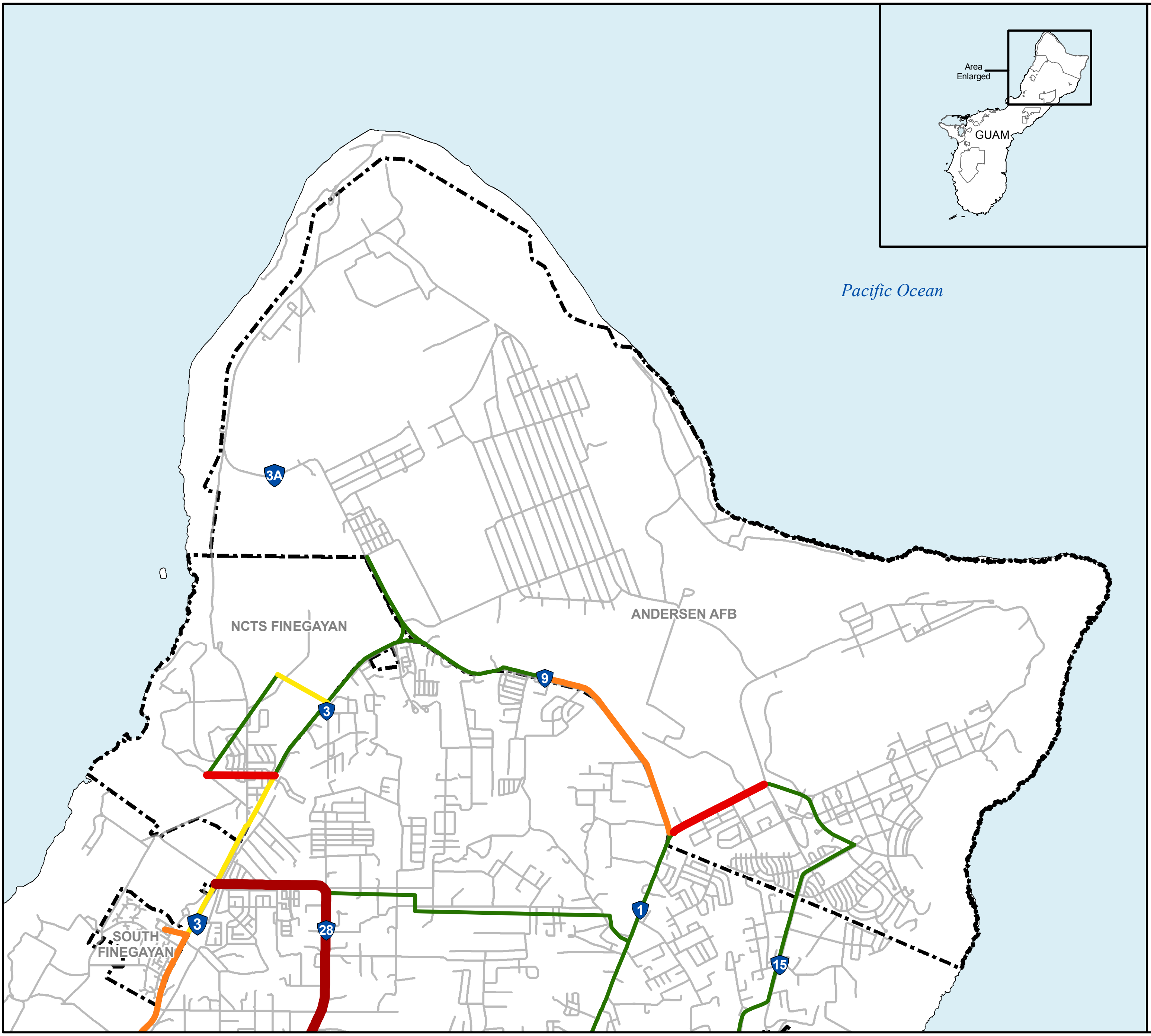


Figure 4.2-32

North Region– 2014 p.m. Peak Congestion Levels – Alternative 3

Legend

Volume to Capacity Ratios

- 🟩 0.00 - 0.90
- 🟨 0.91 - 0.99
- 🟧 1.00 - 1.15
- 🟥 1.16 - 1.50
- 🟫 1.51 or more

Existing Land Use

- — Streets
- ⌐·┐ Military Installation

N
W E
S

Feet
0 3,500 7,000
0 1,000 2,000
Meters

Printing Date: March 11, 2010

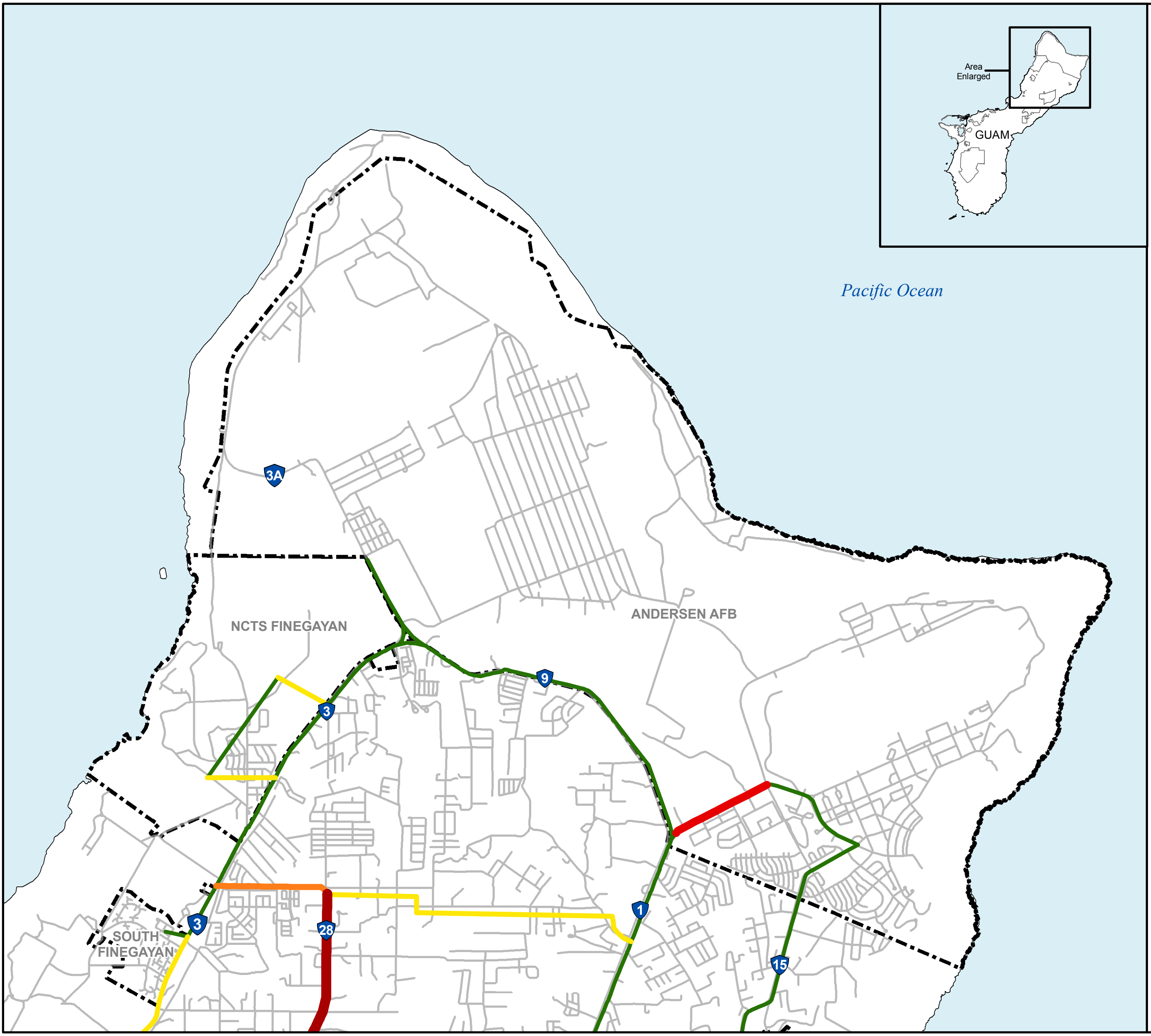


Figure 4.2-33

North Region–
2030 a.m. Peak
Congestion Levels –
Alternative 3

Printing Date: March 11, 2010

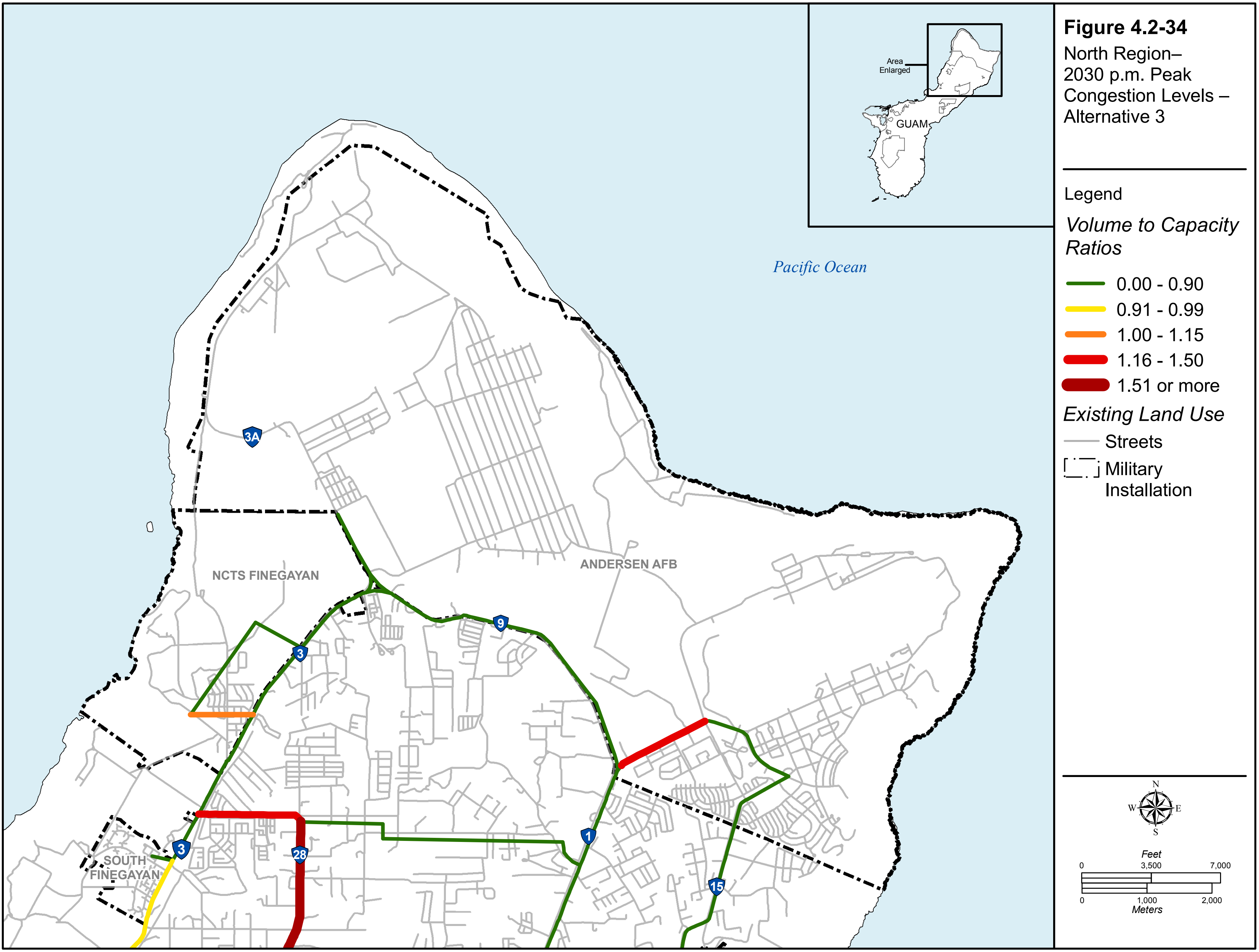


Figure 4.2-34
North Region–
2030 p.m. Peak
Congestion Levels –
Alternative 3

Printing Date: March 12, 2010

The results of the future operational analysis are shown in Table 4.2-13 for both the 2014 a.m. and p.m. and 2030 a.m. and p.m. conditions.

For the North Region, there are three intersections for which traffic is worse in 2014 than in 2030 in both the a.m. and p.m. peak hour. This can be attributed to an increase in construction equipment and personnel in addition to the first military deployment that would occur in 2010.

As shown in Table 4.2-13, there are three intersections and three access points with LOS F for at least one peak hour, which is considered unacceptable. The Route 1/29 intersection is operating at LOS F in the a.m. and p.m. peak hours in both 2014 and 2030.

Table 4.2-13. Alternative 3 Future Level of Service and Delay Results – North Region

	2014				*2030*			
	a.m. Peak Hour		*p.m. Peak Hour*		*a.m. Peak Hour*		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*								
Route 1/9	C	25.9	D	38.2	C	24.4	D	53.0
Route 1/29	F	347.0	F	278.8	F	85.3	F	90.5
Route 3/28	F	95.2	F	92.8	F	90.2	D	53.9
Route 15/29**	C	27.0	C	22.8	F	161.4	C	26.2
Unsignalized* **								
Route 3/3A/9	F	142.3	F	565.0	E	47.2	F	100.7
Military Access Points								
Route 3 – Main Cantonment/Commercial Gate	—	—	—	—	F	91.6	D	39.9
Route 3 – Main Cantonment/Main Gate	—	—	—	—	D	51.6	F	155.9
Route 3 – South Finegayan/Residential Gate	—	—	—	—	F	141.7	D	50.1
Route 9 – Andersen AFB/ Andersen AFB North Gate****	—	—	—	—	F	1031.0	F	9051.1

Legend: AFB = Air Force Base; LOS = Level of Service.
Notes: *Signalized intersection LOS based on average delay for the overall intersection.
**Intersection is proposed to be signalized in future build conditions.
***Unsignalized intersection LOS based on approach delay on STOP-controlled approach.
****Delay exceeded maximum calculated value.

Public Transportation Impacts. Impacts to the public transportation system relate to the delays caused by increased levels of congestion on roadways and at intersections. This would affect the demand response and paratransit services, increasing passenger wait times and missed transfers. While there is no existing fixed-route service in the North Region, planning efforts have proposed new routes along Routes 1 and 3.

Implementation of new transit services should take into consideration the impacts of the military relocation.

Pedestrian and Bicycle Impacts. There are no impacts to the pedestrian and bicycle facilities in the North Region. Along Route 1, future traffic volumes and congestion should not negatively affect the experience or safety of the pedestrian and cyclist using the shoulder as a running or biking lane. Any future planning for pedestrian and bicycle facilities needs to consider the impacts of the military relocation.

Central

On Base Roadways:

Andersen South

Construction. The impacts for Alternative 3 are the same as Alternative 1.

Operation. The impacts for Alternative 3 are the same as Alternative 1.

Barrigada

Construction. Alternative 3 proposes to utilize Navy Barrigada and Air Force Barrigada for construction of family housing and community support structures to accommodate the relocation of Marines from Okinawa to Guam. The Residential Gate in Navy Barrigada would be located near the present intersection of Sabana Barrigada and Route 16 in the northern portion of the site. The Residential Gate for Air Force Barrigada would be located near the intersection of Route 15 and Fadian Point Road. The two bases (Navy Barrigada and Air Force Barrigada) would be connected through an approximately 1.5 mi (2.5 km) long connector road that is proposed to run alongside the eastern edge of the Admiral Nimitz Golf Course.

Based on the relatively low traffic demand on Barrigada, the construction traffic impact would be less than significant for Alternative 3.

Operation. The existing two lane roadways in Barrigada have a daily capacity of approximately 5,000 vpd. The expected increase in traffic and the current traffic demand is well below that capacity. Therefore, the impact would be less than significant for Alternative 3.

Off Base Roadways:

Future Traffic Impacts. Alternative 3 of the Army AMDTF proposed action involves collocation of facilities with the Marine Corps at NCTS Finegayan, Navy Barrigada, and Air Force Barrigada. Alternative 2 of the Army AMDTF is similar in that Army facilities would be located at Navy Barrigada. Thus, effects of Army AMDTF Alternatives 2 and 3 are captured in the following analysis.

A summary of future ADT volumes and the v/c ratio for 2014 and 2030 for Alternative 3 can be found in Table 4.2-14. Generally, there is a substantial increase in volumes on roadways from 2008 to 2014, and then a modest decrease in volumes on roadways from 2014 to 2030. See Table 4.1-8 for the 2008 volume summary. This can be attributed to the increase in construction traffic and coinciding military expansion during peak construction time, which is in 2014, and then a reduction in traffic once off-island construction workers leave the island.

Figure 4.2-35 through Figure 4.2-38 show future levels of traffic congestion in the Central Region for the a.m. and p.m. peak hours, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested.

Table 4.2-14. Alternative 3 Future ADT and Volume to Capacity Ratio Summary – Central Region

	2014		*2030*	
Roadway	*ADT Summary*	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 1	Route 1 ranges from 59,000 to 100,000 vpd. Traffic decreases significantly south of the intersection with Route 4.	The v/c ratio is generally less than 1.00 in both the a.m. and p.m. condition; however, there are small segments near the intersections with 14A, and 30 that have a v/c ratio of greater than 1, which indicates the roadway is congested in Tamuning.	Route 1 ranges from 52,000 to 93,000 vpd. Traffic decreases significantly south of the intersection with Route 4.	The v/c ratio is generally less than 1.00 in both the a.m. and p.m. condition; however, there is a segment south of Route 30 that has a v/c ratio of greater than 1 in the p.m. peak. The roadway is congested in Tamuning.
Route 3	Route 3 ranges from 57,000 to 70,000 vpd. Traffic increases toward the intersection with Route 1.	The v/c ratio in both the a.m. and p.m. peak is 1.00-1.15. This indicates the roadway is considered congested.	Route 3 ranges from 48,000 to 60,000 vpd. Traffic increases toward the intersection with Route 1.	The v/c ratio is between 1.00-1.15, indicating the roadway is considered congested at this location.
Route 8/8A	Route 8 ranges from 51,000 to 65,000 vpd. There is a decrease in traffic west of the intersection with Sunset Boulevard. Route 8A has 3,500 vpd.	During peak hours, the v/c ratio is 0.00-0.90 east of Tiyan Parkway, 0.91-0.99 west of Tiyan Parkway, and 0.00-0.90 west of Route 16. Other than a small section near the intersection of Route 10, the roadway is not considered congested.	Route 8 ranges from 52,000 to 60,000 vpd. There is a decrease in traffic west of the intersection with Sunset Boulevard. Route 8A has 2,500 vpd.	During the a.m. peak, the v/c ratio is 0.00-0.90. During the p.m. peak, the v/c ratio is 0.00-0.90 east of Tiyan Parkway, 0.81-0.99 west of Tiyan Parkway, and 0.00-0.90 west of Route 16. The roadway is not considered congested.
Route 10	Route 10 ranges from 56,000 to 58,000 vpd between Routes 8 and 15.	In the a.m. peak, a small segment south of the intersection with Route 15 has a v/c ratio between 1.15-1.50. During the p.m. peak, Route 10 has a v/c ratio of 1.00-1.15 north of Route 32 to Route 8. The roadway is primarily congested during the p.m. peak.	Route 10 ranges from 56,000 to 58,000 vpd between Routes 8 and 15.	In the a.m. peak, Route 10 has a v/c ratio of 1.16-1.50 between Route 32 and Route 15. During the p.m. peak, Route 10 has a v/c ratio of 1.00-1.15 north of Route 32 to Route 8. The roadway is primarily congested during the p.m. peak.
Route 15	Route 15 ranges from 13,000 to 24,000 vpd. There is an increase in traffic south of the intersection with Route 26.	North of Route 26 and west of Route 10, Route 15 has a v/c ratio of 0.00-0.90 during peak hours. The middle section of Route 15 has a v/c ratio of 0.91-0.99, with a v/c ratio of 1.00-1.15 at Route 10. The roadway is only congested near the intersection with Route 10.	Route 15 ranges from 8,100 to 23,000 vpd. There is an increase in traffic south of the intersection with Route 26.	The v/c ratio is less than 1.00 during peak hours. The roadway is not considered congested.

Roadway	*2014*		*2030*	
	ADT Summary	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 16	Route 16 ranges from 59,000 to 91,000 vpd. There is a decrease in traffic south of the residential developments south of Route 25.	The v/c ratio is generally less than 1.00 in the a.m. and p.m. for the segment of the road south of Route 25. North of Route 25, the v/c level is greater than 1, indicating the roadway is considered congested at this location.	Route 16 ranges from 49,000 to 91,000 vpd. There is a decrease in traffic south of the residential developments south of Route 25.	The v/c ratio is less than 1.00 during peak hours, except for near the intersection with Route 27. The roadway is considered congested at this location.
Route 25	Route 25 ranges from 24,000 to 28,000 vpd.	Route 25 has a v/c ratio greater than 1.50, indicating that the roadway is considered congested.	Route 25 ranges from 27,000 to 30,000 vpd.	The v/c ratio is 1.00-1.15 during peak hours, indicating congestion.
Route 26	Route 26 ranges from 10,000 to 25,000 vpd. There is a decrease in traffic south of the large residential development just north of the intersection with Route 15.	Route 26 primarily has a v/c ratio greater than 1.00 during both the a.m. and p.m. peak. The roadway is considered congested.	Route 26 ranges from 9,000 to 27,000 vpd. There is a decrease in traffic south of the large residential development just north of the intersection with Route 15.	The v/c ratio is less than 1.00 during peak hours, except for south of Route 25 where the v/c ratio is 1.00-1.15 in the a.m. peak. The roadway is considered congested at this location.
Route 27	Route 27 ranges from 58,000 to 61,000 vpd between Routes 16 and 1.	The v/c ratio of 0.91-0.99 during the a.m. peak. This roadway is not considered congested.	Route 27 ranges from 53,000 to 56,000 vpd between Routes 16 and 1.	The v/c ratio is 0.00-0.90 during peak hours, indicating the roadway is not considered congested.
Route 28	Route 28 ranges from 21,000 to 24,000 vpd.	The v/c ratio is greater than 1.50 in both the a.m. and p.m. peak, indicating the roadway is considered congested.	Route 28 ranges from 22,000 to 24,000 vpd.	The v/c ratio is greater than 1.50 in both the a.m. and p.m. peak, indicating the roadway is considered congested.
Chalan Lujuna	Chalan Lujuna ranges from 22,000 to 23,000 vpd.	The v/c ratio is 1.00-1.15 during the peak hours, indicating the roadway is considered congested.	Chalan Lujuna ranges from 7,100 to 7,800 vpd.	The v/c ratio is 0.00-0.90 during peak hours, indicating the roadway is not considered congested.

Legend: ADT = average daily traffic; v/c = volume to capacity; vpd = vehicles per day.

For the Central Region, there are 16 intersections for which the traffic is worse in 2014 than in 2030 for both the a.m. and p.m. peak hour. As shown in Table 4.2-15, there are 23 out of 28 intersections and one out of five access points with LOS F for at least one peak hour, which is considered unacceptable. The following intersections would operate at LOS F in the a.m. and p.m. peak hours in both 2014 and 2030:

- Route 1/28
- Route 1/26
- Route 1/27
- Route 1/3
- Route 1/16
- Route 1/10A
- Route 1/14 (ITC)
- Route 1/30
- Route 1/8
- Route 4/7A
- Route 8/10
- Route 10/15
- Route 16/27
- Route 16/10A

Public Transportation Impacts. Impacts to the public transportation system relate to the delays caused by increased levels of congestion on roadways and at intersections. In the Central Region, this would affect the fixed-route service along Routes 1 and 10, as well as the demand response and paratransit services. Delays on the roadways would increase passenger travel times, longer headways, and missed transfers. This would also affect the fixed-route services proposed for Routes 16 and 26. Implementation of new transit services should take into consideration the impacts of the military relocation.

Pedestrian and Bicycle Impacts. There are limited impacts to the pedestrian and bicycle facilities in the Central Region. Along Routes 1 and 10, future traffic volumes and congestion should not negatively affect the experience or safety of the pedestrian using the existing sidewalk; however, it could impact a cyclist wanting to use the outside lane when unable to use the sidewalk. Future improvements to Routes 8 and 26 would also impact the intermittent sidewalk along these roadways and provide an opportunity to fully complete the facility. In addition, any future planning for pedestrian and bicycle facilities needs to consider the impacts of the military relocation.

Apra Harbor

On Base Roadways:

Naval Base Guam

Construction. The impacts for Alternative 3 are the same as Alternative 1.

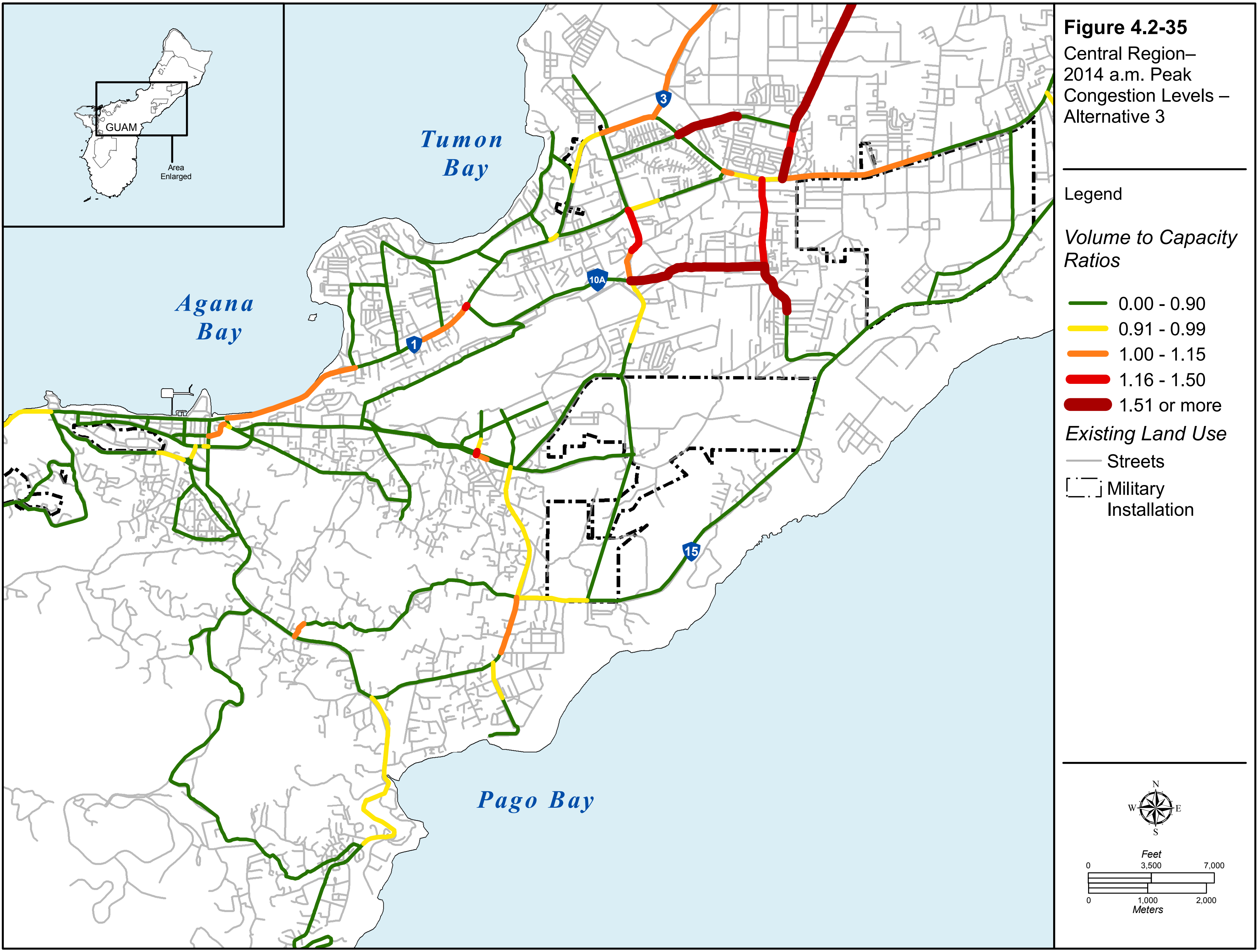
Operation. The impacts for Alternative 3 are the same as Alternative 1.

Off Base Roadways:

Future Traffic Impacts. A summary of future ADT volumes and the v/c ratio for 2014 and 2030 for Alternative 3 can be found in Table 4.2-16. Generally, there is a substantial increase in volumes on roadways from 2008 to 2014, and then a modest decrease in volumes on roadways from 2014 to 2030. See Table 4.1-15 for the 2008 volume summary. This can be attributed to the increase in construction traffic and coinciding military expansion during peak construction time, which is in 2014, and then a reduction in traffic once off-island construction workers leave the island.

Figure 4.2-35

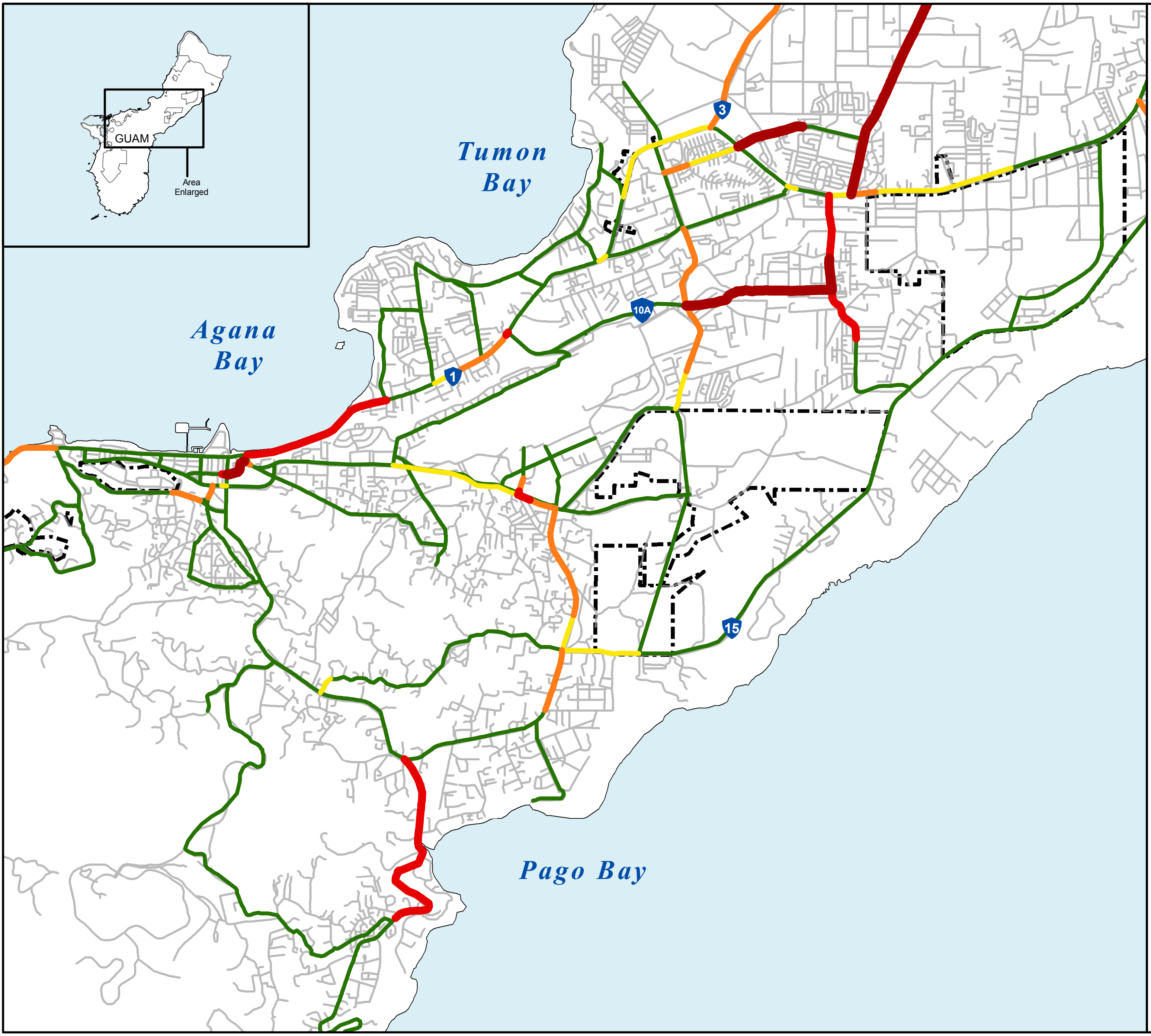
Central Region–
2014 a.m. Peak
Congestion Levels –
Alternative 3



Printing Date: March 12, 2010

Figure 4.2-36

Central Region– 2014 p.m. Peak Congestion Levels – Alternative 3



Printing Date: March 12, 2010

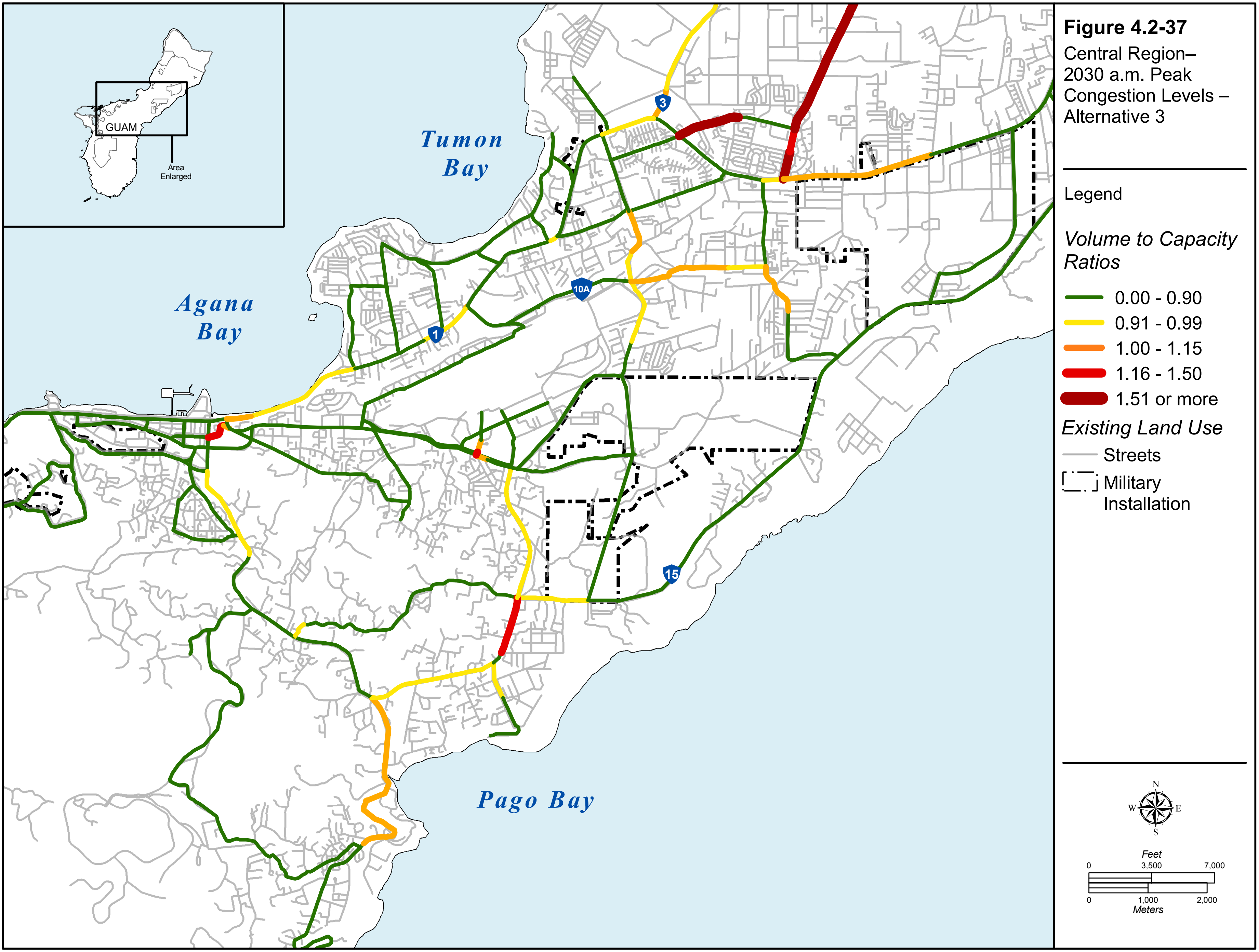


Figure 4.2-37
Central Region–2030 a.m. Peak Congestion Levels – Alternative 3

Printing Date: March 12, 2010

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-38. Central Region - 2030 p.m. Peak Congestion Levels- Alternative 3.mxd

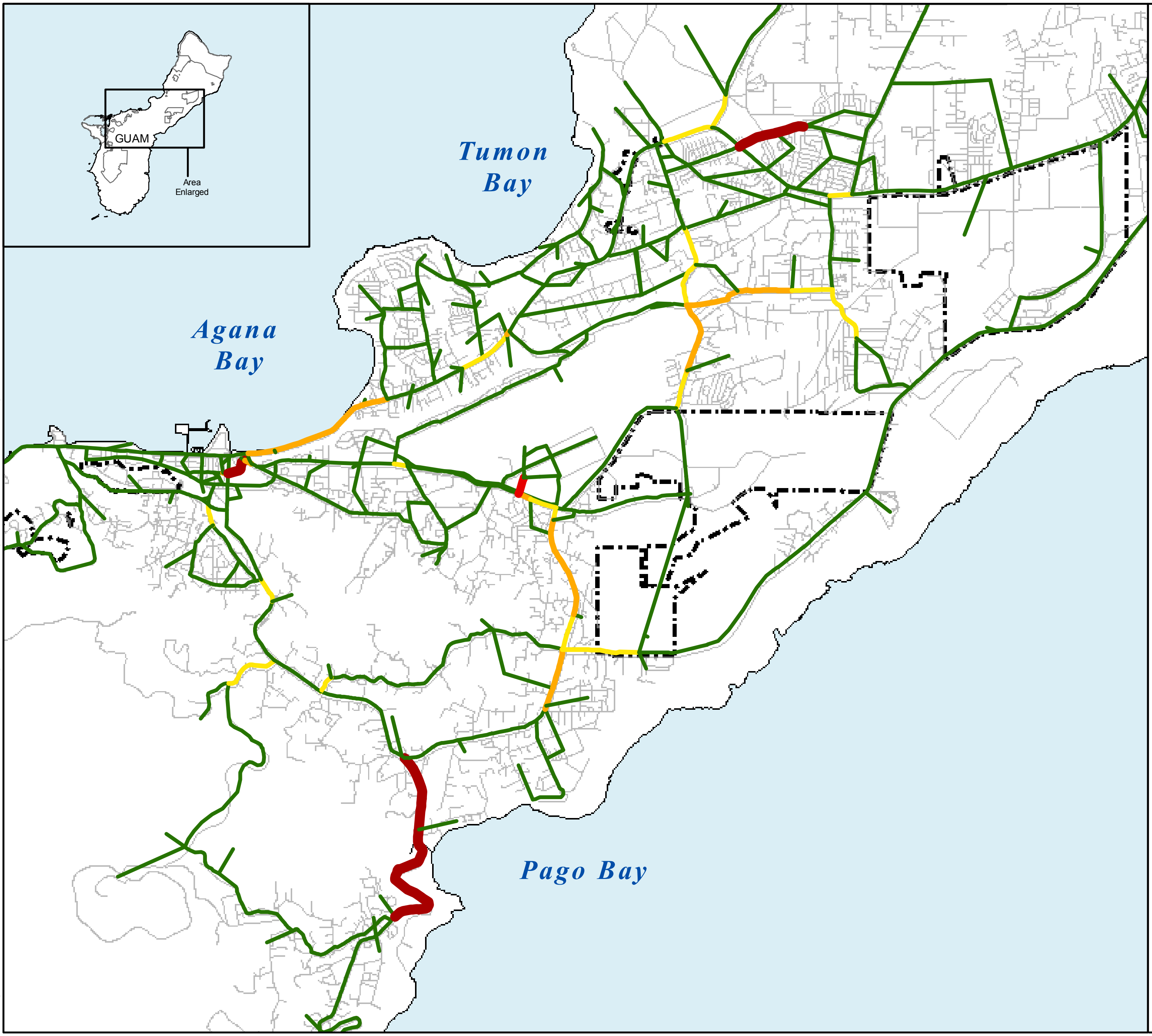


Figure 4.2-38
Central Region–
2030 p.m. Peak
Congestion Levels –
Alternative 3

Table 4.2-15. Alternative 3 Future Level of Service and Delay Results – Central Region

	2014				*2030*			
	a.m. Peak Hour		*p.m. Peak Hour*		*a.m. Peak Hour*		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*								
Route 1/28	F	255.0	F	275.6	F	198.5	F	139.5
Route 1/26	F	135.1	F	278.1	F	89.4	F	209.1
Route 1/27	F	1937.3	F	1013.1	F	151.1	F	399.6
Route 1/27A	F	82.5	E	78.7	F	120.2	F	157.1
Route 1/3	F	417.1	F	357.1	F	341.3	F	474.4
Route 1/16	F	277.0	F	386.7	F	232.2	F	340.3
Route 1/14 (North San Vitores)	F	157.5	F	96.2	E	66.6	E	71.5
Route 1/14A	F	307.3	F	338.1	E	71.0	F	112.3
Route 1/10A	F	188.1	F	196.7	F	129.6	F	193.6
Route 1/14B	F	149.4	F	144.0	E	79.8	E	78.5
Route 1/14 (ITC)	F	127.0	F	294.6	F	176.8	F	315.8
Route 1/30	F	348.3	F	406.2	F	148.5	F	253.3
Route 1/8	F	162.2	F	164.3	F	102.7	F	155.5
Route 1/4	C	24.8	D	40.1	C	30.5	F	107.2
Route 1/6 (Adelup)	C	34.9	F	110.7	C	29.7	F	958.7
Route 4/7A	F	274.6	F	1007.5	F	586.7	F	339.2
Route 4/10	F	164.5	E	61.4	F	199.7	E	65.9
Route 4/17	C	34.5	D	39.4	D	39.6	E	55.9
Route 8/33	C	32.6	D	46.2	D	52.9	C	29.1
Route 8/10	F	227.5	F	317.6	F	137.9	F	171.8
Route 10/15	F	175.5	F	139.6	F	197.9	F	147.2
Route 16/27A	F	126.0	F	175.8	D	44.9	F	80.6
Route 16/27	F	534.1	F	685.7	F	455.3	F	470.0
Route 16/10A	F	232.4	F	149.5	F	210.3	F	692.7
Route 26/25**	F	165.5	D	43.1	F	85.4	E	62.3
Route 26/15**	F	3444.5	F	3416.0	C	30.2	C	25.4
Route 28/27A**	D	38.5	E	60.5	D	41.3	E	65.2
Unsignalized***								
Route 7/7A	F	173.9	F	280.0	D	28.3	F	87.7
Military Access Points								
Route 1 - South Andersen Main Gate/(Turner Street)**	—	—	—	—	C	32.4	E	79.5
Route 15 - South Andersen/Second Gate	—	—	—	—	C	22.1	C	21.1
Route 16 - Navy Barrigada/ Residential Gate	—	—	—	—	D	37.1	F	84.5
Route 8A - Navy Barrigada/(Residential Gate) (on base)	—	—	—	—	NA	NA	NA	NA
Route 15 - Barrigada Air Force/(Chada Street)**	—	—	—	—	E	64.4	C	25.9

Legend: ITC = International Trade Center; LOS = Level of Service; NA=Not Applicable.
Notes: *Signalized intersection LOS based on average delay for the overall intersection.
**Intersection is proposed to be signalized in future build conditions.
***Unsignalized intersection LOS based on approach delay on STOP-controlled approach.
****Delay exceeded maximum calculated value.

Table 4.2-16. Alternative 3 Future ADT and Volume to Capacity Ratio Summary – Apra Harbor Region

	2014		*2030*	
Roadway	*ADT Summary*	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 1	Route 1 ranges from 23,000 to 47,000 vpd. The traffic decreases into the entrance into Naval Base Guam, which is at the Route 1/2A intersection.	Route 1 has a v/c ratio less than 1.00. This roadway is not considered congested.	Route 1 ranges from 24,000 to 56,000 vpd. The traffic decreases into the entrance into Naval Base Guam, which is at the Route 1/2A intersection.	Route 1 has a v/c ratio less than 1.00. This roadway is not considered congested.
Route 2A	Route 2A has 36,000 vpd.	The v/c ratio is 0.00-0.90 during peak hours, indicating the roadway is not considered congested.	Route 2A has 36,000 vpd.	The v/c ratio is 0.00-0.90 during peak hours, indicating the roadway is not considered congested.
Route 11	Route 11 has 14,000 vpd.	The v/c ratio is 0.00-0.90 during peak hours, indicating the roadway is not considered congested.	Route 11 has 8,800 vpd.	The v/c ratio is 0.00-0.90 during peak hours, indicating the roadway is not considered congested.

Legend: ADT = average daily traffic; v/c = volume to capacity; vpd = vehicles per day.

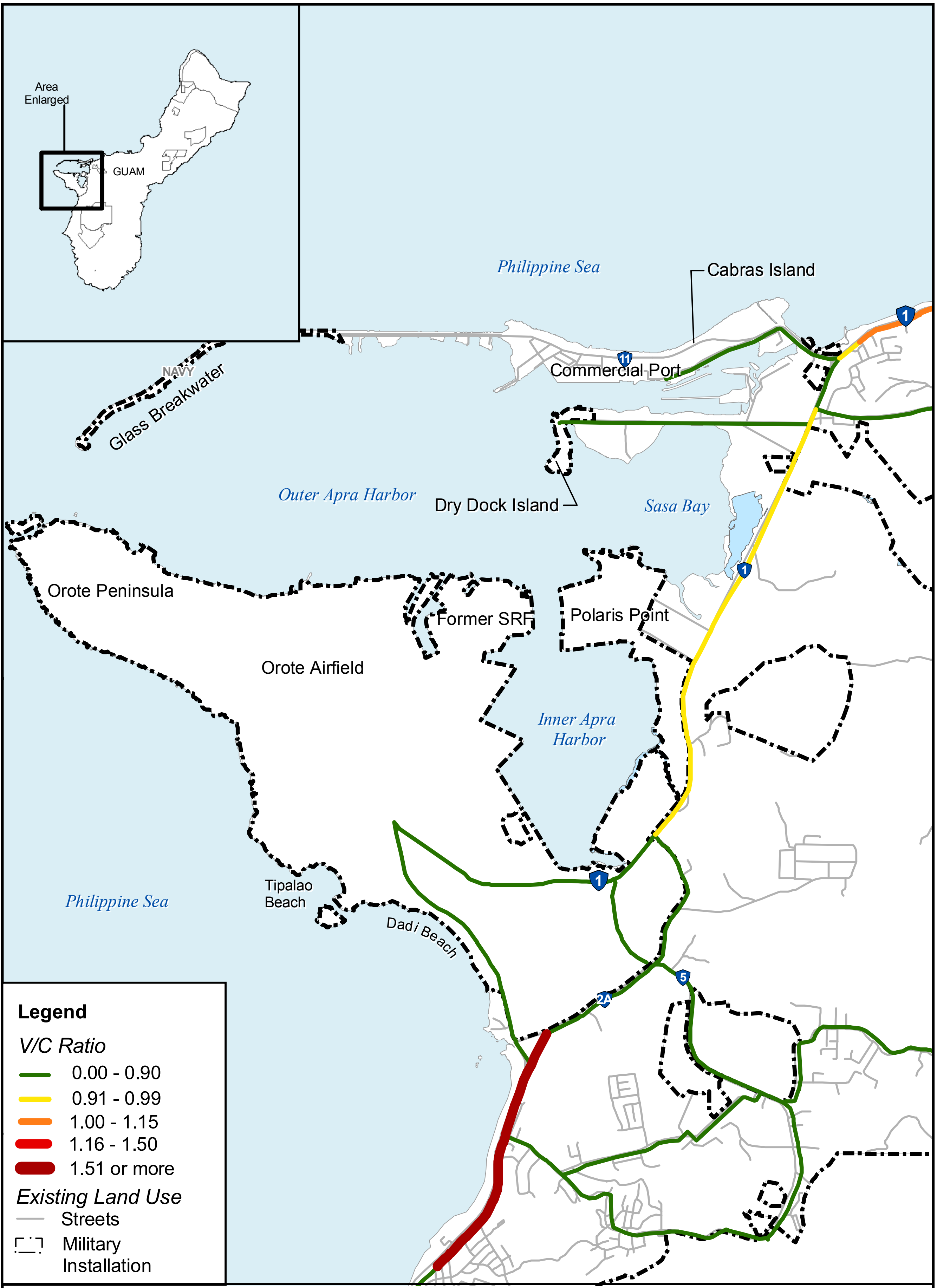
Figure 4.2-39 through Figure 4.2-42 show future levels of traffic congestion in the Apra Harbor Region for the a.m. and p.m. peak hours for 2014 and 2030, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested. As shown in Table 4.2-17, Route 1/2A is operating at LOS F in the a.m. peak hour for 2014, which is considered unacceptable.

Table 4.2-17. Alternative 3 Future Level of Service and Delay Results – Apra Harbor Region

	2014				*2030*			
	a.m. Peak Hour		*p.m. Peak Hour*		*a.m. Peak Hour*		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*								
Route 1/11	C	25.4	E	63.1	B	18.4	D	40.1
Route 1/Polaris Point	A	3.2	A	2.4	A	5.8	A	7.4
Route 1/6 (west)	D	50.7	B	17.1	C	27.4	C	23.0
Route 1/2A	F	89.7	E	58.3	E	67.5	D	54.1
Route 5/2A	E	69.4	C	21.5	E	55.1	C	22.8

Legend: LOS = Level of Service.
Note: *Signalized intersection LOS based on average delay for the overall intersection.

Public Transportation Impacts. Impacts to the public transportation system in the Apra Harbor Region should be minimal and would relate to the delays caused by increased levels of congestion on Route 5 or at intersections near DoD lands. This would possibly affect the fixed-route service along Route 1, as well as any demand response and paratransit services. Implementation of new transit services should take into consideration the impacts of the military relocation.



Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4192_MXDs\Figure 4.2-39. Apra Harbor Region - 2014 a.m. Peak Congestion Levels- Alternative 3.mxd

Figure 4.2-39

Apra Harbor Region – 2014 a.m. Peak Congestion Levels – Alternative 3

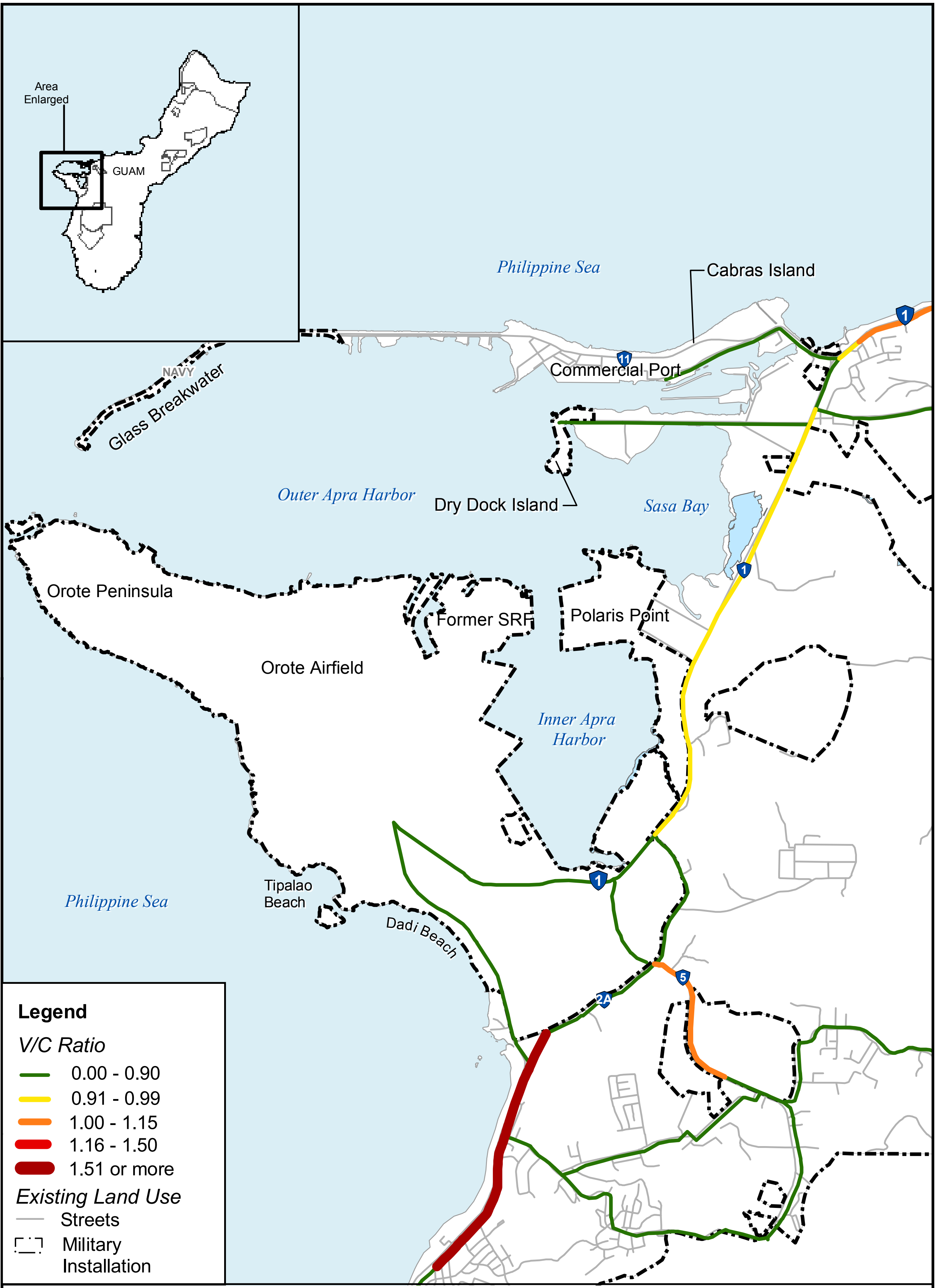


Figure 4.2-40
Apra Harbor Region – 2014 p.m. Peak Congestion Levels – Alternative 3

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4192_MXDs\Figure 4.2-41. Apra Harbor Region - 2014 p.m. Peak Congestion Levels- Alternative 3.mxd

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4192_MXDs\Figure 4.2-42. Apra Harbor Region - 2030 a.m. Peak Congestion Levels- Alternative 3.mxd

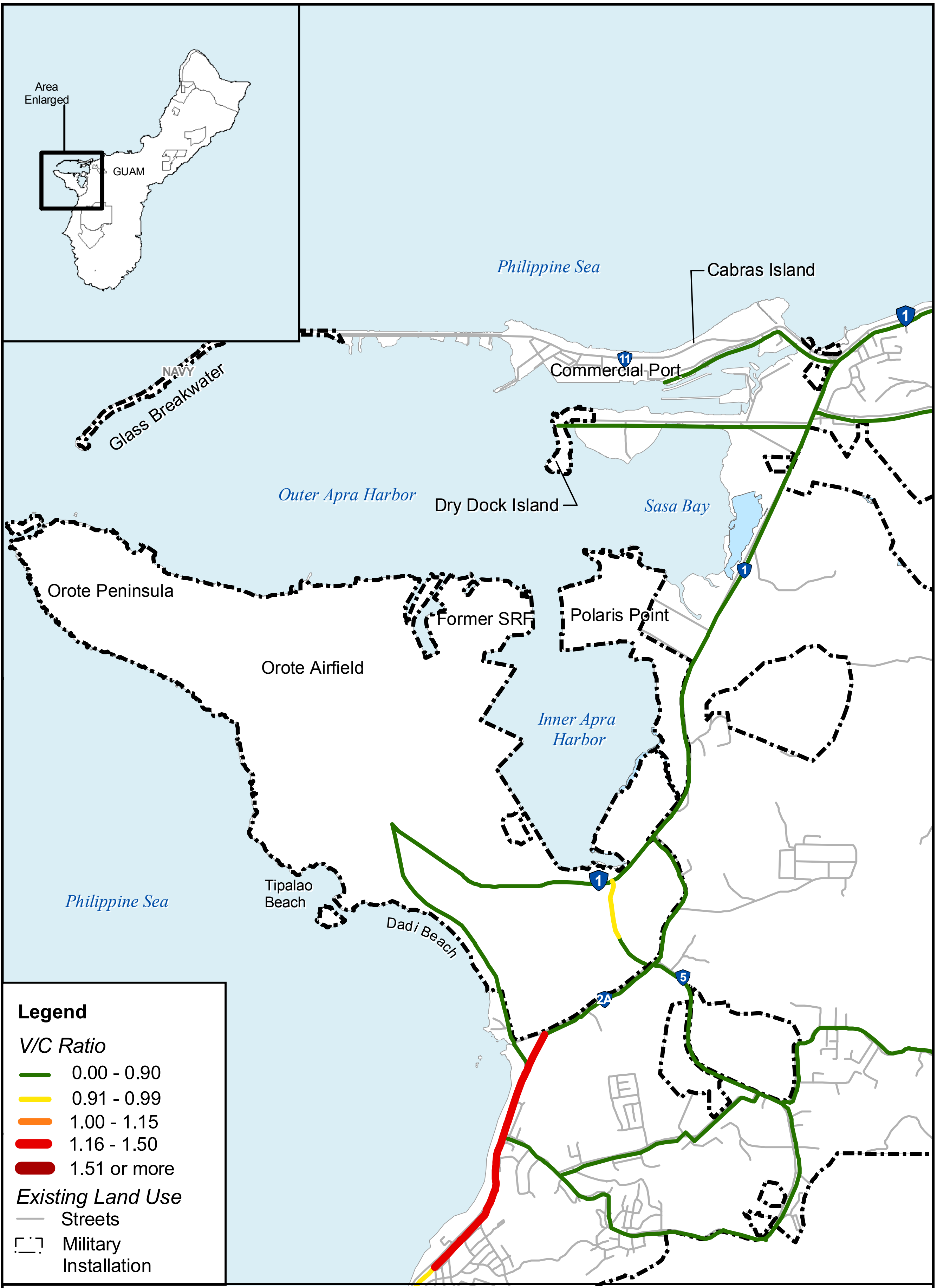


Figure 4.2-41
Apra Harbor Region – 2030 a.m. Peak Congestion Levels – Alternative 3

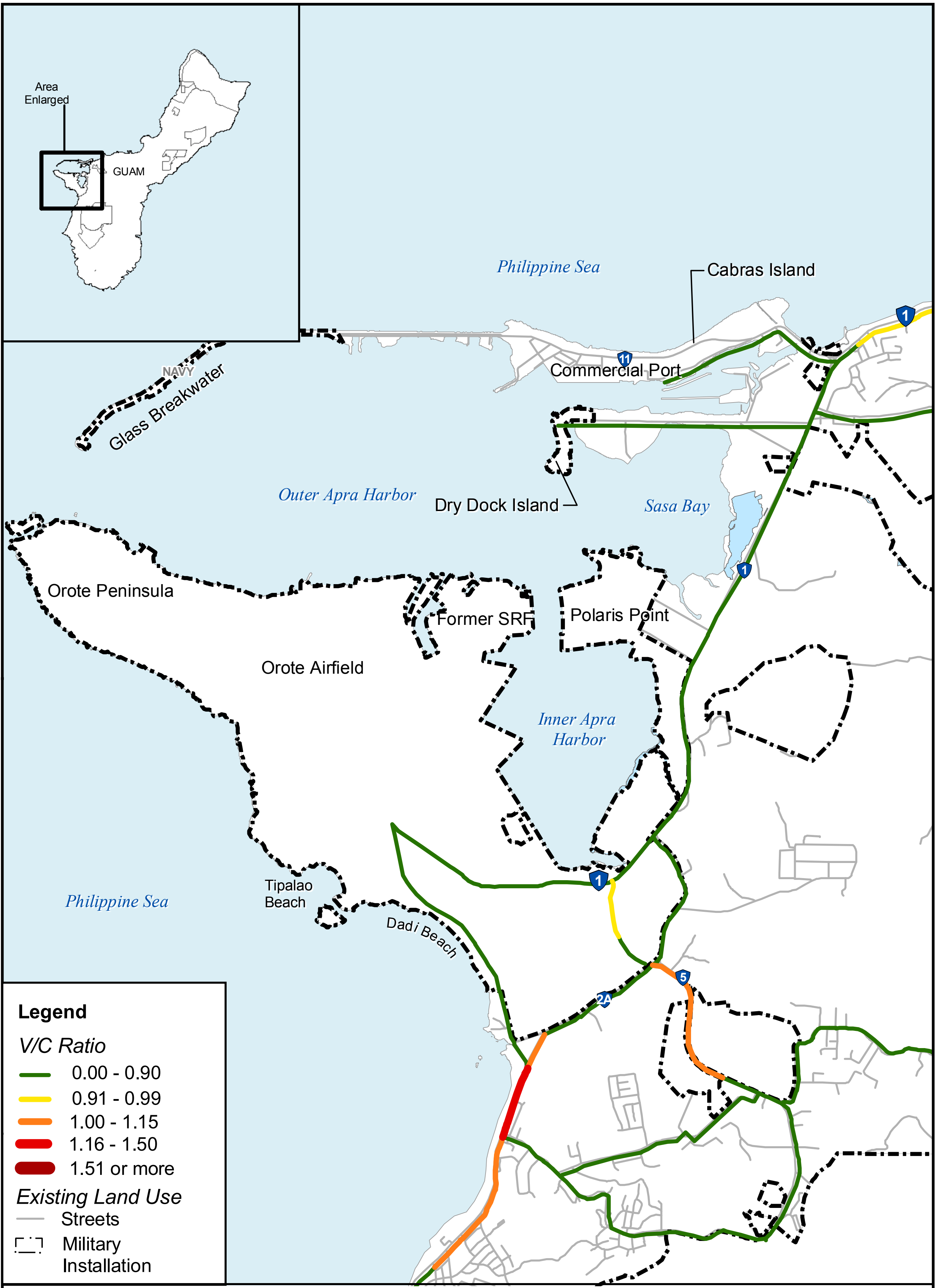


Figure 4.2-42

Apra Harbor Region – 2030 p.m. Peak Congestion Levels – Alternative 3

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4192_MXDs\Figure 4.2-42. Apra Harbor Region - 2030 p.m. Peak Congestion Levels- Alternative 3.mxd

Pedestrian and Bicycle Impacts. There are no impacts to the pedestrian and bicycle facilities in the Apra Harbor Region. Along Route 1, future traffic volumes and congestion should not negatively affect the experience or safety of the pedestrian and cyclist using the shoulder as a running or biking lane. Any future planning for pedestrian and bicycle facilities needs to consider the impacts of the military relocation.

South

On Base Roadways:

Naval Munitions Site

Construction. The impacts for Alternative 3 are the same as Alternative 1.

Operation. The impacts for Alternative 3 are the same as Alternative 1.

Off Base Roadways:

Future Traffic Impacts. A summary of future ADT volumes and the v/c ratio for 2014 and 2030 for Alternative 3 can be found in Table 4.2-18. Generally, there is a substantial increase in volumes on roadways from 2008 to 2014, and then a modest decrease in volumes on roadways from 2014 to 2030. See Table 4.1-20 for the 2008 volume summary. This can be attributed to the increase in construction traffic and coinciding military expansion during peak construction time, which is in 2014, and then a reduction in traffic once off-island construction workers leave the island.

Table 4.2-18. Alternative 3 Future ADT and Volume to Capacity Ratio Summary - South Region

Roadway	*2014*		*2030*	
	ADT Summary	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 5	Route 5 ranges from 9,800 to 17,000 vpd. Traffic decreases as Route 5 approaches the intersection with Route 17.	The v/c ratio is 0.91-0.99 in the a.m. peak and 1.00-1.15 in the p.m. peak. The roadway is congested during the p.m. peak hours.	Route 5 ranges from 11,000 to 17,000 vpd. Traffic decreases as Route 5 approaches the intersection with Route 17.	The v/c ratio is 0.91-0.99 in the a.m. peak and 1.00-1.15 in the p.m. peak. The roadway is congested during the p.m. peak hours.
Route 12	Route 12 ranges from 1,800 to 5,600 vpd. The traffic increases toward the intersection with Route 2.	The v/c ratio is 0.00-0.90 during both the a.m. and p.m. peak, indicating the roadway is not considered congested.	Route 12 ranges from 2,300 to 6,100 vpd. The traffic increases toward the intersection with Route 2.	The v/c ratio is 0.00-0.90 during both the a.m. and p.m. peak, indicating the roadway is not considered congested.

Legend: ADT = average daily traffic; v/c = volume to capacity; vpd = vehicles per day.

Figure 4.2-43 through Figure 4.2-46 show future levels of traffic congestion in the South Region for the a.m. and p.m. peak hours for 2014 and 2030, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested. Although there are numerous intersections with capacity issues, there are currently few roadways included in this study with an existing high v/c ratio.

The roads in the South Region do not exhibit high levels of congestion. During both the afternoon peaks, Route 5 between Naval Base Guam and the NMS has an LOS F.

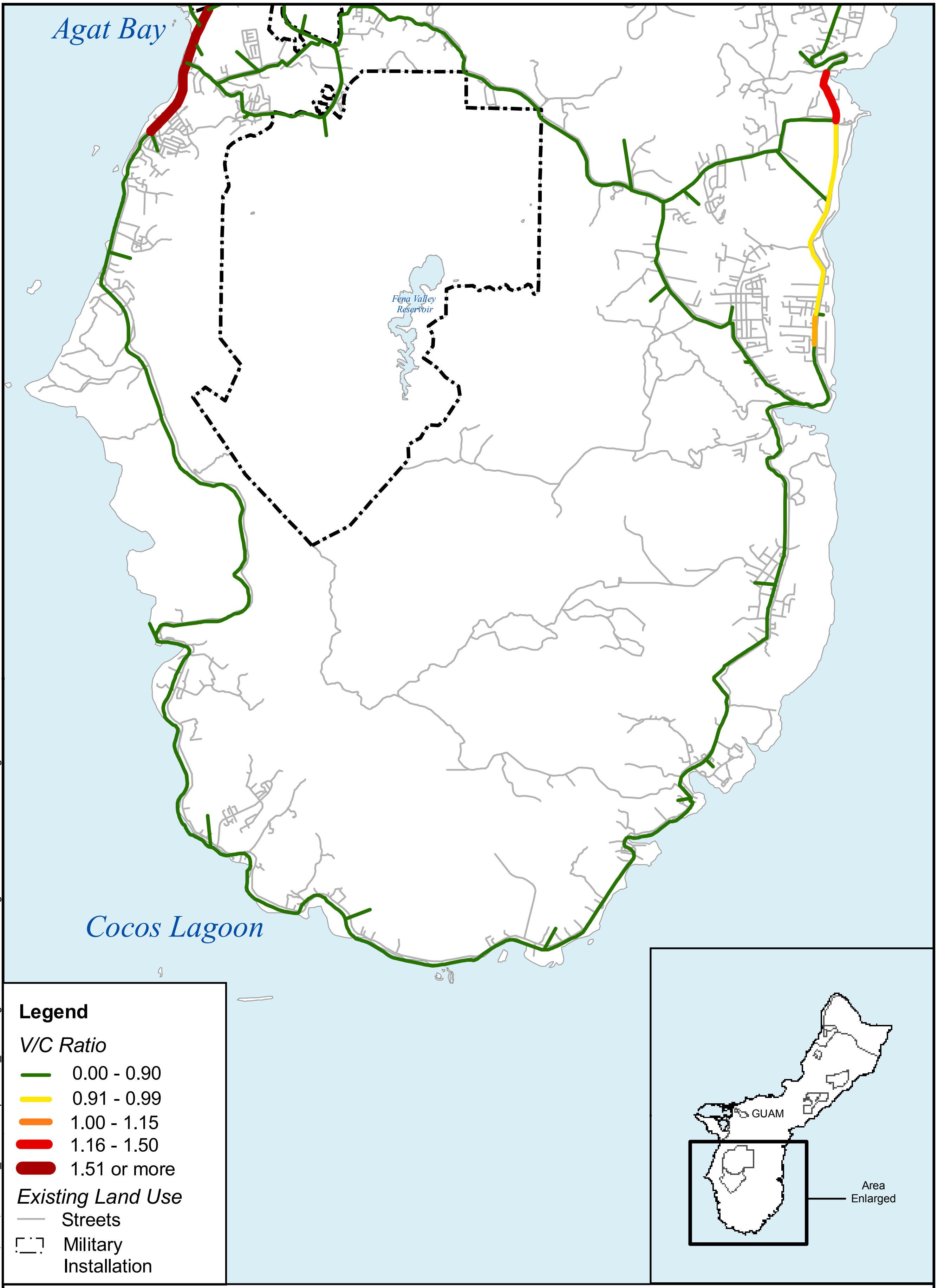


Figure 4.2-43
South Region – 2014 a.m. Peak Congestion Levels – Alternative 3

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-43. South Region - 2014 a.m. Peak Congestion Levels- Alternative 3.mxd

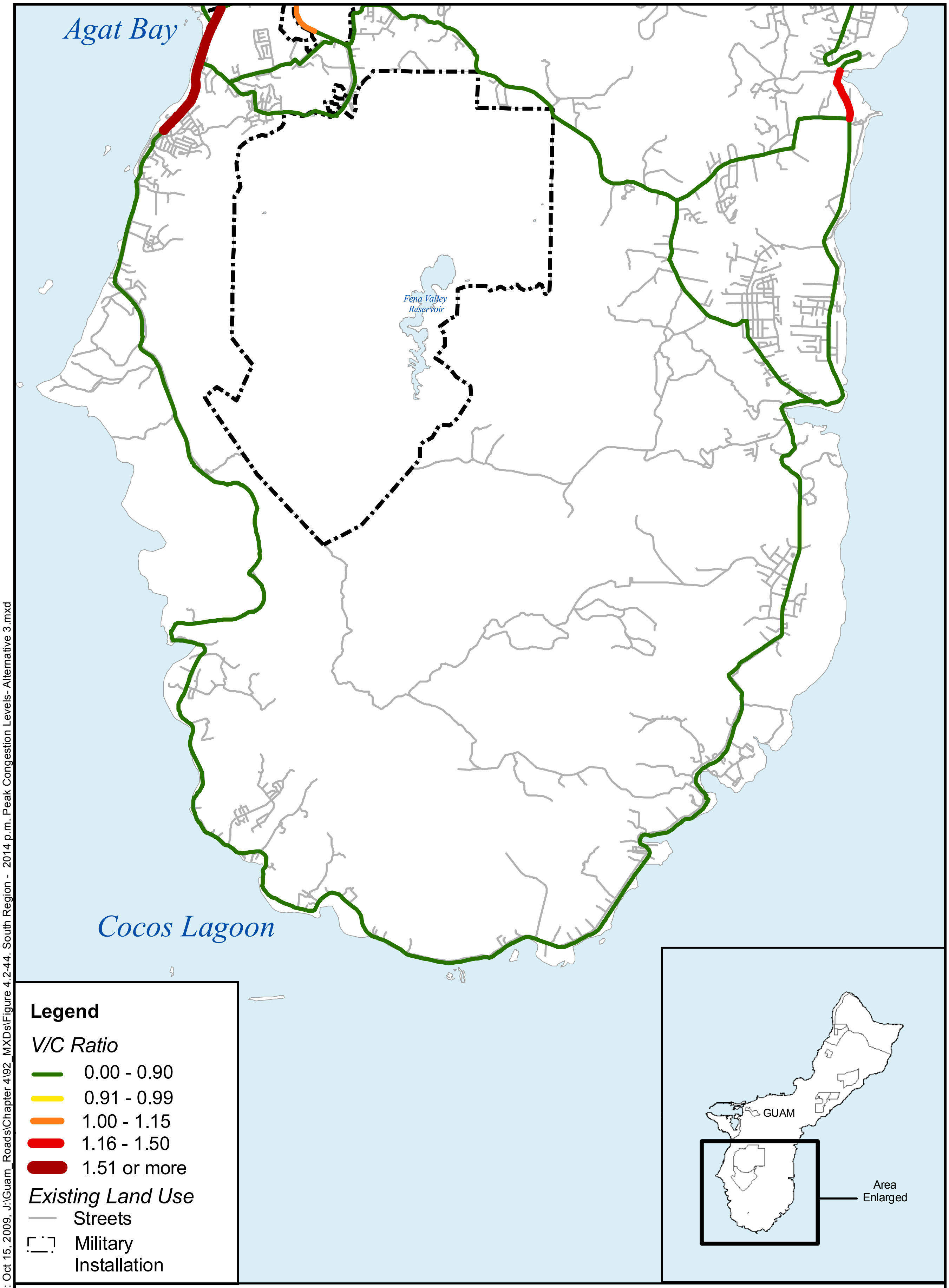


Figure 4.2-44
South Region – 2014 p.m. Peak Congestion Levels – Alternative 3

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-44. South Region - 2014 p.m. Peak Congestion Levels- Alternative 3.mxd

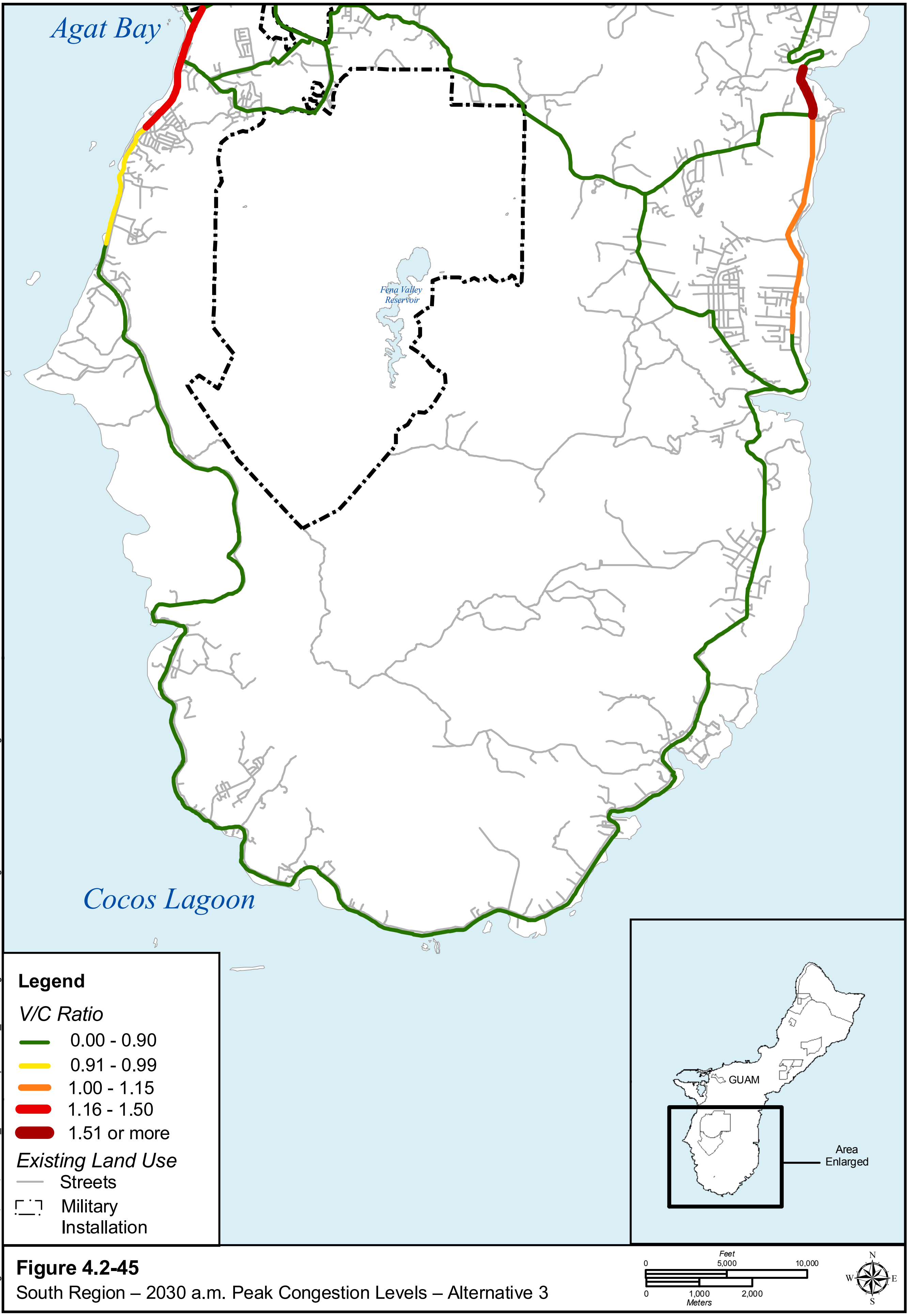


Figure 4.2-45
South Region – 2030 a.m. Peak Congestion Levels – Alternative 3

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-45, South Region - 2030 a.m. Peak Congestion Levels- Alternative 3.mxd

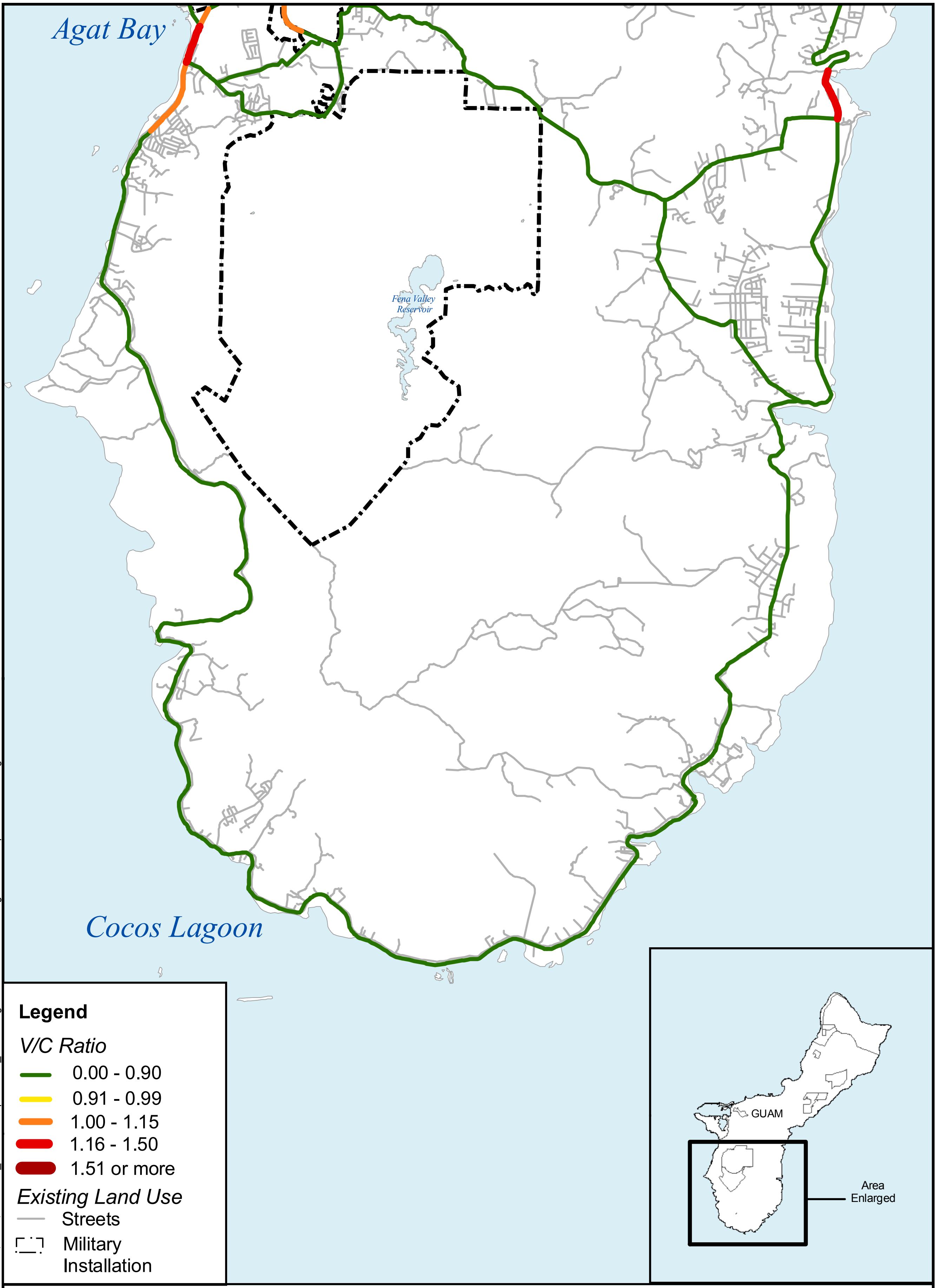


Figure 4.2-46
South Region – 2030 p.m. Peak Congestion Levels – Alternative 3

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-46. South Region - 2030 p.m. Peak Congestion Levels- Alternative 3.mxd

As shown in Table 4.2-19, the Route 5/17 intersection has LOS F for the p.m. peak hour in 2030, which is considered unacceptable. Route 4/4A and Route 5/17 have fairly free-flowing conditions in 2014 and become significantly more congested in 2030.

Table 4.2-19. Alternative 3 Future Level of Service and Delay Results – South Region

	2014				*2030*			
	a.m. Peak Hour		*p.m. Peak Hour*		*a.m. Peak Hour*		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*								
Route 2/12	C	29.0	C	25.5	C	30.6	C	24.9
Unsignalized**								
Route 5/17	B	13.3	C	18.3	E	42.5	F	128.5
Route 4/4A	C	21.7	B	17.0	E	44.3	C	21.9
Route 17/4A	B	13.2	B	14.0	C	16.5	C	18.5
Military Access Points								
Route 5 - Naval Munitions Site/Harmon Road**	—	—	—	—	A	9.5	A	10.6

Legend: LOS = Level of Service.

Notes: *Signalized intersection LOS based on average delay for the overall intersection.

**Unsignalized intersection LOS based on approach delay on STOP-controlled approach.

Public Transportation Impacts. Impacts to the demand response and paratransit that service the South Region are minimal. Implementation of new transit services should take into consideration the impacts of the military relocation.

Pedestrian and Bicycle Impacts. There are no impacts to pedestrian and bicycle facilities in the South Region. Any future planning for pedestrian and bicycle facilities needs to consider the impacts of the military relocation.

Proposed Mitigation Measures

On Base Roadways:

The proposed mitigation measures would be the same as for Alternative 1.

Off Base Roadways:

The proposed mitigation measures would be the same as for Alternative 1.

4.2.2.4 Alternative 8

North

On Base Roadways:

Andersen AFB

Construction. The impacts for Alternative 8 are the same as Alternative 1.

Operation. The impacts for Alternative 8 are the same as Alternative 1.

Finegayan

Construction. In this Alternative, the Former FAA parcel is utilized but Harmon Annex is not used. Additional housing is constructed at Air Force Barrigada. The alternative has very similar construction in Finegayan as explained in Alternative 2.

The impacts for Alternative 8 are the same as Alternative 1

Operation. The impacts for Alternative 8 are the same as Alternative 1

Off Base Roadways:

Future Traffic Impacts. A summary of future ADT volumes and the v/c ratio for 2014 and 2030 for Alternative 8 can be found in Table 4.2-20. Generally, there is a substantial increase in volumes on roadways from 2008 to 2014, and then a modest decrease in volumes on roadways from 2014 to 2030. See Table 4.1-3 for the 2008 volume summary. This can be attributed to the increase in construction traffic and coinciding military expansion during peak construction time, which is in 2014, and then a reduction in traffic once off-island construction workers leave the island. Overall, traffic is comparable to Alternative 1.

Figure 4.2-47 through Figure 4.2-50 show future levels of traffic congestion in the North Region for the a.m. and p.m. peak hours, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested.

The road indirectly serving the DoD lands is the most congested. During both the morning and afternoon peaks, the road with the greatest congestion levels in the North Region is Route 28 with LOS F.

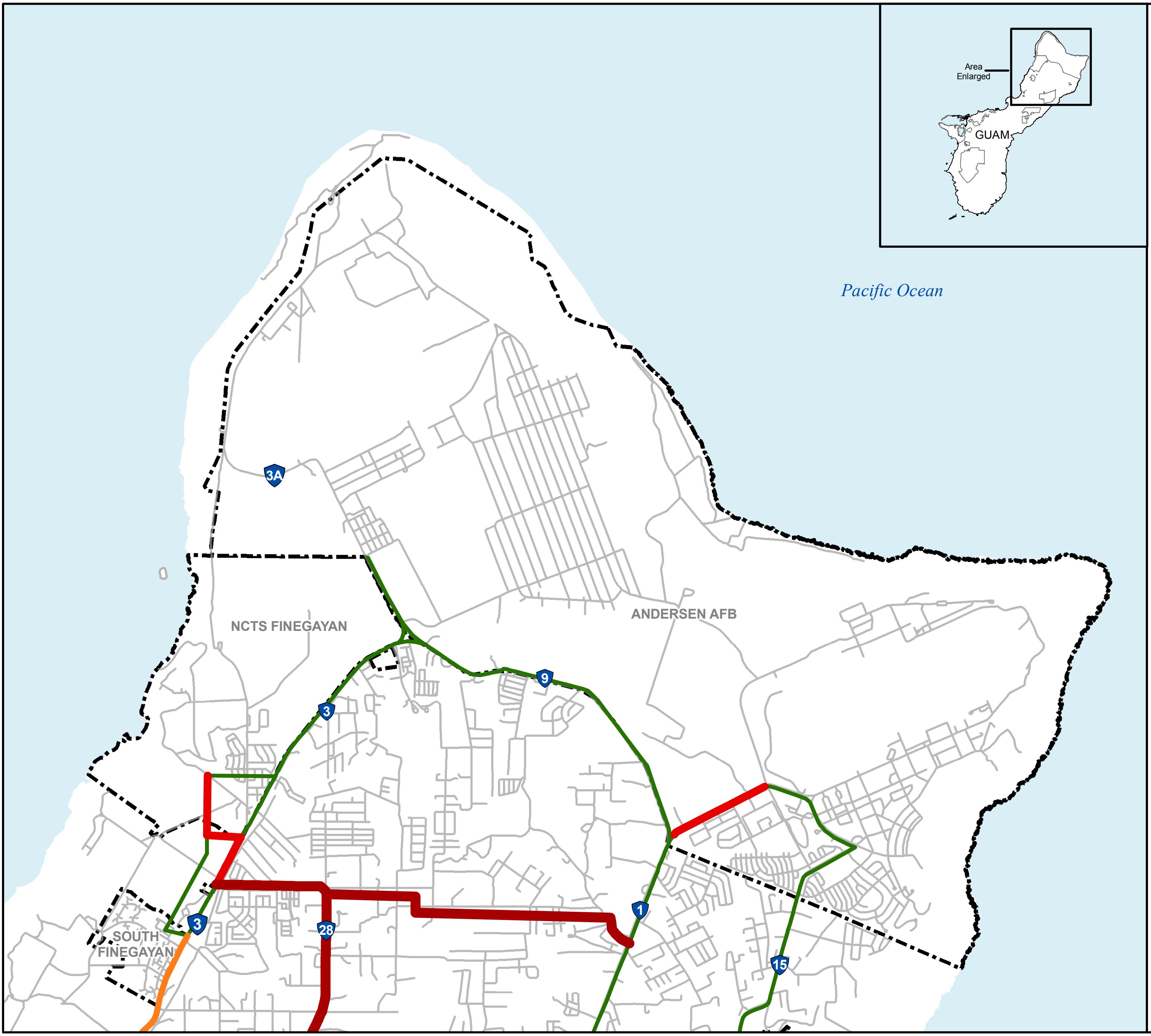


Figure 4.2-47
North Region–
2014 a.m. Peak
Congestion Levels –
Alternative 8

Printing Date: April 1, 2010

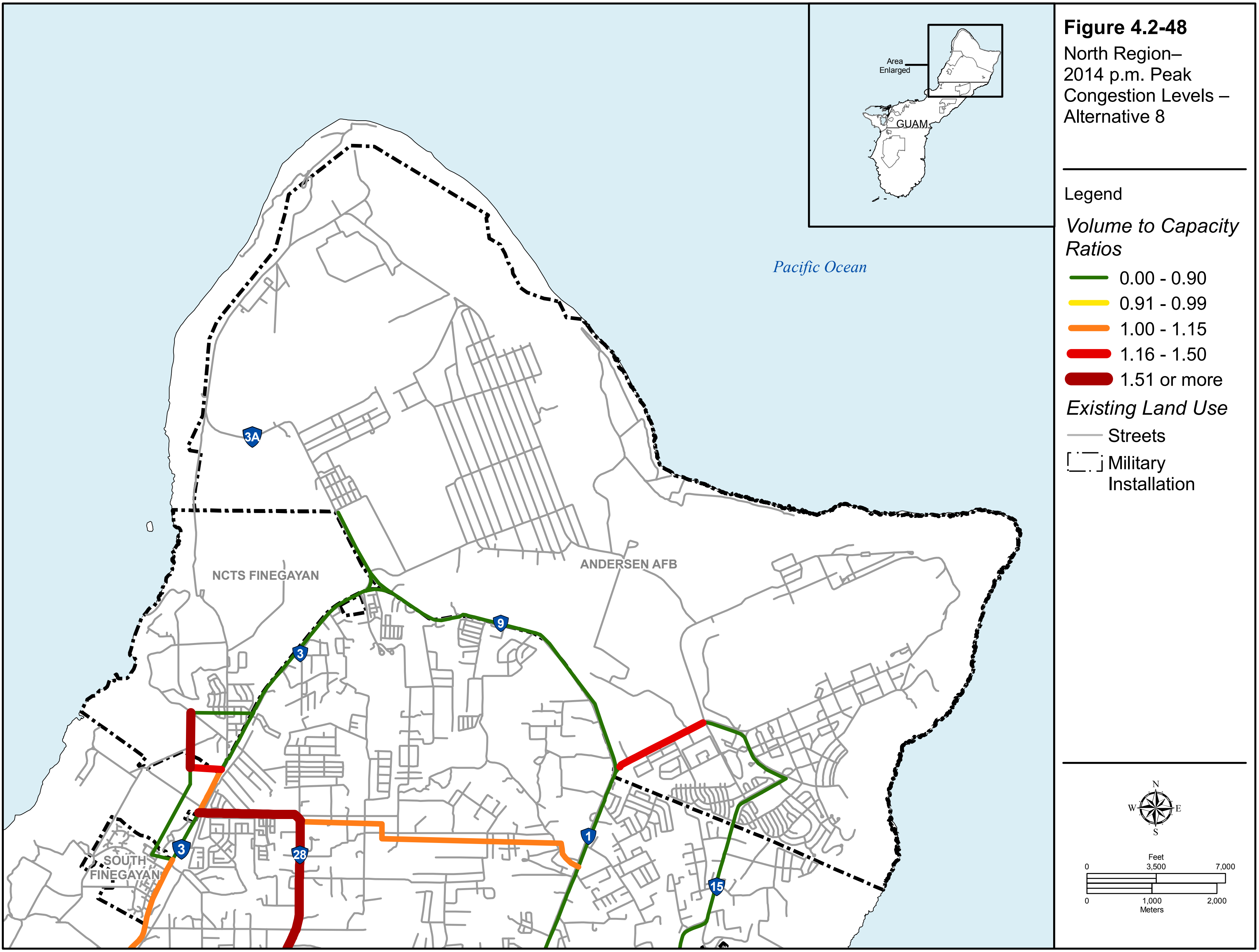


Figure 4.2-48
North Region–
2014 p.m. Peak
Congestion Levels –
Alternative 8

Printing Date: April 1, 2010

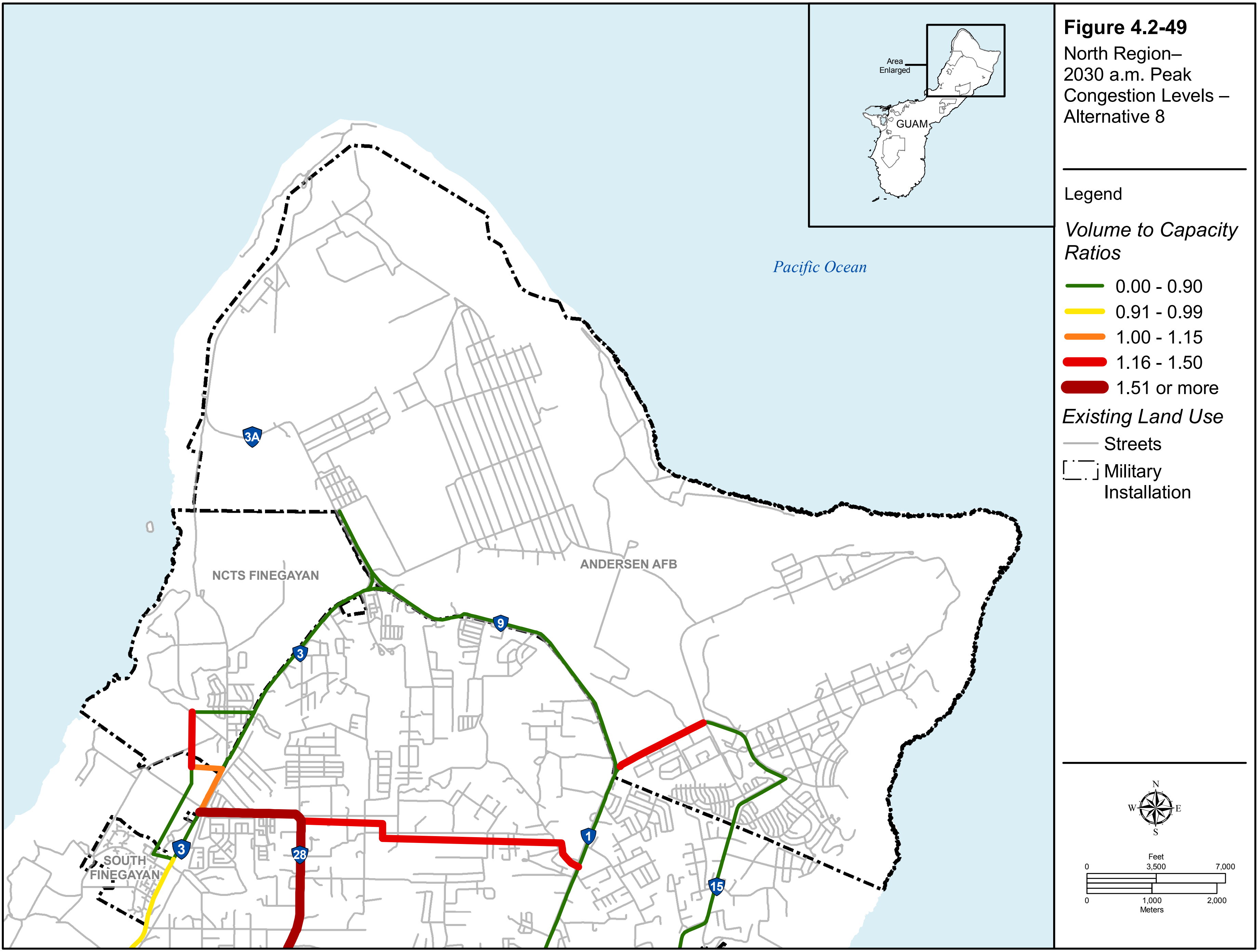


Figure 4.2-49

North Region–
2030 a.m. Peak
Congestion Levels –
Alternative 8

Printing Date: April 1, 2010

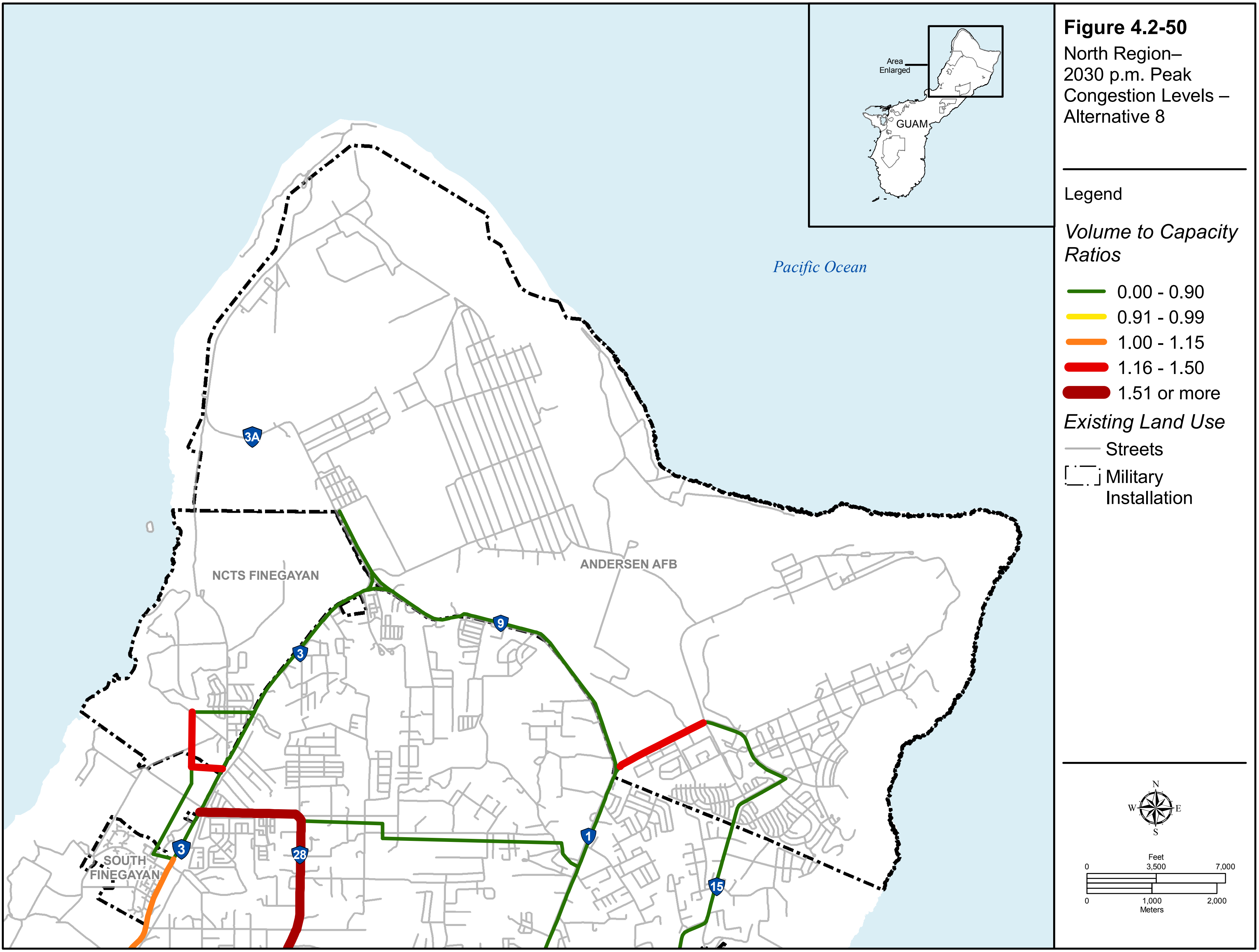


Figure 4.2-50
North Region–
2030 p.m. Peak
Congestion Levels –
Alternative 8

Printing Date: April 1, 2010

Table 4.2-20. Alternative 8 Future ADT and Volume to Capacity Ratio Summary – North Region

	2014		*2030*	
Roadway	*ADT Summary*	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 1	Route 1 ranges from 27,000 to 48,000 vpd. Traffic decreases as Route 1 approaches Andersen AFB.	The v/c ratio is 0.00-0.90 during the a.m. and p.m. peak hours, indicating the roadway is not considered congested.	Route 1 ranges from 20,000 to 40,000 vpd. Traffic decreases as Route 1 approaches Andersen AFB.	The v/c ratio is 0.00-0.90 during the a.m. and p.m. peak hours, indicating the roadway is not considered congested.
Route 3	Route 3 ranges from 22,000 to 69,000 vpd. Traffic decreases north of the intersection with Route 28.	During the a.m. and p.m. peak, Route 3 south of the Residential Gate has a v/c ratio greater than 1. North of the Residential Gate, the v/c ratio is less than 1. The roadway is congested south of the military installation.	Route 3 ranges from 19,000 to 53,000 vpd. Traffic decreases north of the intersection with Route 28.	During peak hours, Route 3 has a v/c ratio of less than 1 and is not considered to be congested, with the exception of a small portion north of the intersection with Route 28.
Route 9	Route 9 ranges from 12,000 to 19,000 vpd. There is a decrease in traffic east of the two residential developments on Route 9.	The v/c ratio is 0.00-0.90 during the a.m. and p.m. peak hours, indicating the roadway is not considered congested.	Route 9 ranges from 10,000 to 16,000 vpd. There is a decrease in traffic east of the two residential developments on Route 9.	The v/c ratio is 0.00-0.90 during the a.m. and p.m. peak hours, indicating the roadway is not considered congested.
Route 15	Route 15 has 6,000 vpd in the North.	The v/c ratio is 0.00-0.90 during the a.m. and p.m. peak hours, indicating the roadway is not considered congested.	Route 15 has 7,500 vpd in the North.	The v/c ratio is 0.00-0.90 during the a.m. and p.m. peak hours, indicating the roadway is not considered congested.
Route 28	Route 28 ranges from 22,000 to 26,000 vpd. Traffic increases closer to the intersection with Route 1.	The v/c ratio is greater than 1.51 in the a.m. and p.m. peak hours. The roadway is considered congested.	Route 28 ranges from 16,000 to 21,000 vpd. Traffic increases closer to the intersection with Route 1.	The v/c ratio is greater than 1.51 in the a.m. and p.m. peak hours. The roadway is considered congested.

Legend: ADT = average daily traffic; AFB = Air Force Base; v/c = volume to capacity; vpd = vehicles per day.

The results of the future operational analysis are shown in Table 4.2-21 for both the 2014 a.m. and p.m. and 2030 a.m. and p.m. conditions.

For the North Region, there are three intersections for which the traffic is worse in 2014 than in 2030 in both the a.m. and p.m. peak hour. This can be attributed to an increase in construction equipment and personnel in addition to the first military deployment that would occur in 2010.

As shown in Table 4.2-21, there are three intersections and two access points with LOS F for at least one peak hour, which is considered unacceptable. None of the intersections are operating at LOS F in the a.m. and p.m. peak hours in both 2014 and 2030.

Table 4.2-21. Alternative 8 Future Level of Service and Delay Results – North Region

	2014				*2030*			
	a.m. Peak Hour		*p.m. Peak Hour*		*a.m. Peak Hour*		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*								
Route 1/9	C	25.8	D	38.2	C	23.3	D	53.0
Route 1/29	F	338.4	F	192.3	E	73.2	E	57.7
Route 3/28	E	57.3	F	131.1	C	33.2	D	47.5
Route 15/29**	C	22.9	C	24.1	C	32.9	C	30.0
Unsignalized* **								
Route 3/3A/9	F	176.0	F	561.5	D	27.0	F	140.7
Military Access Points								
Route 3 - Main Cantonment/Commercial Gate	—	—	—	—	B	18.4	C	30.4
Route 3 - Main Cantonment/Main Gate	—	—	—	—	D	41.0	E	56.7
Route 3 - South Finegayan/Residential Gate	—	—	—	—	C	31.1	B	19.0
Route 9 – Andersen AFB/ Andersen AFB North Gate****	—	—	—	—	F	1031.0	F	NA

Notes: *Signalized intersection LOS based on average delay for the overall intersection.
**Intersection is proposed to be signalized in future build conditions.
***Unsignalized intersection LOS based on approach delay on STOP-controlled approach.
****Delay exceeded maximum calculated value.
Legend: AFB = Air Force Base; LOS = Level of Service; NA = Not Applicable.

Public Transportation Impacts. Impacts would be similar to those of Alternative 1.

Pedestrian and Bicycle Impacts. Impacts would be similar to those of Alternative 1.

Central

On Base Roadways:

Andersen South

Construction. The impacts for Alternative 8 are the same as Alternative 1.

Operation. The impacts for Alternative 8 are the same as Alternative 1.

Barrigada

Construction. Only Air Force Barrigada is used for constructing off base housing and community support structures. The construction is similar to explained in Alternative 3, except there is no Connector road to the Navy Barrigada base (because Navy Barrigada is not being utilized).

The impacts for Alternative 8 are similar to those of Alternative 3.

Operation. Impacts for Alternative 8 would be similar to those of Alternative 3; however, there would be more impacts to the Air Force Barrigada area near Route 15, due to heavier traffic loading in that area.

Off Base Roadways:

Future Traffic Impacts. A summary of future ADT volumes and the v/c ratio for 2014 and 2030 for Alternative 8 can be found in Table 4.2-22. Generally, there is a substantial increase in volumes on roadways from 2008 to 2014, and then a modest decrease in volumes on roadways from 2014 to 2030. See Table 4.1-8 for the 2008 volume summary. This can be attributed to the increase in construction traffic and coinciding military expansion during peak construction time, which is in 2014, and then a reduction in traffic once off-island construction workers leave the island.

Figure 4.2-51 through Figure 4.2-54 show future levels of traffic congestion in the Central Region for the a.m. and p.m. peak hours, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested. There are a few areas of congestion in the Central Region, primarily on roads that serve the DoD lands to the north and the commercial districts in Tamuning and Hagatna. During the morning and afternoon peaks in both 2014 and 2030, the road with the greatest congestion levels in the Central Region is Route 28 and a portion of Route 26. Segments of Routes 1, 10, 15, 16, 25, and 26 also exhibit failing congestion levels. All have an LOS F in both the a.m. and p.m. peak hours.

For the Central Region, there are 13 intersections for which the traffic is worse in 2014 than in 2030 for both the a.m. and p.m. peak hour. As shown in Table 4.2-23, there are 22 out of 28 intersections with LOS F for at least one peak hour, which is considered unacceptable. The following intersections would operate at LOS F in the a.m. and p.m. peak hours in both 2014 and 2030:

- Route 1/28
- Route 1/26
- Route 1/27
- Route 1/10A
- Route 1/14 (ITC)
- Route 1/30
- Route 4/7A
- Route 8/10
- Route 10/15
- Route 16/27
- Route 16/10A
- Route 7/7A

Table 4.2-22. Alternative 8 Future ADT and Volume to Capacity Ratio Summary – Central Region

	2014		*2030*	
Roadway	*ADT Summary*	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 1	Route 1 ranges from 40,000 to 100,000 vpd. Traffic decreases significantly south of the intersection with Route 4.	The v/c ratio is generally less than 1 in the p.m. condition. In the a.m. condition, there are segments near the intersections with 14A, 30, 28, 16, and Route 6 that have a v/c ratio of more than 1, which indicates the roadway is congested in Tamuning.	Route 1 ranges from 33,000 to 96,000 vpd. Traffic decreases significantly south of the intersection with Route 4.	The v/c ratio is generally less than 1 in both the a.m. and p.m. condition; however, there are segments south of Route 30, near Route 14, and north of 28 that have a v/c ratio of more than 1 in the p.m. peak. The roadway is congested in Tamuning.
Route 3	Route 3 ranges from 57,000 to 71,000 vpd. Traffic increases toward the intersection with Route 1.	The v/c ratio in both the a.m. and p.m. peak is 1.00-1.15. This indicates the roadway is considered congested.	Route 3 ranges from 48,000 to 59,000 vpd. Traffic increases toward the intersection with Route 1.	The v/c ratio is generally between 1.00-1.15, indicating the roadway is considered congested at this location.
Route 8/8A	Route 8 ranges from 52,000 to 67,000 vpd. There is a decrease in traffic west of the intersection with Sunset Boulevard. Route 8A has 5,800 vpd.	During peak hours, the v/c ratio is generally 0.00-0.90 Other than a small section near Tiyan Parkway, the roadway is not considered congested.	Route 8 ranges from 50,000 to 59,000 vpd. There is a decrease in traffic west of the intersection with Sunset Boulevard. Route 8A has 5,700 vpd.	During peak hours, the v/c ratio is generally 0.00-0.90 Other than a small section near Tiyan Parkway, the roadway is not considered congested.
Route 10	Route 10 ranges from 60,000 to 63,000 vpd between Routes 8 and 15.	The v/c ratio in the a.m. and p.m. conditions is greater than 1. The roadway is considered congested.	Route 10 ranges from 58,000 to 60,000 vpd between Routes 8 and 15.	The v/c ratio in the a.m. and p.m. conditions is greater than 1. The roadway is considered congested.
Route 15	Route 15 ranges from 6,600 to 26,000 vpd. There is an increase in traffic south of the intersection with Route 26.	North of Route 26, Route 15 has a v/c ratio of 0.00-0.90 in both a.m. and p.m. conditions. South of Route 26, the v/c ratio is generally greater than 1.00 in the a.m. and less than 1.00 in the p.m. The roadway is congested between Routes 10 26 in the a.m. condition.	Route 15 ranges from 8,200 to 24,000 vpd. There is an increase in traffic south of the intersection with Route 26.	North of Route 26, Route 15 has a v/c ratio of 0.00-0.90 in both a.m. and p.m. conditions. South of Route 26, the v/c ratio is generally greater than 1.00 in the a.m. and less than 1.00 in the p.m. The roadway is congested between Routes 10 26 in the a.m. and p.m. condition.

Roadway	*2014*		*2030*	
	ADT Summary	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 16	Route 16 ranges from 50,000 to 96,000 vpd. There is a decrease in traffic south of the residential developments south of Route 25.	The v/c ratio is generally less than 1.00 in the a.m. and p.m. for the segment of the road south of Route 25. North of Route 25 (and around the intersection), the v/c level is greater than 1.00, indicating the roadway is congested at this location.	Route 16 ranges from 42,000 to 80,000 vpd. There is a decrease in traffic south of the residential developments south of Route 25.	The v/c ratio is less than 1.00 during peak hours, except for south of the intersection with Route 25. The roadway is considered congested at this location.
Route 25	Route 25 ranges from 24,000 to 28,000 vpd.	Route 25 has a v/c ratio greater than 1.00, indicating that the roadway is congested.	Route 25 ranges from 30,000 to 34,000 vpd.	The v/c ratio is generally greater than 1.00 during peak hours, indicating the roadway is congested.
Route 26	Route 26 ranges from 14,000 to 28,000 vpd. There is a decrease in traffic south of the large residential development just north of the intersection with Route 15.	Route 26 generally has a v/c ratio greater than 1.00 during both the a.m. and p.m. peak conditions. The roadway is considered congested.	Route 26 ranges from 17,000 to 36,000 vpd. There is a decrease in traffic south of the large residential development just north of the intersection with Route 15.	The v/c ratio is less than 1.00 north of Route 25 during peak hours. South of Route 25, the v/c ratio is greater than 1.00 in the both a.m. and p.m. peak conditions. The roadway is considered congested at this location.
Route 27	Route 27 ranges from 60,000 to 63,000 vpd between Routes 16 and 1.	The v/c ratio is less than 1.00 during the a.m. and p.m. peak conditions. This roadway is not considered congested.	Route 27 ranges from 49,000 to 52,000 vpd between Routes 16 and 1.	The v/c ratio is 0.00-0.90 during peak conditions, indicating the roadway is not considered congested.
Route 28	Route 28 ranges from 23,000 to 26,000 vpd.	The v/c ratio is greater than 1.50 in both the a.m. and p.m. peak hours, indicating the roadway is considered congested.	Route 28 ranges from 18,000 to 24,000 vpd.	The v/c ratio is greater than 1.50 in both the a.m. and p.m. peak, indicating the roadway is considered congested.
Chalan Lujuna	Chalan Lujuna has 23,000 vpd.	The v/c ratio is 1.00-1.15 during the a.m. and p.m. peak hours, indicating the roadway is considered congested.	Chalan Lujuna ranges from 6,000 to 7,000 vpd.	The v/c ratio is 0.00-0.90 during the a.m. and p.m. peak hours, indicating the roadway is not considered congested.

Legend: ADT = average daily traffic; v/c = volume to capacity; vpd = vehicles per day.

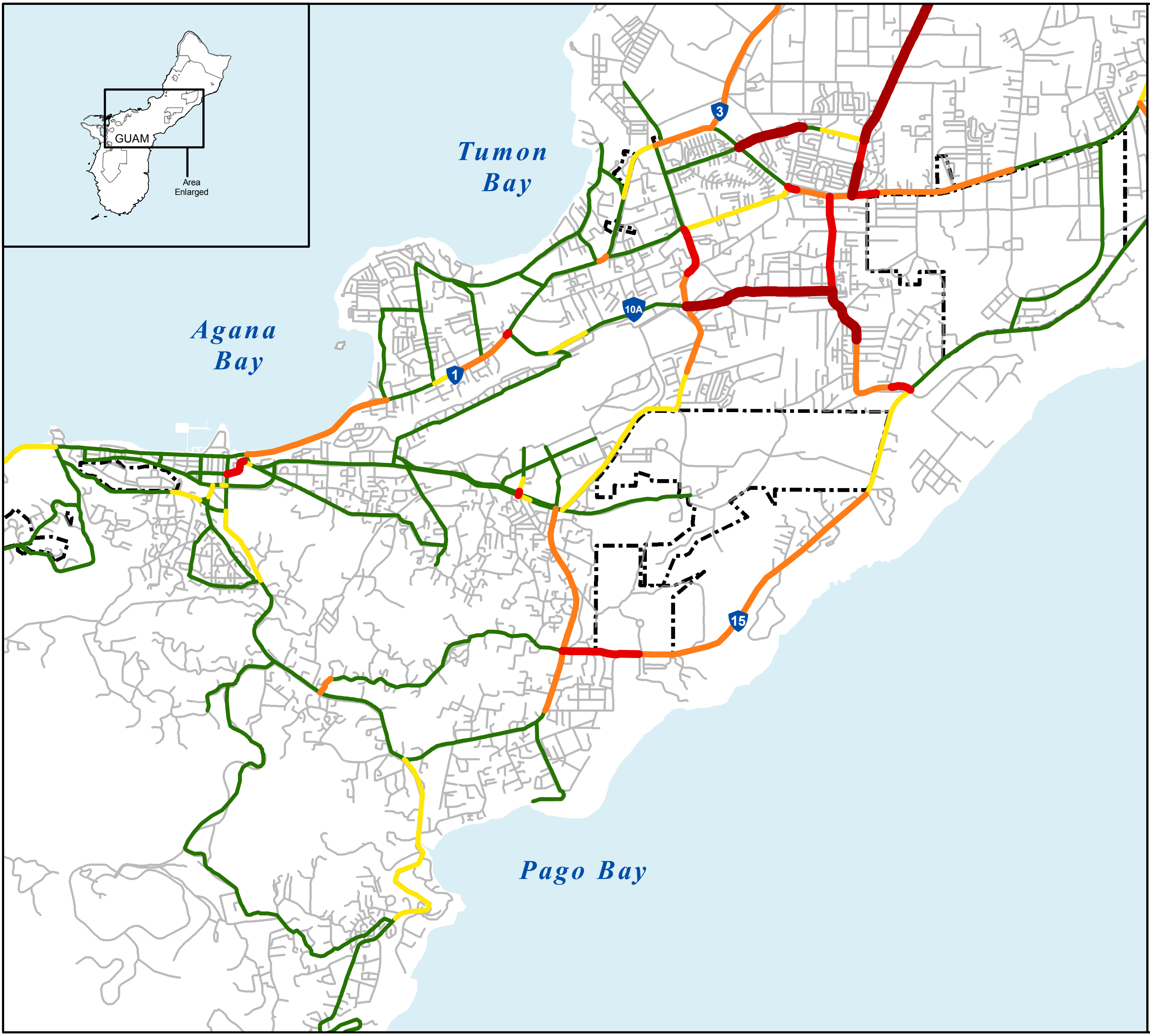


Figure 4.2-51
Central Region–2014 a.m. Peak Congestion Levels – Alternative 8

Legend

Volume to Capacity Ratios

🟩	0.00 - 0.90
🟨	0.91 - 0.99
🟧	1.00 - 1.15
🟥	1.16 - 1.50
🟥	1.51 or more

Existing Land Use

—	Streets
▭	Military Installation

Printing Date: April 1, 2010

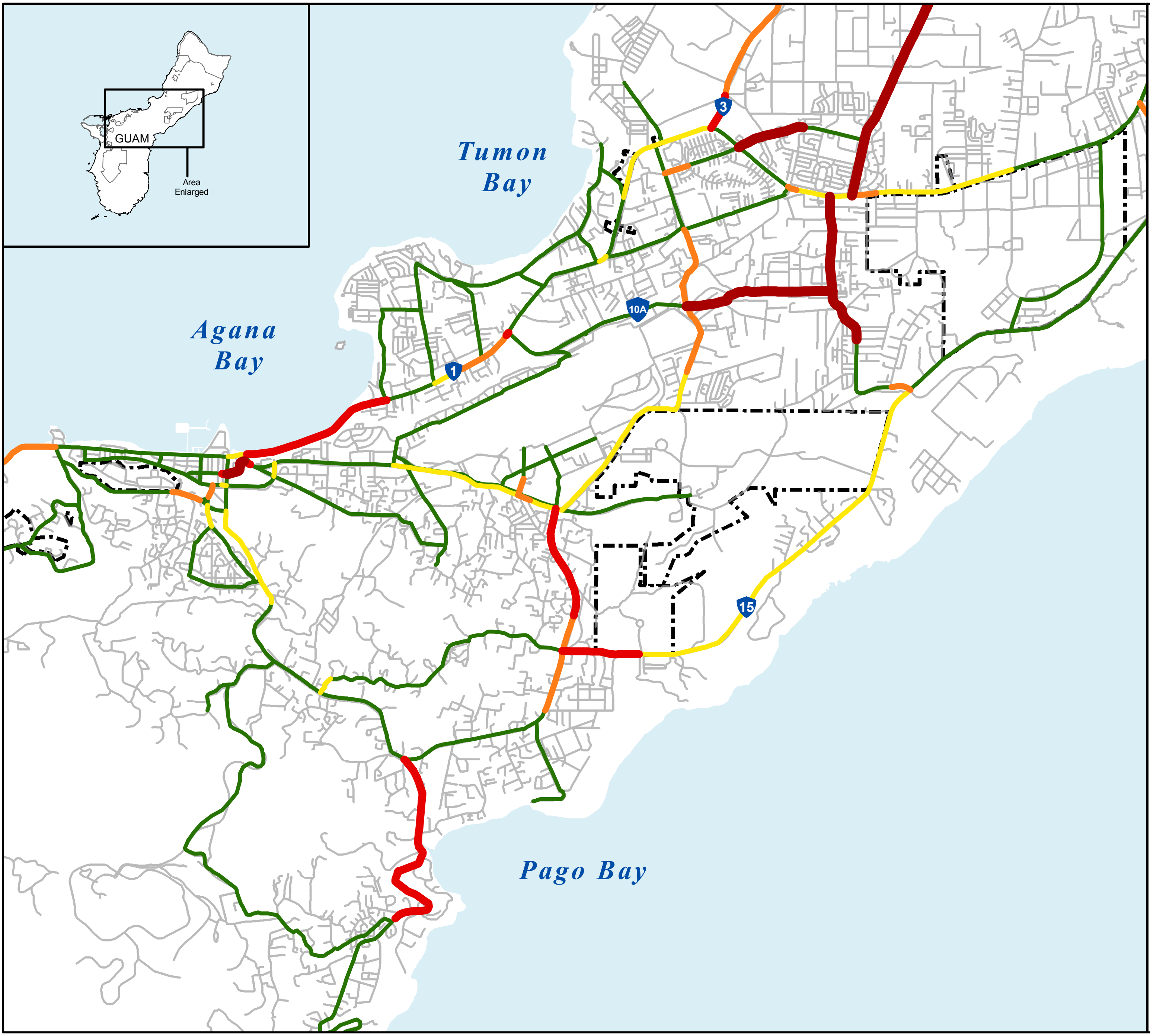


Figure 4.2-52

Central Region–2014 p.m. Peak Congestion Levels – Alternative 8

Printing Date: April 1, 2010

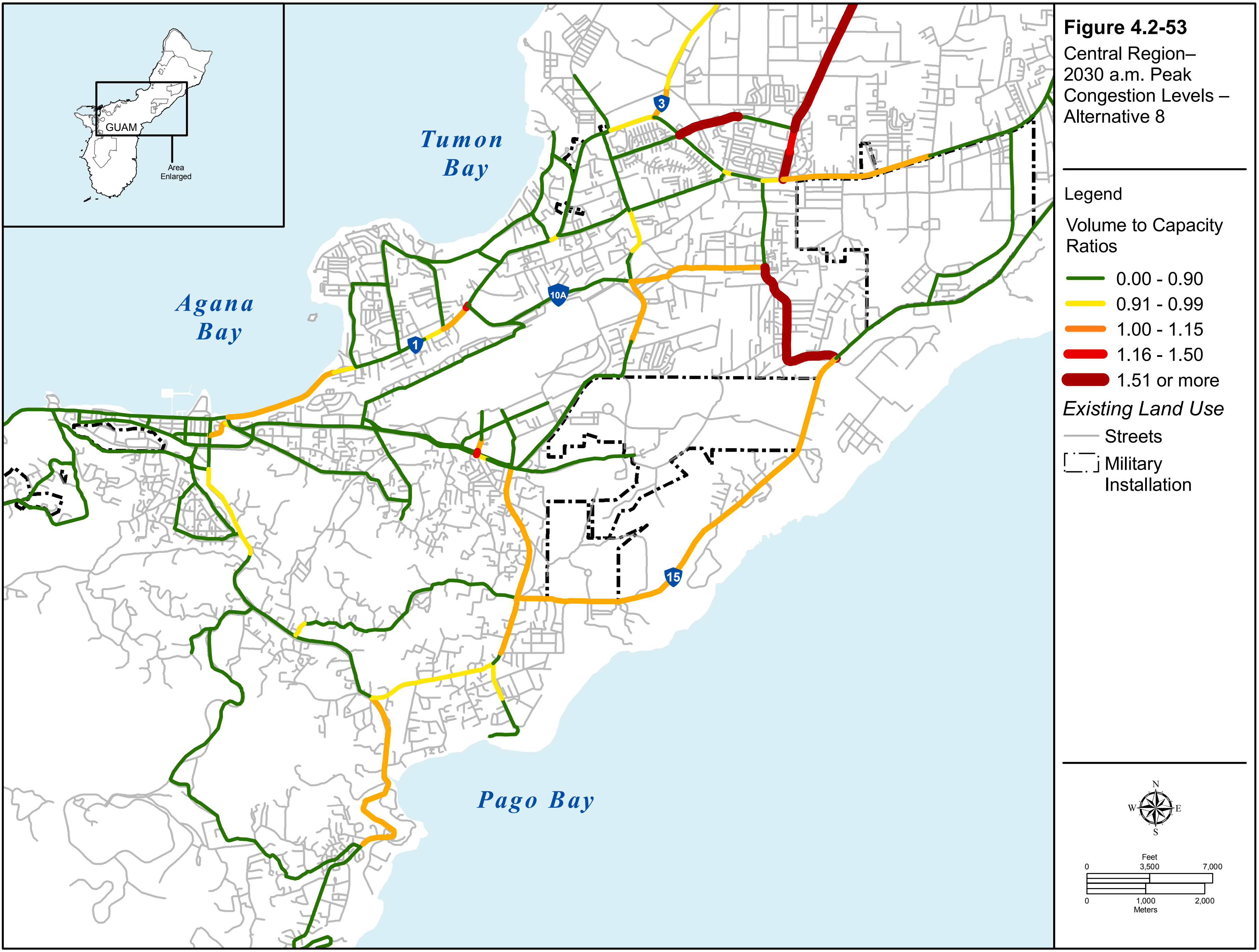
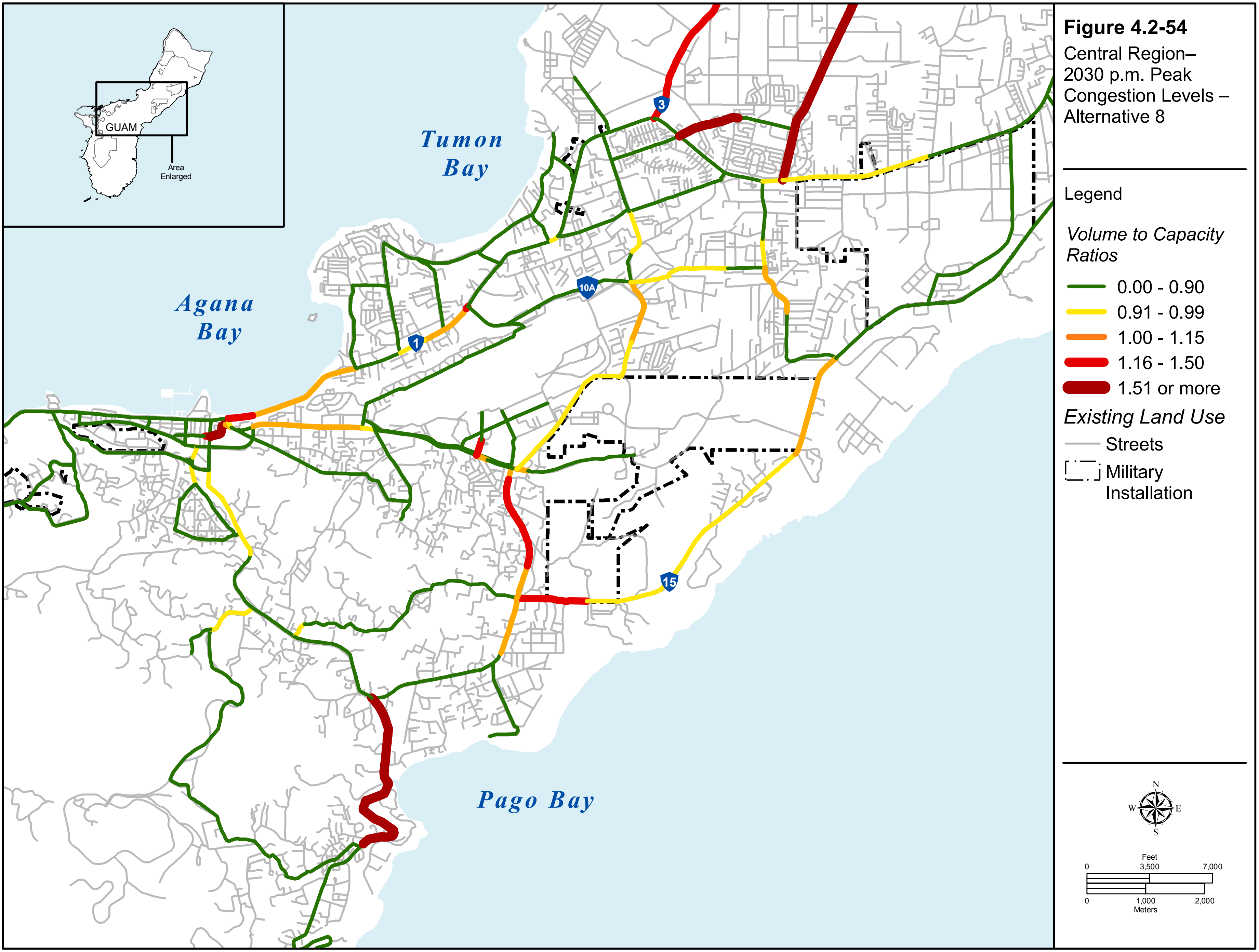


Figure 4.2-53
Central Region–2030 a.m. Peak Congestion Levels – Alternative 8

Printing Date: April 1, 2010

Figure 4.2-54

Central Region–2030 p.m. Peak Congestion Levels – Alternative 8



Printing Date: April 1, 2010

Table 4.2-23. Alternative 8 Future Level of Service and Delay Results – Central Region

	2014				*2030*			
	a.m. Peak Hour		*p.m. Peak Hour*		*a.m. Peak Hour*		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*								
Route 1/28	F	275.4	F	252.3	F	215.5	F	115.3
Route 1/26	F	154.6	F	265.3	F	145.9	F	250.6
Route 1/27	F	210.5	F	627.3	F	178.8	F	329.4
Route 1/27A	F	98.4	F	178.0	D	53.9	D	51.2
Route 1/3	F	113.9	F	106.8	E	70.5	E	64.7
Route 1/16	F	180.3	F	144.6	E	57.0	F	103.9
Route 1/14 (North San Vitores)	F	178.9	F	146.8	E	69.6	E	77.6
Route 1/14A	F	313.4	F	328.3	E	74.2	F	126.0
Route 1/10A	F	182.1	F	221.3	F	126.1	F	186.0
Route 1/14B	F	153.4	F	146.2	F	90.4	E	79.5
Route 1/14 (ITC)	F	158.9	F	318.3	F	113.6	F	267.2
Route 1/30	F	365.0	F	338.6	F	146.3	F	285.3
Route 1/8	F	200.1	F	199.7	E	77.8	F	150.4
Route 1/4	C	25.4	D	36.0	C	33.6	D	33.5
Route 1/6 (Adelup)	C	34.5	F	114.0	D	38.1	D	44.9
Route 4/7A	F	273.8	F	541.8	F	372.9	F	654.2
Route 4/10	F	160.5	F	82.9	F	198.7	E	71.0
Route 4/17	C	33.9	C	34.3	D	40.1	E	56.2
Route 8/33	D	38.7	E	72.1	D	45.5	E	77.8
Route 8/10	F	351.4	F	474.5	F	177.3	F	218.4
Route 10/15	F	260.9	F	235.5	F	197.9	F	178.1
Route 16/27A	C	28.9	E	75.0	C	31.4	D	35.5
Route 16/27	F	459.6	F	587.3	F	361.1	F	336.6
Route 16/10A	F	556.5	F	494.6	F	582.9	F	488.7
Route 26/25**	F	116.2	D	42.4	F	113.1	F	119.3
Route 26/15**	D	45.0	C	34.1	F	154.9	F	168.2
Route 28/27A**	C	47.4	F	89.4	C	31.3	E	59.6
Unsignalized***								
Route 7/7A	F	174.7	F	290.0	F	174.7	F	300.8
Military Access Points								
Route 1 - South Andersen Main Gate/(Turner Street)**					C	32.4	E	78.8
Route 15 - South Andersen/Second Gate	—	—	—	—	C	22.1	C	22.6
Route 16 - Navy Barrigada/ Residential Gate	—	—	—	—	NA	NA	NA	NA
Route 8A - Navy Barrigada/(Residential Gate) (on base)	—	—	—	—	NA	NA	NA	NA
Route 15 - Barrigada Air Force/(Chada Street)**	—	—	—	—	D	48.4	D	43.2

Legend: ITC = International Trade Center; LOS = Level of Service; NA= Not Applicable.
Notes: *Signalized intersection LOS based on average delay for the overall intersection.
**Intersection is proposed to be signalized in future build conditions.
***Unsignalized intersection LOS based on approach delay on STOP-controlled approach.
****Delay exceeded maximum calculated value.

Public Transportation Impacts. Impacts would be similar to those of Alternative 1.

Pedestrian and Bicycle Impacts. Impacts would be similar to those of Alternative 1.

Apra Harbor

On Base Roadways:

Naval Base Guam

Construction. The impacts for Alternative 8 are the same as Alternative 1.

Operation. The impacts for Alternative 8 are the same as Alternative 1.

Off Base Roadways:

Future Traffic Impacts. A summary of future ADT volumes and the v/c ratio for 2014 and 2030 for Alternative 8 can be found in Table 4.2-24. Generally, there is a substantial increase in volumes on roadways from 2008 to 2014, and then a modest decrease in volumes on roadways from 2014 to 2030. See Table 4.1-15 for the 2008 volume summary. This can be attributed to the increase in construction traffic and coinciding military expansion during peak construction time, which is in 2014, and then a reduction in traffic once off-island construction workers leave the island.

Table 4.2-24. Alternative 8 Future ADT and Volume to Capacity Ratio Summary – Apra Harbor Region

	2014		*2030*	
Roadway	*ADT Summary*	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 1	Route 1 ranges from 23,000 to 63,000 vpd. The traffic decreases into the entrance into Naval Base Guam, which is at the Route 1/2A intersection.	The v/c ratio is generally less than 1.00. This roadway is not considered congested.	Route 1 ranges from 24,000 to 56,000 vpd. The traffic decreases into the entrance into Naval Base Guam, which is at the Route 1/2A intersection.	The v/c ratio is less than 1.00. This roadway is not considered congested.
Route 2A	Route 2A has 35,000 vpd.	The v/c ratio is 0.00-0.90 during the a.m. and p.m. peak hours, indicating the roadway is not considered congested.	Route 2A has 35,000 vpd.	The v/c ratio is 0.00-0.90 during the a.m. and p.m. peak hours, indicating the roadway is not considered congested.
Route 11	Route 11 has 14,000 vpd.	The v/c ratio is 0.00-0.90 during peak hours, indicating the roadway is not considered congested.	Route 11 has 8,800 vpd.	The v/c ratio is 0.00-0.90 during peak hours, indicating the roadway is not considered congested.

Legend: ADT = average daily traffic; v/c = volume to capacity; vpd = vehicles per day.

Figure 4.2-55 through Figure 4.2-58 show future levels of traffic congestion in the Apra Harbor Region for the a.m. and p.m. peak hours for 2014 and 2030, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested.

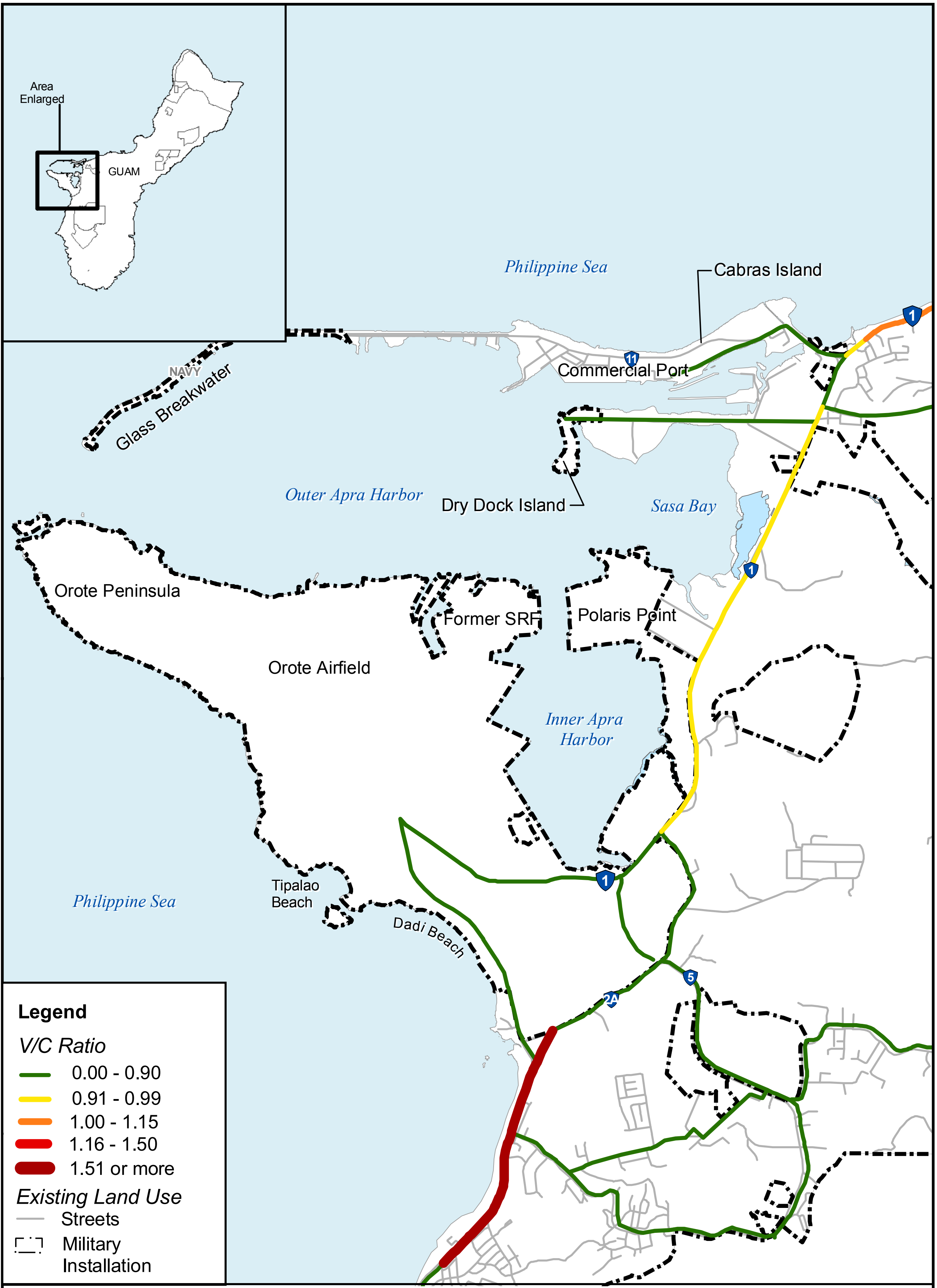


Figure 4.2-55
Apra Harbor Region – 2014 a.m. Peak Congestion Levels – Alternative 8

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4192_MXDs\Figure 4.2-55. Apra Harbor Region - 2014 a.m. Peak Congestion Levels- Alternative 8.mxd

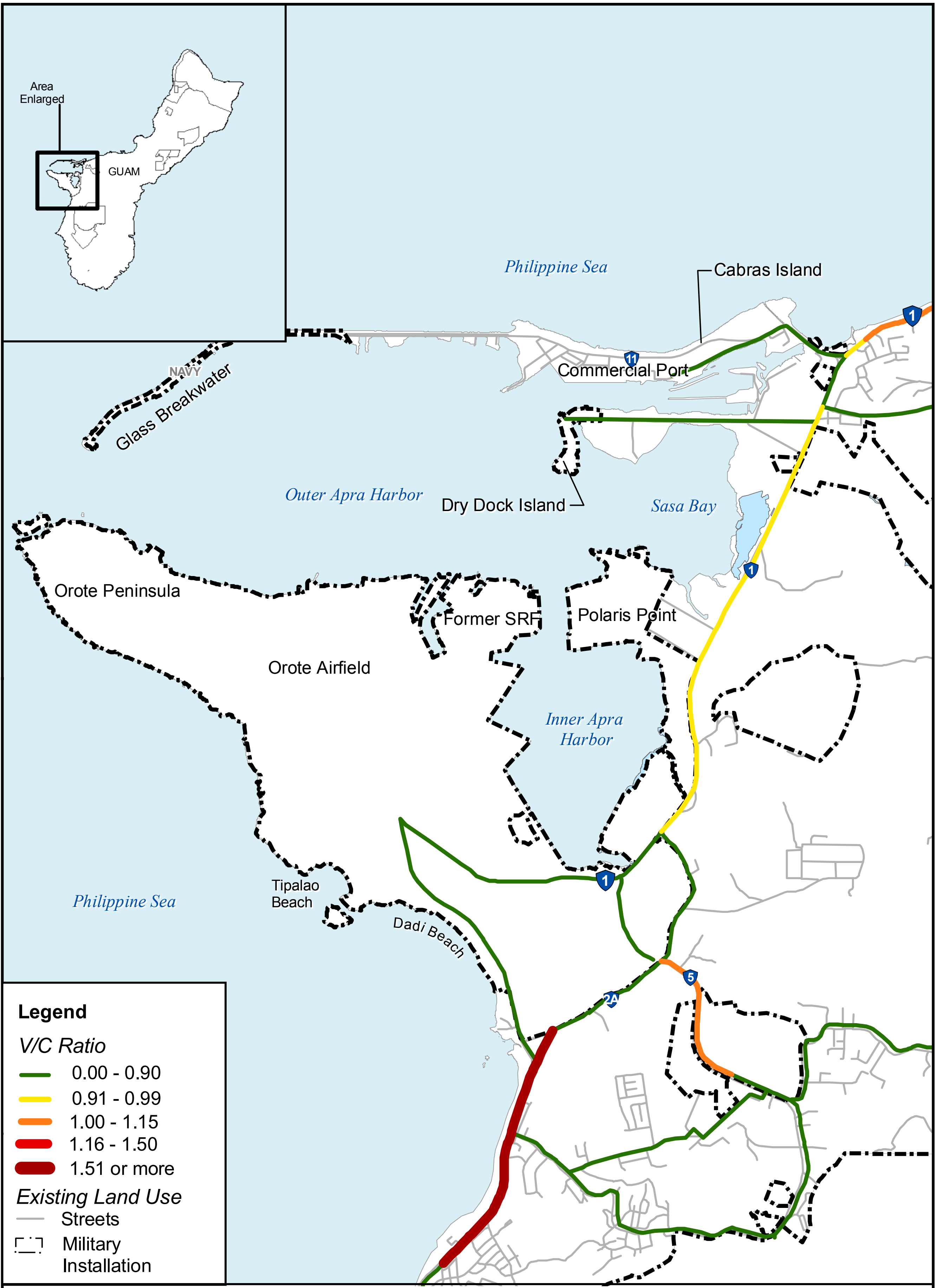


Figure 4.2-56
Apra Harbor Region – 2014 p.m. Peak Congestion Levels – Alternative 8

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4192_MXDs\Figure 4.2-56. Apra Harbor Region - 2014 p.m. Peak Congestion Levels- Alternative 8.mxd

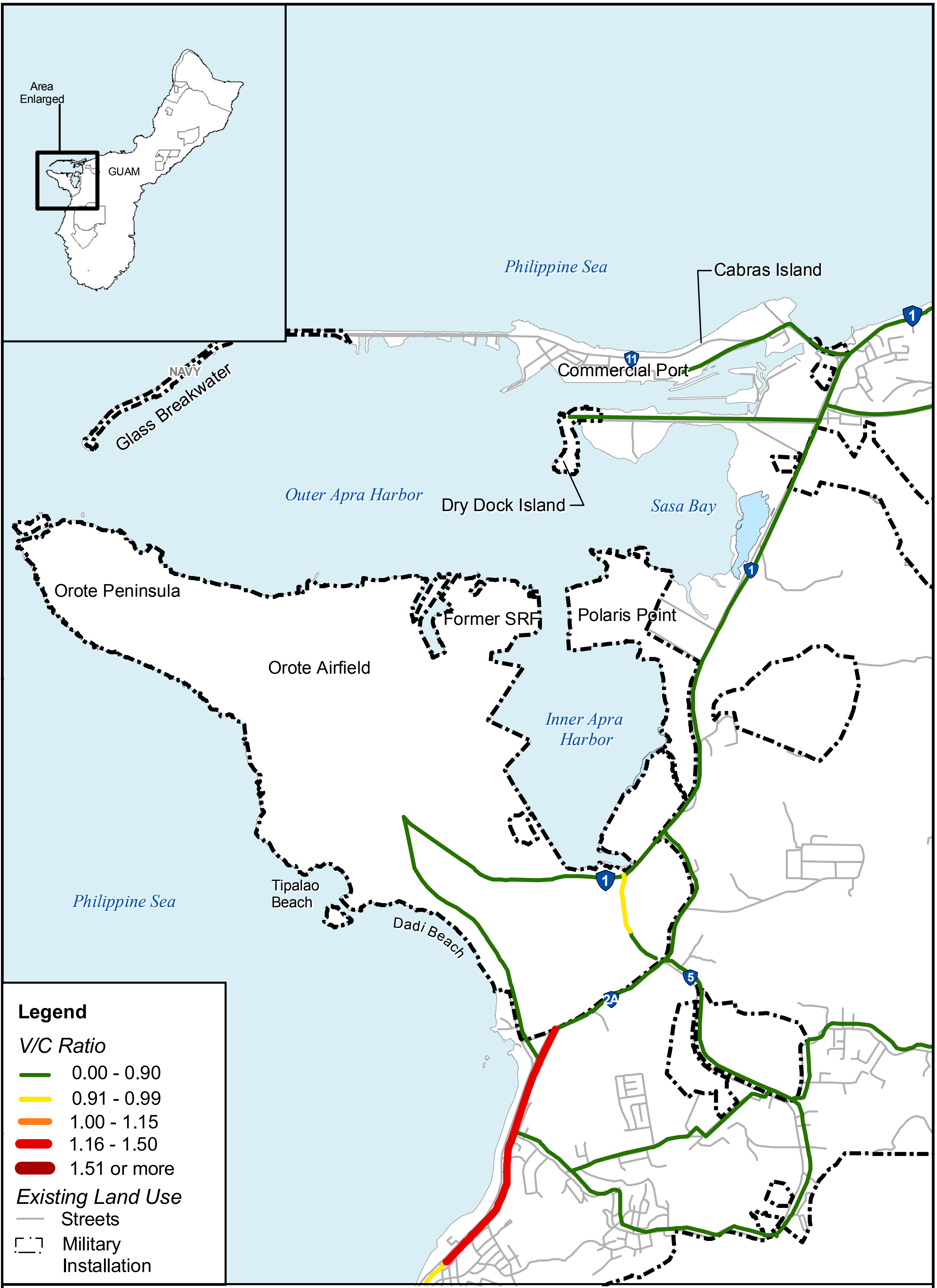


Figure 4.2-57

Apra Harbor Region – 2030 a.m. Peak Congestion Levels – Alternative 8

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4192_MXDs\Figure 4.2-57. Apra Harbor Region - 2030 a.m. Peak Congestion Levels- Alternative 8.mxd

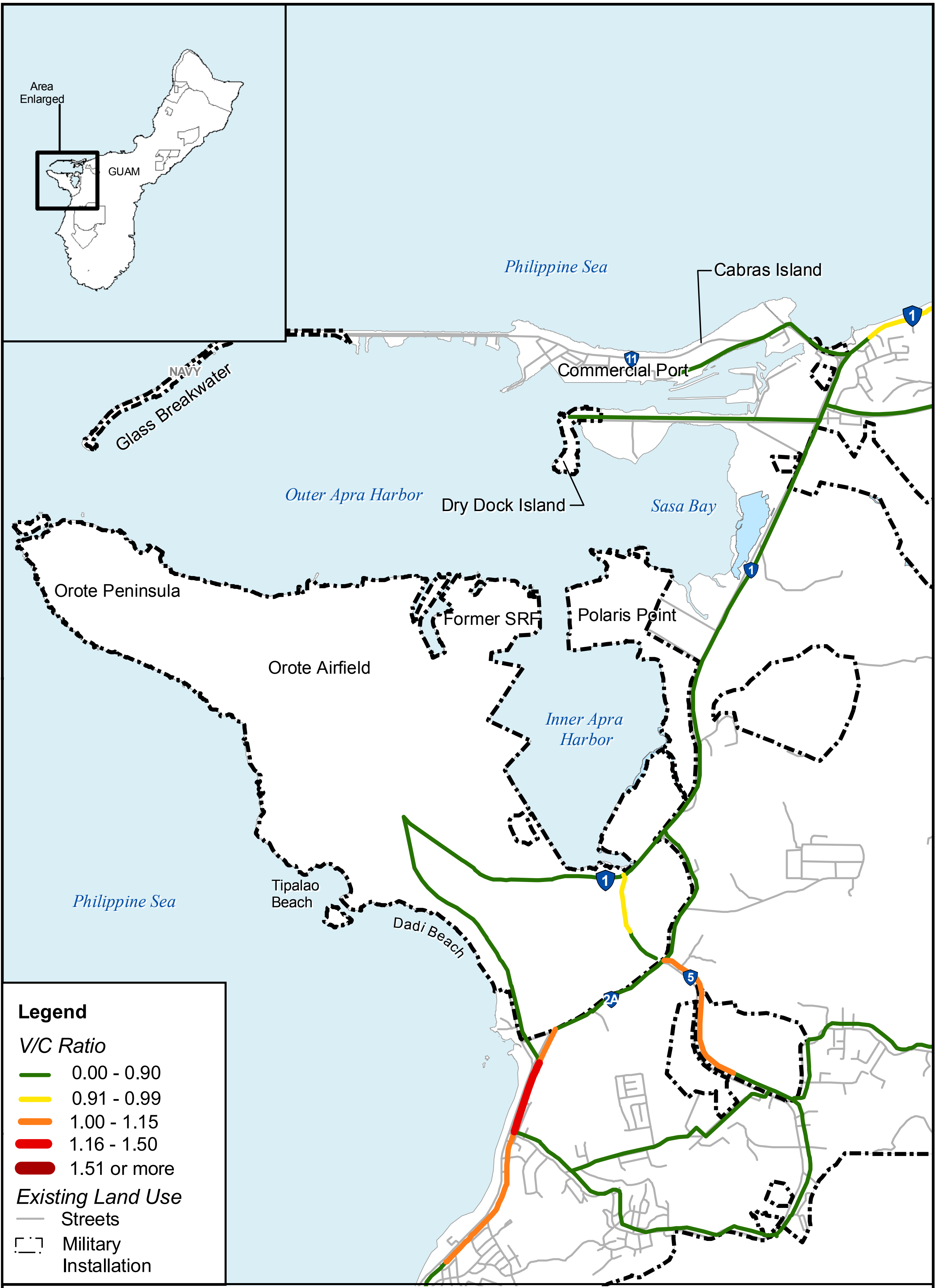


Figure 4.2-58

Apra Harbor Region – 2030 p.m. Peak Congestion Levels – Alternative 8

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4192_MXDs\Figure 4.2-58. Apra Harbor Region - 2030 p.m. Peak Congestion Levels- Alternative 8.mxd

As shown in Table 4.2-25, Route 1/2A is operating at LOS F in the a.m. peak hour for 2014, which is considered unacceptable.

Table 4.2-25. Alternative 8 Future Level of Service and Delay Results – Apra Harbor Region

	2014				*2030*			
	a.m. Peak Hour		*p.m. Peak Hour*		*a.m. Peak Hour*		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*								
Route 1/11	C	25.3	E	67.7	B	14.3	D	43.3
Route 1/Polaris Point	A	4.5	A	5.5	A	6.8	A	7.5
Route 1/6 (west)	D	49.5	C	24.1	B	18.4	C	22.0
Route 1/2A	F	89.4	E	59.8	E	67.5	E	57.5
Route 5/2A	E	69.6	C	22.9	E	79.9	C	25.9

Note: *Signalized intersection LOS based on average delay for the overall intersection.

Public Transportation Impacts. Impacts would be similar to those of Alternative 1.

Pedestrian and Bicycle Impacts. Impacts would be similar to those of Alternative 1.

South

On Base Roadways:

Naval Munitions Site

Construction. The impacts for Alternative 8 are the same as Alternative 1.

Operation. The impacts for Alternative 8 are the same as Alternative 1.

Off Base Roadways:

Future Traffic Impacts. A summary of future ADT volumes and the v/c ratio for 2014 and 2030 for Alternative 3 can be found in Table 4.2-26. Generally, there is a substantial increase in volumes on roadways from 2008 to 2014, and then a modest decrease in volumes on roadways from 2014 to 2030. See Table 4.1-20 for the 2008 volume summary. This can be attributed to the increase in construction traffic and coinciding military expansion during peak construction time, which is in 2014, and then a reduction in traffic once off-island construction workers leave the island.

Table 4.2-26. Alternative 8 Future ADT and Volume to Capacity Ratio Summary – South Region

Roadway	*2014*		*2030*	
	ADT Summary	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 5	Route 5 ranges from 10,000 to 17,000 vpd. Traffic decreases as Route 5 approaches the intersection with Route 17.	The v/c ratio is generally 0.00-0.90 in the a.m. peak and 1.00-1.15 in the p.m. peak. The roadway is congested during the p.m. peak hour.	Route 5 ranges from 11,000 to 18,000 vpd. Traffic decreases as Route 5 approaches the intersection with Route 17.	The v/c ratio is generally 0.00-0.90 in the a.m. peak and 1.00-1.15 in the p.m. peak. The roadway is congested during the p.m. peak hour.
Route 12	Route 12 ranges from 2,700 to 5,400 vpd. The traffic increases toward the intersection with Route 2.	The v/c ratio is 0.00-0.90 during both the a.m. and p.m. peak, indicating the roadway is not considered congested.	Route 12 ranges from 2,300 to 6,000 vpd. The traffic increases toward the intersection with Route 2.	The v/c ratio is 0.00-0.90 during both the a.m. and p.m. peak, indicating the roadway is not considered congested.

Legend: ADT = average daily traffic; v/c = volume to capacity; vpd = vehicles per day.

Figure 4.2-59 through Figure 4.2-62 show future levels of traffic congestion in the South Region for the a.m. and p.m. peak hours for 2014 and 2030, respectively. The color of the roadways corresponds to the LOS on the road. The green roads have an LOS of A, B, or C; the yellow roads have an LOS of D or E; and the orange and red roads have an LOS of F, with red being the most severely congested.

The roads in the South Region do not exhibit high levels of congestion. During both the afternoon peaks, Route 5 between Naval Base Guam and the NMS has an LOS F.

As shown in Table 4.2-27, none of the intersections have LOS F in either the a.m. or p.m. peak hours in 2014 or 2030. Conditions remain fairly stable from 2014 to 2030.

Table 4.2-27. Alternative 8 Future Level of Service and Delay Results – South Region

	2014				*2030*			
	a.m. Peak Hour		*p.m. Peak Hour*		*a.m. Peak Hour*		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*								
Route 2/12	C	31.6	C	24.9	C	30.7	C	27.0
Unsignalized**								
Route 5/17	B	13.1	C	17.1	B	14.8	E	42.4
Route 4/4A	C	23.3	C	17.2	E	47.4	C	24.0
Route 17/4A	B	13.0	B	14.0	C	16.1	C	18.6
Military Access Points								
Route 5 - Naval Munitions Sites/Harmon Road.**	—	—	—	—	A	9.5	A	10.6

Notes: *Signalized intersection LOS based on average delay for the overall intersection.
**Unsignalized intersection LOS based on approach delay on STOP-controlled approach.
Legend: LOS = Level of Service.

Public Transportation Impacts. Impacts would be similar to those of Alternative 1.

Pedestrian and Bicycle Impacts. Impacts would be similar to those of Alternative 1.

Proposed Mitigation Measures

On Base Roadways:

The proposed mitigation measures would be the same as for Alternative 1.

Off Base Roadways:

The mitigation measures for Alternative 8 would be similar to those of Alternative 1.

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-59. South Region - 2014 a.m. Peak Congestion Levels- Alternative 8.mxd

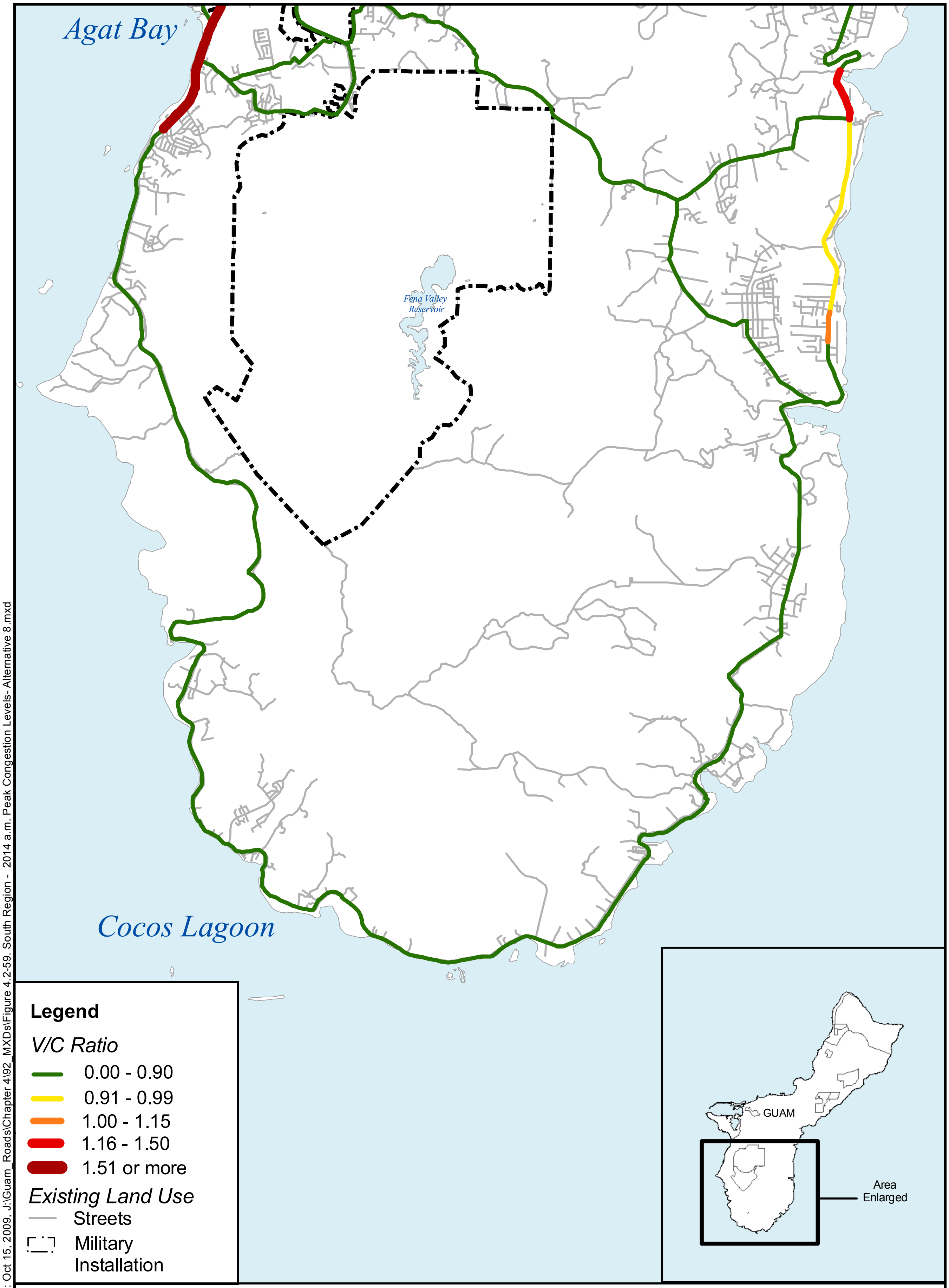
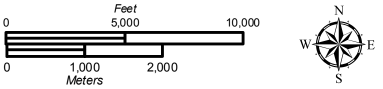


Figure 4.2-59

South Region – 2014 a.m. Peak Congestion Levels – Alternative 8



Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-60. South Region - 2014 p.m. Peak Congestion Levels- Alternative 8.mxd

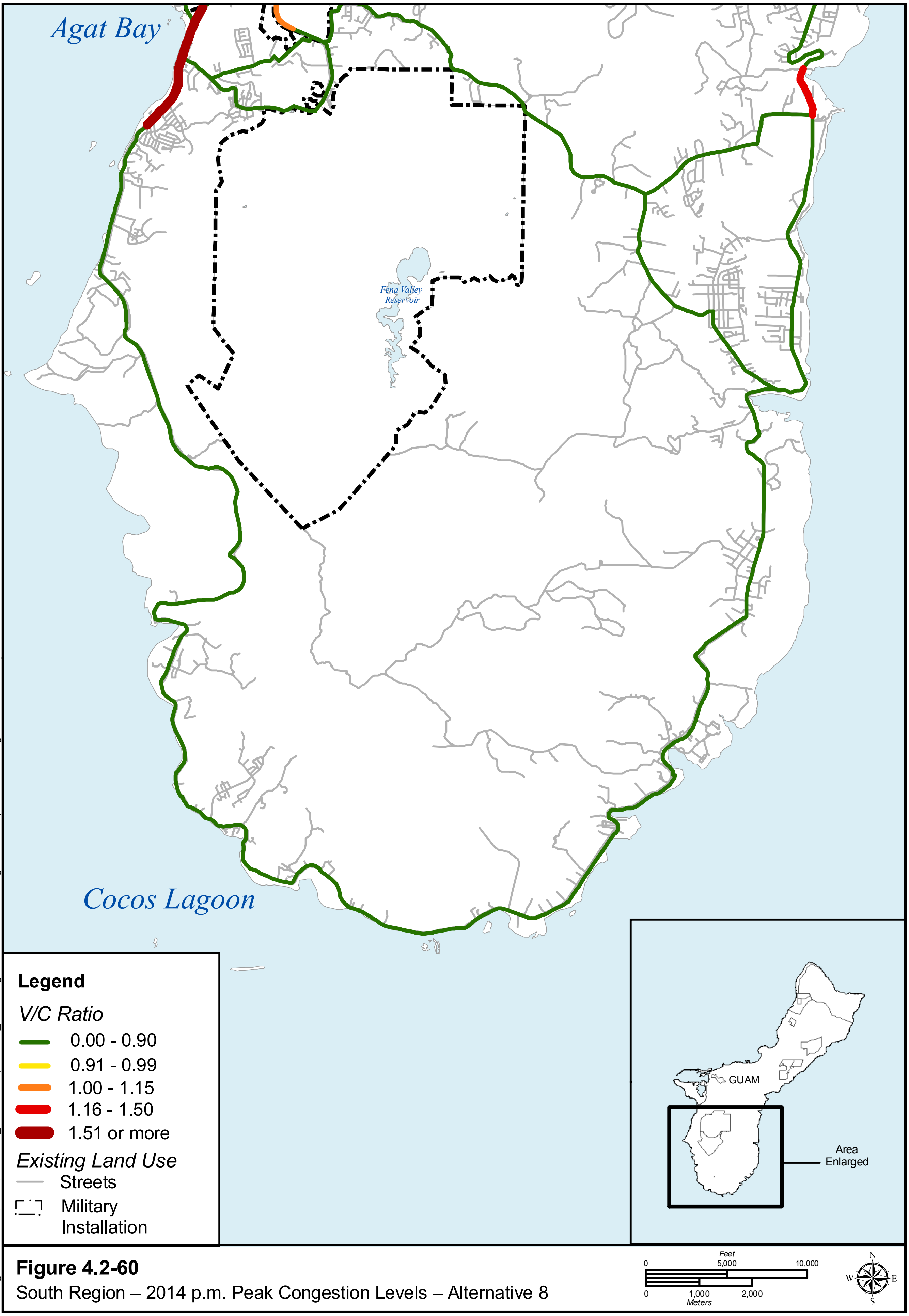


Figure 4.2-60

South Region – 2014 p.m. Peak Congestion Levels – Alternative 8

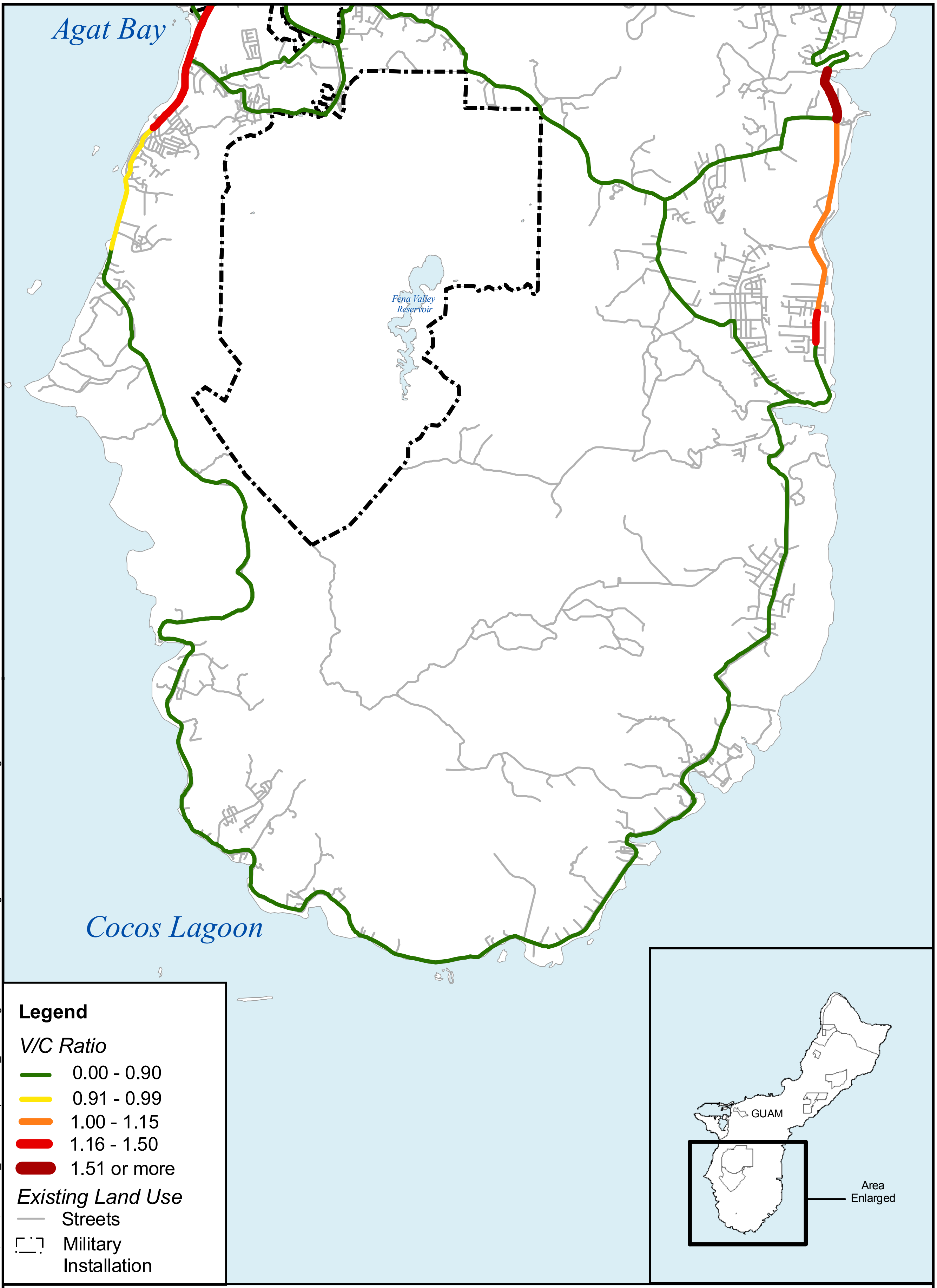


Figure 4.2-61

South Region – 2030 a.m. Peak Congestion Levels – Alternative 8

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-61. South Region - 2030 a.m. Peak Congestion Levels- Alternative 8.mxd

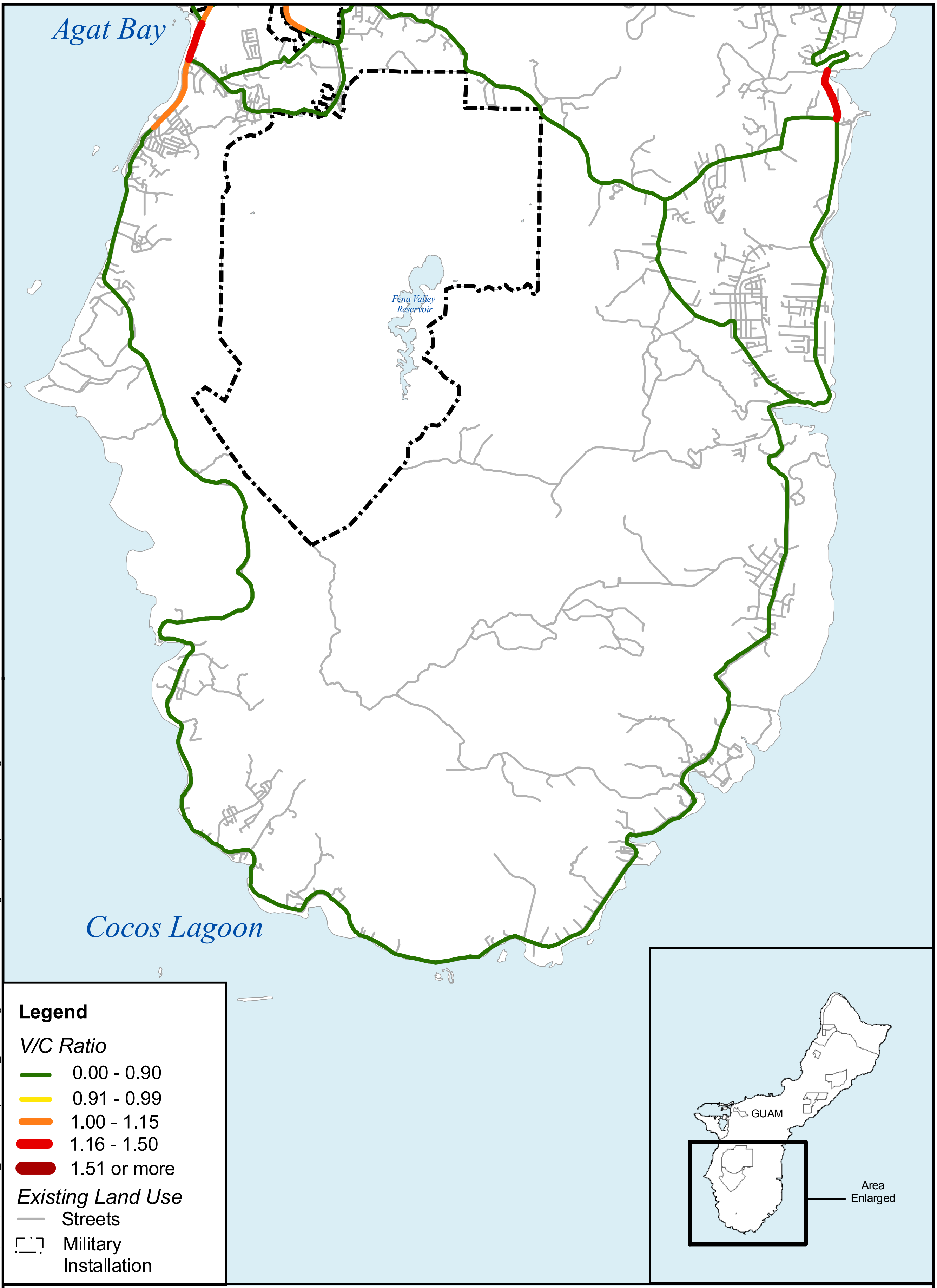


Figure 4.2-62
South Region – 2030 p.m. Peak Congestion Levels – Alternative 8

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-62. South Region - 2030 p.m. Peak Congestion Levels- Alternative 8.mxd

4.2.2.5 No-Action Alternative (Off Base Roadways)

The no-action alternative includes all projects included in the fiscally constrained 2030 Guam Transportation Plan; however, it does not include the military relocation or roadway projects proposed specifically for the relocation as described in the build alternatives.

2014

Future Traffic Impacts

Most of the roads included in this study are considered congestion-free in 2014. A summary of future ADT volumes and the v/c ratio for 2014 for the no-action alternative can be found in Table 4.2-28. The exceptions are Route 25 and the southern portion of Route 28, which both have a v/c ratio greater than 1, indicating that the roadway is congested. The v/c ratios are considerably better compared to Alternatives 1/2, 3, and 8 in 2014, most noticeably on the following roadways, which all have congestion where there is no congestion in the no-action alternative in 2014:

Alternatives 1 and 2

- Route 1
- Route 3
- Route 8
- Route 10
- Route 15
- Route 26
- Route 28

Alternative 3

- Route 1
- Route 3
- Route 10
- Route 16
- Route 26

Alternative 8

- Route 1
- Route 3
- Route 5
- Route 8
- Route 10
- Route 25
- Route 26

Figure 4.2-63 through Figure 4.2-70 show future levels of traffic congestion in the North, Central, Apra Harbor, and South Regions for the a.m. and p.m. peak hours for 2014. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested.

The results of the future operational analysis are shown in Table 4.2-29 for both the 2014 a.m. and p.m. conditions.

As shown in Table 4.2-29, islandwide, there are 17 out of 42 intersections with LOS F for at least one peak hour, which is considered unacceptable. The following intersections are operating at LOS F in the a.m. and p.m. peak hours in 2014:

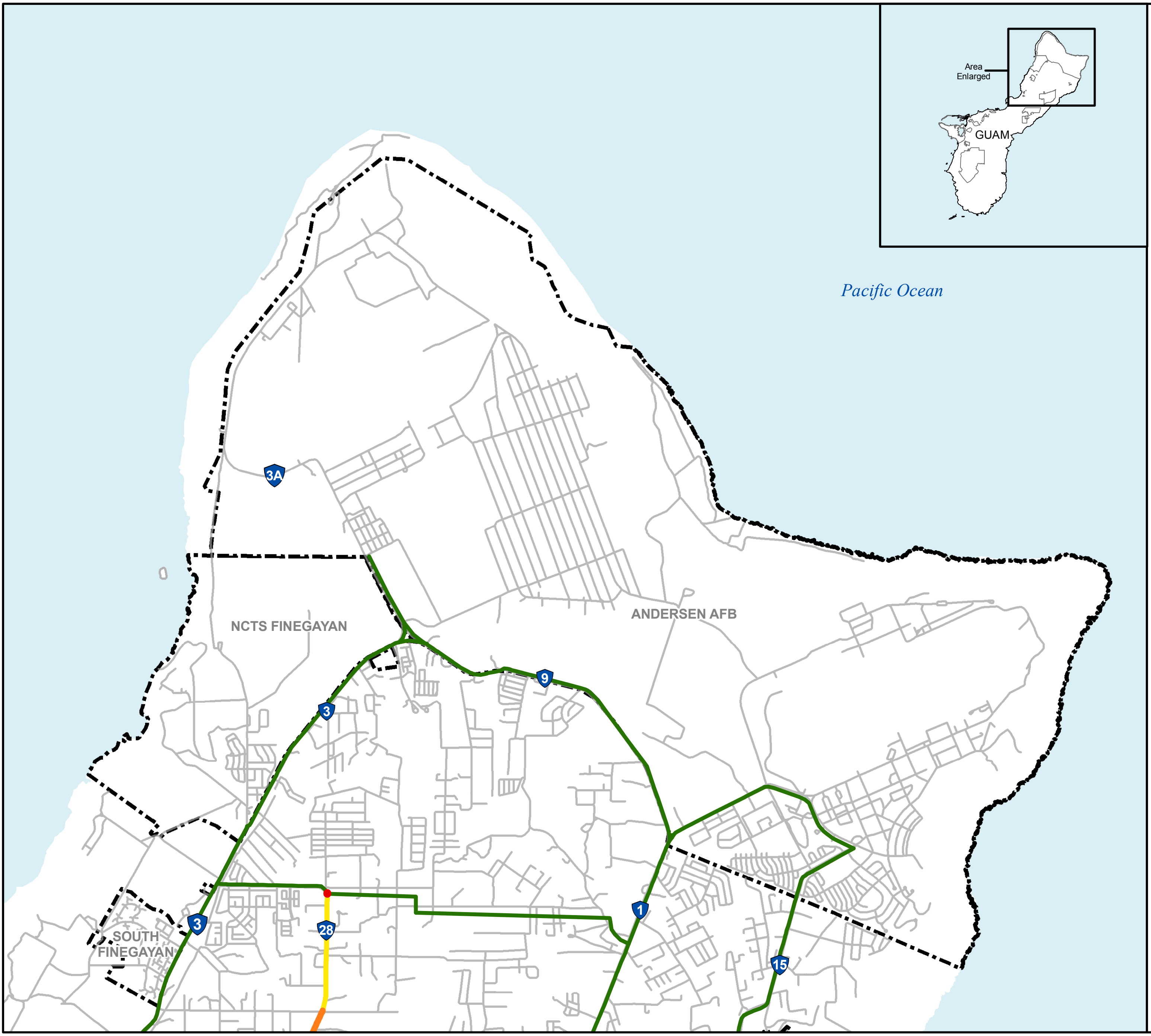
- Route 1/28
- Route 1/27
- Route 1/3
- Route 1/14A
- Route 1/10A
- Route 1/30
- Route 4/7A
- Route 16/27
- Route 16/10A
- Route 7/7A
- Route 15/29
- Route 28/27A

Table 4.2-28. No-Action Alternative Future ADT and Volume to Capacity Ratio Summary

Roadway	*2014*	
	ADT Summary	*v/c Ratio*
Route 1	Route 1 ranges from 19,000 to 81,000 vpd. Traffic decreases as Route 1 approaches Andersen AFB and gradually increases toward the intersection with Route 4, where it decreases again.	The v/c ratio is generally between 0.00-0.80 on Route 1. There are small sections of the roadway in Tamuning that have v/c ratios between 0.81-0.99; however, none of the roadway is considered congested.
Route 2A	Route 2A has 31,000 vpd.	The v/c ratio is between 0.00-0.80 on Route 2A. The roadway is not considered congested.
Route 3	Route 3 ranges from 23,000 to 46,000 vpd. Traffic decreases north of the intersection with Route 28.	The v/c ratio is between 0.00-0.80 on Route 3. The roadway is not considered congested.
Route 5	Route 5 ranges from 9,400 to 14,000 vpd. Traffic decreases as Route 5 approaches the intersection with Route 17.	The v/c ratio is generally between 0.81-0.99 on Route 5. The roadway is not considered congested.
Route 8/8A	Route 8 ranges from 41,000 to 48,000 vpd. There is a decrease in traffic west of the intersection with Sunset Boulevard. Route 8A has 3,500 vpd.	The v/c ratio is generally between 0.00-0.80 on Route 8/8A. However, in the p.m. peak hour, v/c ration for Route 8 east of Route 33 is between 0.81-0.99. The roadway is not considered congested.
Route 9	Route 9 ranges from 3,400 to 5,000 vpd.	The v/c ratio is between 0.00-0.80 on Route 9. The roadway is not considered congested.
Route 10	Route 10 ranges from 39,000 to 41,000 vpd between Route 8 and Route 15.	The v/c ratio is between 0.00-0.80 on Route 10. The roadway is not considered congested.
Route 11	Route 11 has 5,500 vpd.	The v/c ratio is between 0.00-0.80 on Route 11. The roadway is not considered congested.
Route 12	Route 12 ranges from 1,300 to 4,900 vpd. Traffic increases toward the intersection with Route 2.	The v/c ratio is between 0.00-0.80 on Route 12. The roadway is not considered congested.
Route 15	Route 15 ranges from 5,200 to 18,000 vpd. Traffic increases gradually south to the intersection with Route 10.	The v/c ratio is between 0.00-0.80 on Route 15. The roadway is not considered congested.
Route 16	Route 16 ranges from 40,000 to 56,000 vpd. There is a decrease in traffic south of the residential developments south of Route 25.	The v/c ratio is between 0.00-0.80 on Route 16. The roadway is not considered congested.
Route 25	Route 25 ranges from 13,000 to 17,000 vpd.	The v/c ratio is 1.16-1.50 on Route 25 in both the a.m. and p.m. peak hour. The roadway is considered congested.
Route 26	Route 26 ranges from 6,800 to 16,000 vpd. There is a decrease in traffic south of the large residential development just north of the intersection with Route 15.	The v/c ratio is generally between 0.00-0.80 on Route 26. There is a small section of the roadway near the intersection with Route 25 where the v/c ratio is between 0.81-0.99; however, none of the roadway is considered congested.
Route 27	Route 27 ranges from 40,000 to 42,000 vpd between Route 16 and Route 1.	The v/c ratio is between 0.00-0.80 on Route 27. The roadway is not considered congested.
Route 28	Route 28 ranges from 9,600 to 19,000 vpd. Traffic generally increases closer to the intersection with Route 1.	The v/c ratio of the northern portion of Route 28 is 0.81-0.99 in the a.m. peak hour and 0.00-0.80 in the p.m. peak hour. The v/c ratio of the southern portion of Route 28 is generally 1.16-1.50, which indicates the road is congested in both the a.m. and p.m. peak hour.
Chalan Lujuna	Chalan Lujuna ranges from 4,400 to 4,900 vpd.	The v/c ratio is between 0.00-0.80 on Chalan Lujuna. The roadway is not considered congested.

Legend: ADT = average daily traffic; AFB = Air Force Base; v/c = volume to capacity; vpd = vehicles per day.

Figure 4.2-63
North Region–2014 a.m. Peak Congestion Levels – No-Action Alternative



Legend

Volume to Capacity Ratios

- 🟩 0.00 - 0.90
- 🟨 0.91 - 0.99
- 🟧 1.00 - 1.15
- 🟥 1.16 - 1.50
- 🟥 1.51 or more

Existing Land Use

- Streets
- Military Installation

Printing Date: April 2, 2010

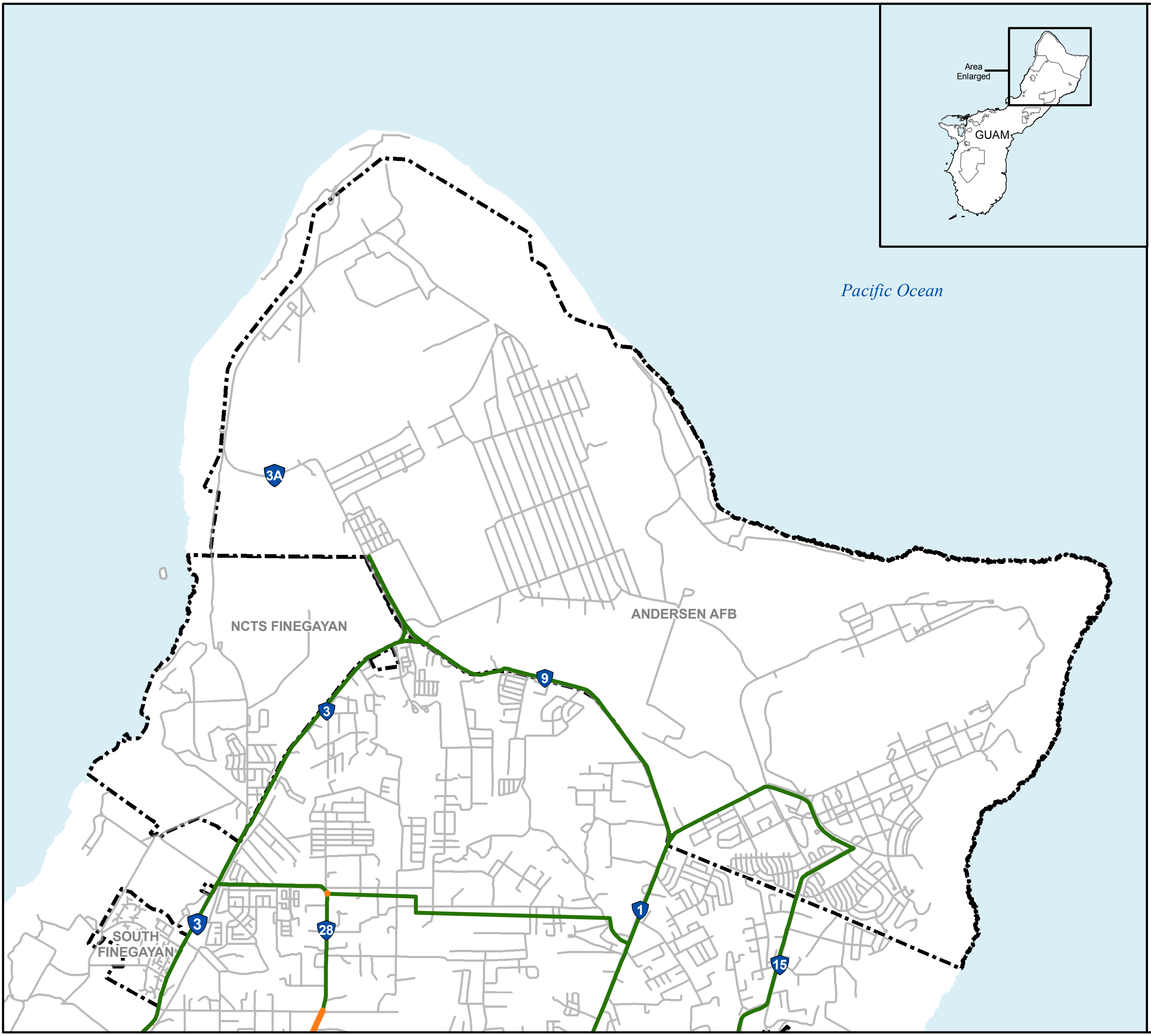


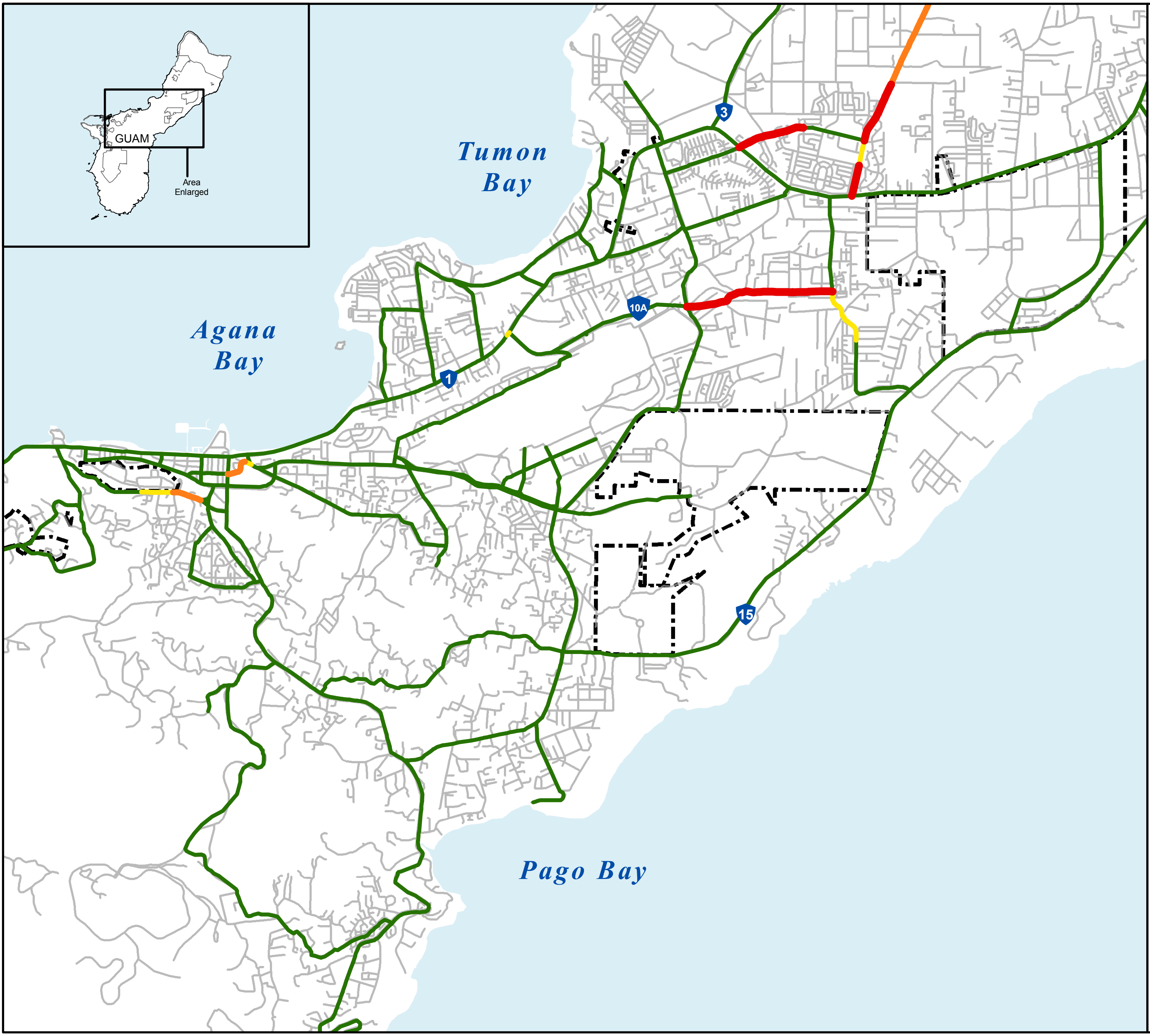
Figure 4.2-64

North Region–
2014 p.m. Peak
Congestion Levels –
No-Action Alternative

Printing Date: April 2, 2010

Figure 4.2-65

Central Region–
2014 a.m. Peak
Congestion Levels –
No-Action Alternative



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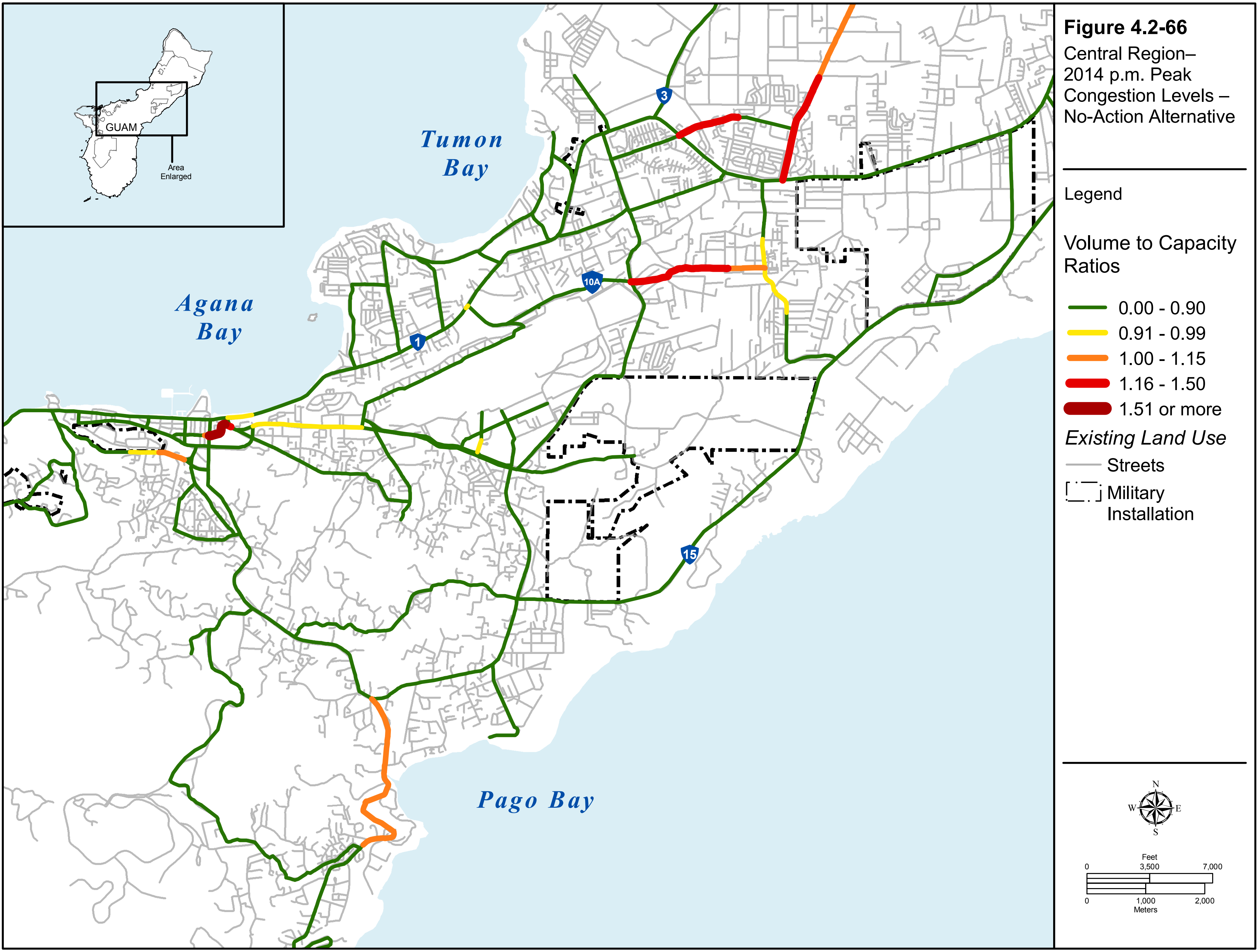


Figure 4.2-66

Central Region–2014 p.m. Peak Congestion Levels – No-Action Alternative

Printing Date: April 2, 2010

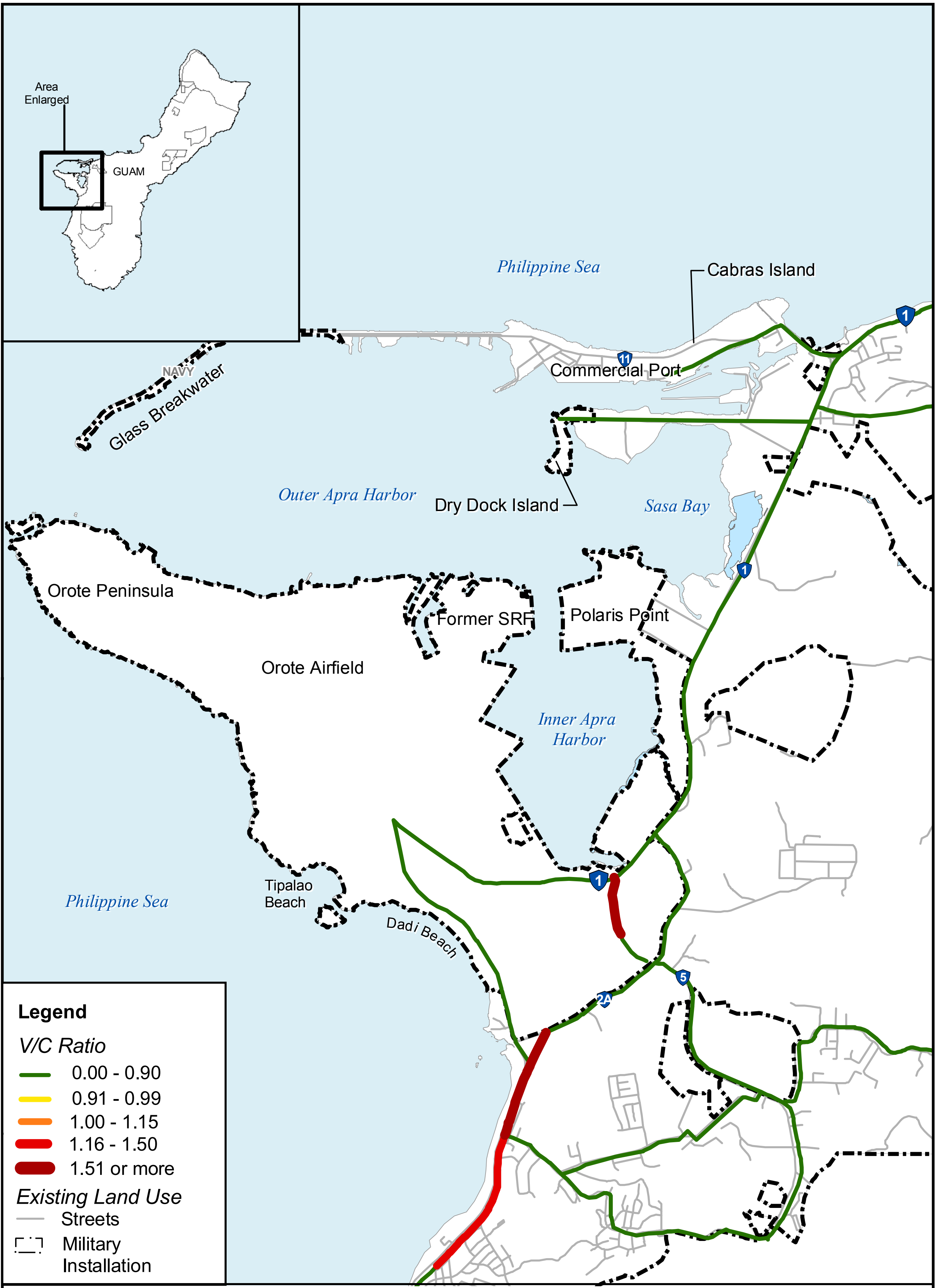


Figure 4.2-67
Apra Harbor Region - 2014 a.m. Peak Congestion Levels- No-Action Alternative

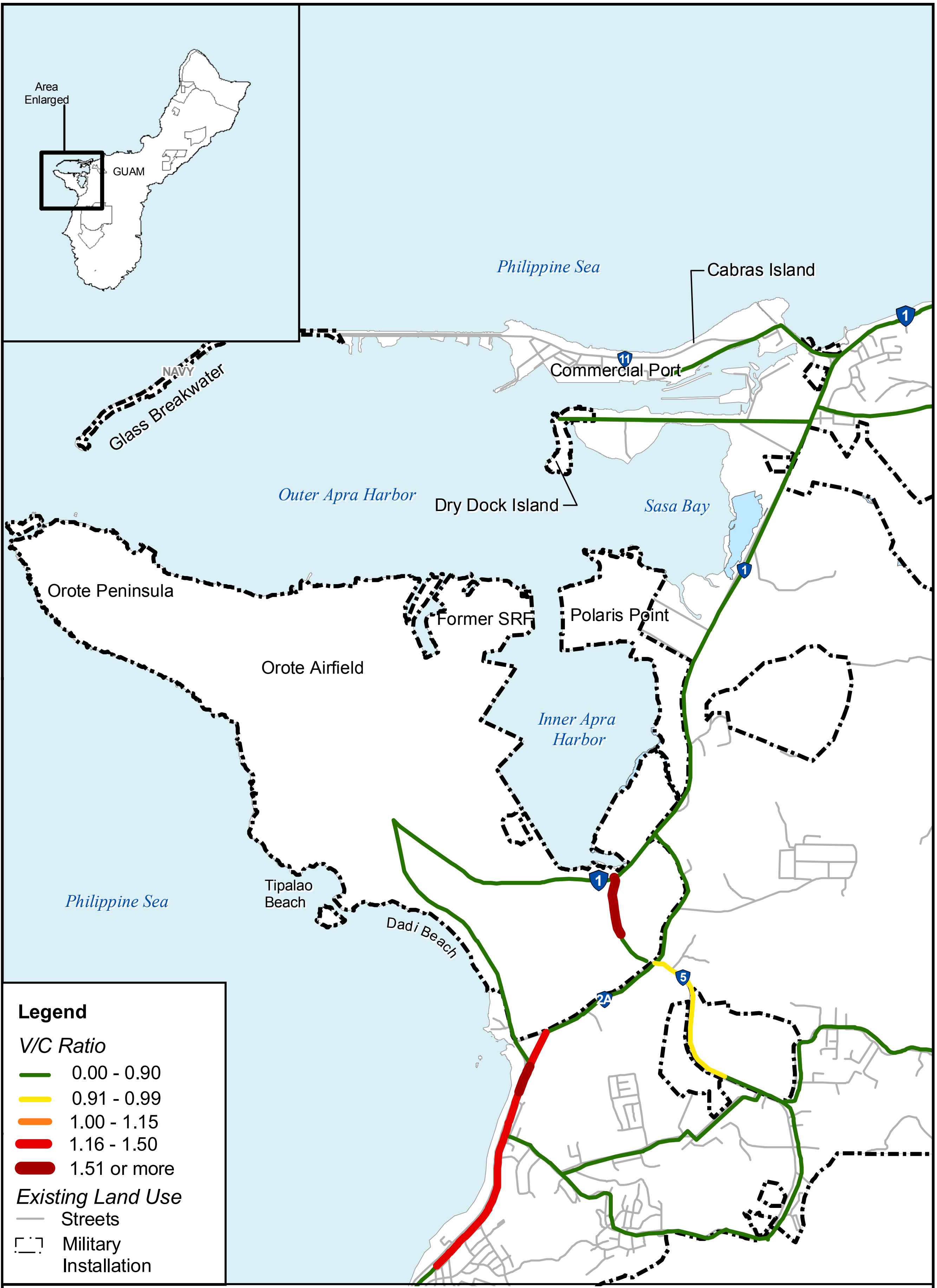


Figure 4.2-68
Apra Harbor Region - 2014 p.m. Peak Congestion Levels- No-Action Alternative

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4192_MXDs\Figure 4.2-68. Apra Harbor Region - 2014 p.m. Peak Congestion Levels- No-Action Alternative.mxd

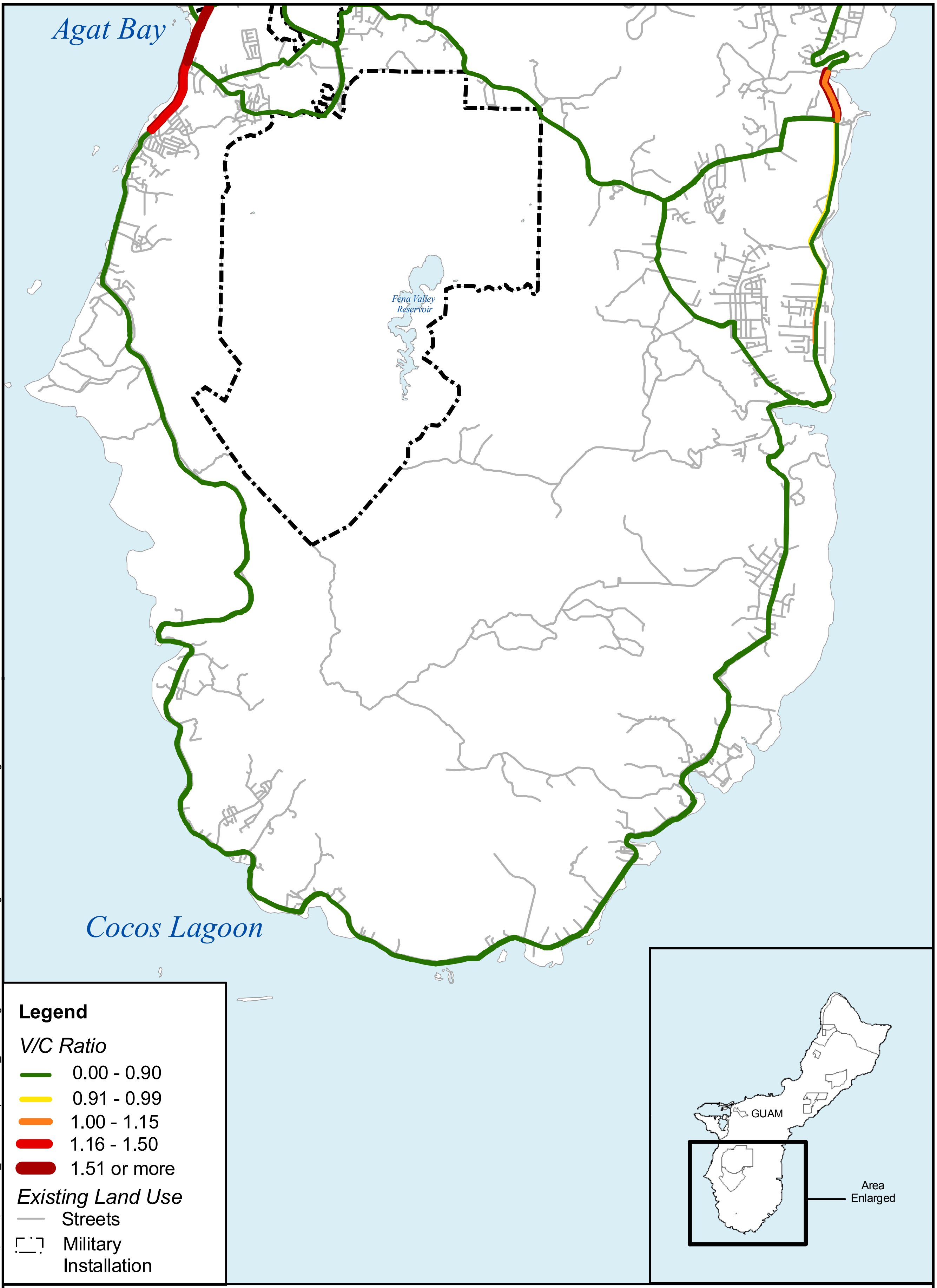


Figure 4.2-69
South Region– 2014 a.m. Peak Congestion Levels – No-Action Alternative

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-69. South Region– 2014 a.m. Peak Congestion Levels – No-Action Alternative.mxd

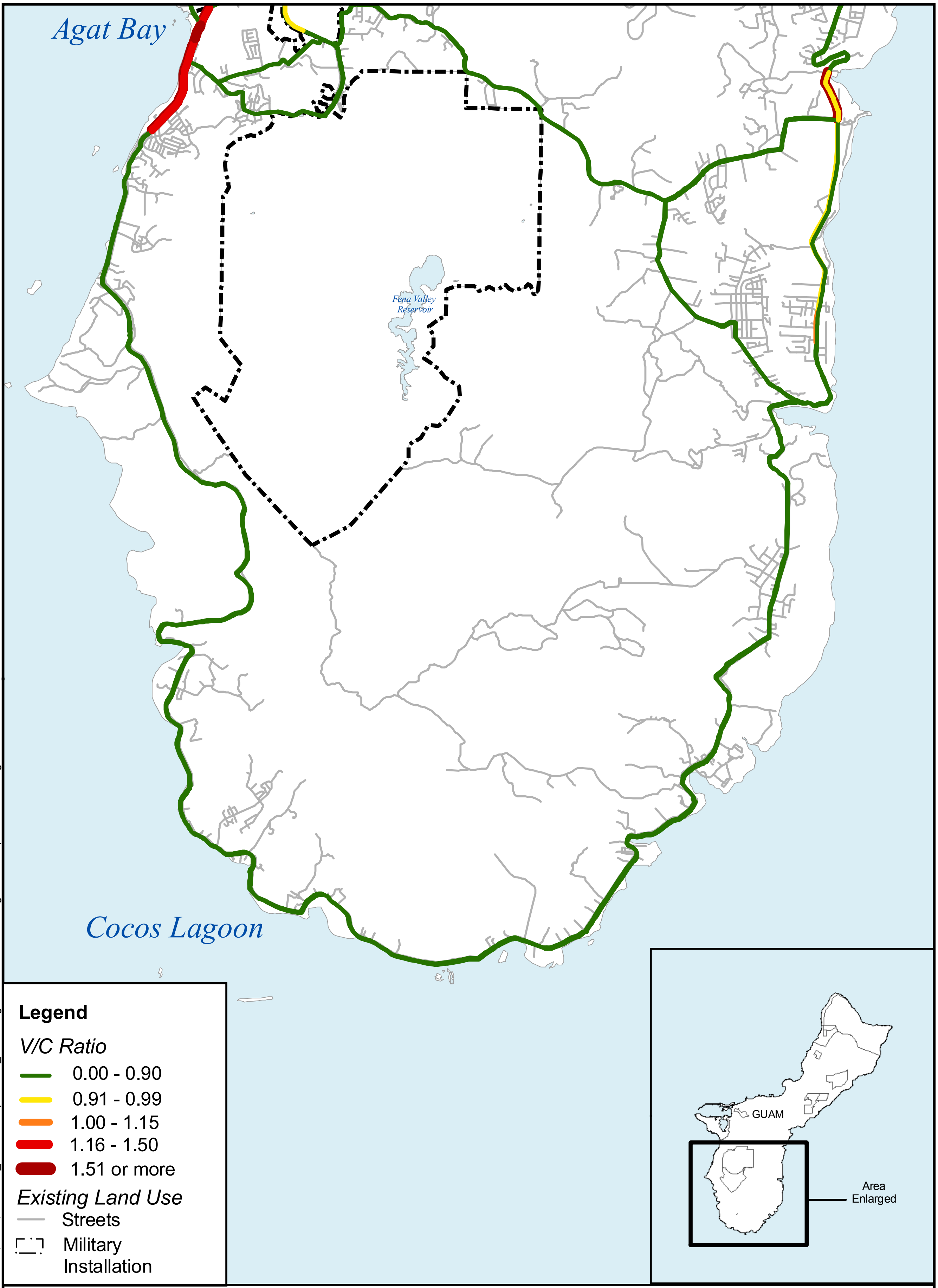


Figure 4.2-70

South Region– 2014 p.m. Peak Congestion Levels – No-Action Alternative

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-70. South Region– 2014 p.m. Peak Congestion Levels – No-Action Alternative.mxd

Table 4.2-29. No-Action Alternative Future Level of Service and Delay Results

	2014			
	a.m. Peak Hour		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*				
Route 1/9	C	21.8	B	19.5
Route 1/29	D	52.2	C	32.5
Route 1/28	F	207.3	F	120.7
Route 1/26	C	21.0	F	84.1
Route 1/27	F	1213.9	F	514.1
Route 1/27A	D	37.0	E	58.4
Route 1/3	F	113.5	F	191.7
Route 1/16	C	27.7	F	143.7
Route 1/14 (North San Vitores)	F	102.8	D	53.7
Route 1/14A	F	205.8	F	155.4
Route 1/10A	F	89.6	F	207.8
Route 1/14B	E	77.6	D	44.3
Route 1/14 (ITC)	E	70.3	F	171.3
Route 1/30	F	371.7	F	263.5
Route 1/8	C	29.0	D	46.4
Route 1/4	C	27.1	C	30.1
Route 1/6 (westerly)	B	10.5	B	12.8
Route 1/11	B	16.6	B	19.9
Route 1/6 (Adelup)	C	20.9	D	39.7
Route 1/Polaris Point	A	4.3	A	6.5
Route 1/2A	F	92.1	E	70.5
Route 5/2A	D	44.5	C	20.9
Route 2/12	E	65.4	B	17.6
Route 3/28	C	20.8	B	10.9
Route 4/7A	F	106.0	F	181.3
Route 4/10	E	59.7	E	79.2
Route 4/17	C	25.8	C	24.1
Route 8/33	D	38.4	F	91.5
Route 8/10	E	58.9	F	105.5
Route 10/15	E	79.3	D	53.9
Route 16/27A	C	25.1	B	15.0
Route 16/27	F	207.6	F	303.1
Route 16/10A	F	540.8	F	674.4
Route 26/25**	C	23.9	C	27.8
Unsignalized***				
Route 5/17	C	23.7	C	15.9
Route 3/3A/9	B	11.9	A	9.7
Route 4/4A	C	16.7	C	15.2
Route 7/7A	F	225.7	F	127.7
Route 15/29	F	142.7	F	220.8
Route 17/4A	C	15.9	C	15.6
Route 26/15	E	43.2	E	46.2
Route 28/27A	F	190.1	F	207.3
Military Access Points				
Route 3 – Main Cantonment/Commercial Gate	—	—	—	—
Route 3 – South Finegayan/Residential Gate	—	—	—	—
Route 1 – South Andersen Main Gate/(Turner Street)	—	—	—	—

	2014			
	a.m. Peak Hour		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*
Route 16 – Navy Barrigada Residential Gate	—	—	—	—
Route 15 – Barrigada Air Force/(Chada Street)	—	—	—	—
Route 5 – Naval Munitions Site/Harmon Road	—	—	—	—

Legend: ITC = International Trade Center; LOS = Level of Service.
Notes: *Signalized intersection LOS based on average delay for the overall intersection.
**Intersection would be signalized in future no action scenario.
***Unsignalized intersection LOS based on approach delay on STOP-controlled approach.

There is a noticeable difference between the no-action alternative and Alternatives 1 and 3 in terms of LOS in 2014. Islandwide, there are 12 intersections with the no-action alternative that have LOS F in both the a.m. and p.m. peak hours in 2014. For Alternatives 1 and 2, this number increases to 24 intersections in 2014; for Alternative 3, 23 intersections; and, for Alternative 8, 22 intersections. This is due to the proposed action, which increases the population and number of vehicles on the island, especially during peak construction time, which would occur in 2014. In addition, in 2014, the widening of Routes 25 and 26 will not have been constructed; thereby, affecting the intersection analysis.

Public Transportation Impacts

The impacts to the public transportation system would result from construction delays associated with the roadway improvements included in the no-action alternative. This could affect the LOS for transit riders by increasing travel times, longer headways, and missed transfers.

Pedestrian and Bicycle Impacts

Impacts to the existing pedestrian and bicycle facilities would occur during construction of roadway improvements included in the no-action alternative. This includes a loss of intermittent sidewalk when widening Route 10A. Intersection improvements would impact safe pedestrian and bicycle crossing during the period of reconstruction.

2030

Future Traffic Impacts

Most of the roads included in this study are considered congestion-free in 2030. A summary of future ADT volumes and the v/c ratio for 2030 for the no-action alternative can be found in Table 4.2-30.

The exceptions are Route 28 and small portions of Routes 1 and 10 that have a v/c ratio greater than 1, which indicates that the roadway is congested. The v/c ratios are considerably better compared to Alternatives 1, 2, 3, and 8 in 2030, most noticeably on the following roadways, which all have congestion where there is no congestion in the no-action alternative in 2030:

Alternatives 1 and 2

- Route 1
- Route 3
- Route 10
- Route 26

Alternative 3

- Route 1
- Route 10
- Route 16
- Route 25
- Route 26

Alternative 8

- Route 1
- Route 3
- Route 10
- Route 15
- Route 25
- Route 26

Table 4.2-30. No-Action Alternative Future ADT and Volume to Capacity Ratio Summary

Roadway	*2030*	
	ADT Summary	*v/c Ratio*
Route 1	Route 1 ranges from 16,000 to 86,000 vpd. Traffic decreases as Route 1 approaches Andersen AFB and gradually increases toward the intersection with Route 4, where it decreases again.	The v/c ratio is generally between 0.00-0.80 on Route 1. There are small sections of the roadway in Tamuning and Andersen South that have v/c ratios between 0.81-0.99. In the p.m. peak hour, a portion of the roadway south of Route 30 has a ratio of 1.00-1.15, which is considered congested.
Route 2A	Route 2A has 33,000 vpd.	The v/c ratio is between 0.00-0.80 on Route 2A. The roadway is not considered congested.
Route 3	Route 3 ranges from 23,000 to 46,000 vpd. Traffic decreases north of the intersection with Route 28.	The v/c ratio is generally between 0.00-0.80 on Route 3 in the a.m. peak hour; however, in the p.m. peak hour, generally south of Route 28, the ratio is 0.81-0.99. The roadway is not considered congested.
Route 5	Route 5 ranges from 10,000 to 16,000 vpd. Traffic decreases as Route 5 approaches the intersection with Route 17.	The v/c ratio is between 0.81-0.99 on Route 5 in the a.m. peak hour; however, in the p.m. peak hour, the ratio is between 1.00-1.15 and is considered congested.
Route 8/8A	Route 8 ranges from 47,000 to 54,000 vpd. There is a decrease in traffic west of the intersection with Sunset Boulevard. Route 8A has 2,900 vpd.	The v/c ratio is generally between 0.00-0.80 on Route 8/8A in the a.m. peak hour; however, in the p.m. peak hour, v/c ratio for Route 8 east of Route 33 is between 1.00-1.15 and is considered congested.
Route 9	Route 9 ranges from 4,400 to 6,900 vpd.	The v/c ratio is between 0.00-0.80 on Route 9. The roadway is not considered congested.
Route 10	Route 10 ranges from 48,000 to 50,000 vpd between Route 8 and Route 15.	The v/c ratio is generally 0.81-0.99 on Route 10; however, there is a portion of Route 10 where the v/c ratio is 1.00-1.15 south of the intersection with Route 15 in the a.m. peak hour. Only that portion of the roadway is considered congested.
Route 11	Route 11 has 7,600 vpd.	The v/c ratio is between 0.00-0.80 on Route 11. The roadway is not considered congested.
Route 12	Route 12 ranges from 2,100 to 5,700 vpd. Traffic increases toward the intersection with Route 2.	The v/c ratio is between 0.00-0.80 on Route 12. The roadway is not considered congested.
Route 15	Route 15 ranges from 7,100 to 21,000 vpd. Traffic increases gradually south to the intersection with Route 10.	The v/c ratio is generally 0.00-0.80 on Route 15; however, there is a portion of Route 15 where the v/c ratio is 0.81-0.99 east of the intersection with Route 10. The roadway is not considered congested.
Route 16	Route 16 ranges from 30,000 to 64,000 vpd. There is a decrease in traffic south of the residential developments south of Route 25.	The v/c ratio is generally 0.00-0.80 on Route 16; however, there is a portion of Route 16 where the v/c ratio is 0.81-0.99 south of the intersection with Route 25. The roadway is not considered congested.
Route 25	Route 25 ranges from 22,000 to 26,000 vpd.	The v/c ratio is generally 0.81-0.99 on Route 25. The roadway is not considered congested.
Route 26	Route 26 ranges from 8,300 to 24,000 vpd. There is a decrease in traffic south of the large residential development just north of the intersection with Route 15.	The v/c ratio is generally between 0.00-0.80 on Route 26. There is a small section of the roadway near the intersection with Route 25 where the v/c ratio is between 0.81-0.99; however, none of the roadway is considered congested.
Route 27	Route 27 ranges from 43,000 to 46,000 vpd between Routes 16 and 1.	The v/c ratio is between 0.00-0.80 on Route 27. The roadway is not considered congested.
Route 28	Route 28 ranges from 11,000 to 22,000 vpd. Traffic generally increases closer to the intersection with Route 1.	The v/c ratio of the southern portion of Route 28 is generally greater than 1, which indicates the road is congested in both the a.m. and p.m. peak hours.
Chalan Lujuna	Chalan Lujuna ranges from 5,400 to 6,100 vpd.	The v/c ratio is between 0.00-0.80 on Chalan Lujuna. The roadway is not considered congested.

Legend: ADT = average daily traffic; AFB = Air Force Base; v/c = volume to capacity; vpd = vehicles per day.

Figure 4.2-71 through Figure 4.2-78 show future levels of traffic congestion in the North, Central, Apra Harbor, and South Regions for the a.m. and p.m. peak hours for 2030. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested.

The results of the future operational analysis are shown in Table 4.2-31 for both the 2030 a.m. and p.m. conditions. As shown in Table 4.2-31, islandwide, there are 24 out of 42 intersections and three out of six access points with LOS F for at least one peak hour, which is considered unacceptable. The following intersections are operating at LOS F in the a.m. and p.m. peak hours in 2030:

- Route 1/28
- Route 1/27
- Route 1/3
- Route 1/14 (North San Vitores)
- Route 1/14A
- Route 1/10A
- Route 1/14 (ITC)
- Route 1/30
- Route 1/8
- Route 4/7A
- Route 4/10
- Route 8/10
- Route 16/27
- Route 16/10A
- Route 15/29
- Route 26/15
- Route 28/27A
- Access Point at Route 16 – Navy Barrigada Residential Gate

There is also a difference between the no-action alternative and Alternatives 1 and 3 in terms of LOS in 2030. Islandwide, there are 17 intersections and one access point in the no-action alternative that have LOS F in both the a.m. and p.m. peak hours in 2030. For Alternative 1, this number decreases to 13 intersections and one access point in 2030; for Alternative 3, 16 intersections and one access point; and for Alternative 8, 14 intersections and one access point. This is due to the proposed action, which includes the roadway widening and intersection improvement projects; however, the results for the no-action alternative in 2030 are worse than 2014 due to natural population growth. That, in conjunction with the departure of the construction population around 2019, accounts for the similarity in the number of intersections operating at LOS F in Alternatives 1, 3, and 8, as compared with the no-action alternative. In addition, the inclusion of the roadway widening projects in 2030 accounts for a lessening in congestion impacts.

Public Transportation Impacts

The impacts to the public transportation system would result from construction delays associated with the roadway improvements included in the no-action alternative. This could affect the LOS for transit riders by increasing travel times, longer headways, and missed transfers.

Pedestrian and Bicycle Impacts

Impacts to the existing pedestrian and bicycle facilities would occur during construction of roadway improvements included in the no-action alternative. This includes a loss of intermittent sidewalk during the widening of Routes 8 and 26, as well as the removal of a shoulder along Route 1. Intersection improvements would impact safe pedestrian and bicycle crossing during the period of reconstruction.

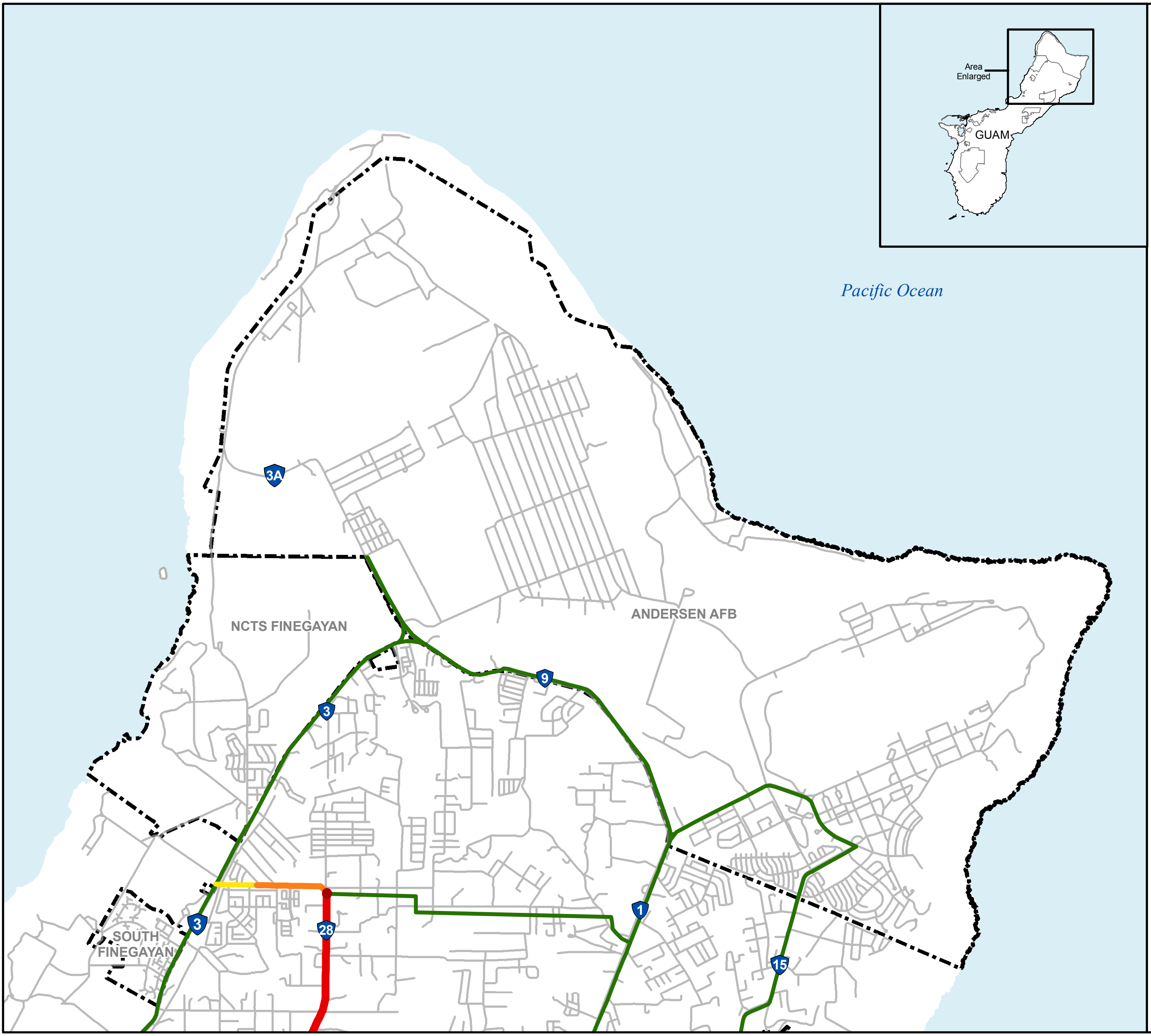


Figure 4.2-71
North Region–
2030 a.m. Peak
Congestion Levels –
No-Action Alternative

Legend

Volume to Capacity Ratios

- 🟩 0.00 - 0.90
- 🟨 0.91 - 0.99
- 🟧 1.00 - 1.15
- 🟥 1.16 - 1.50
- 🟥 1.51 or more

Existing Land Use

- Streets
- Military Installation

Printing Date: April 2, 2010

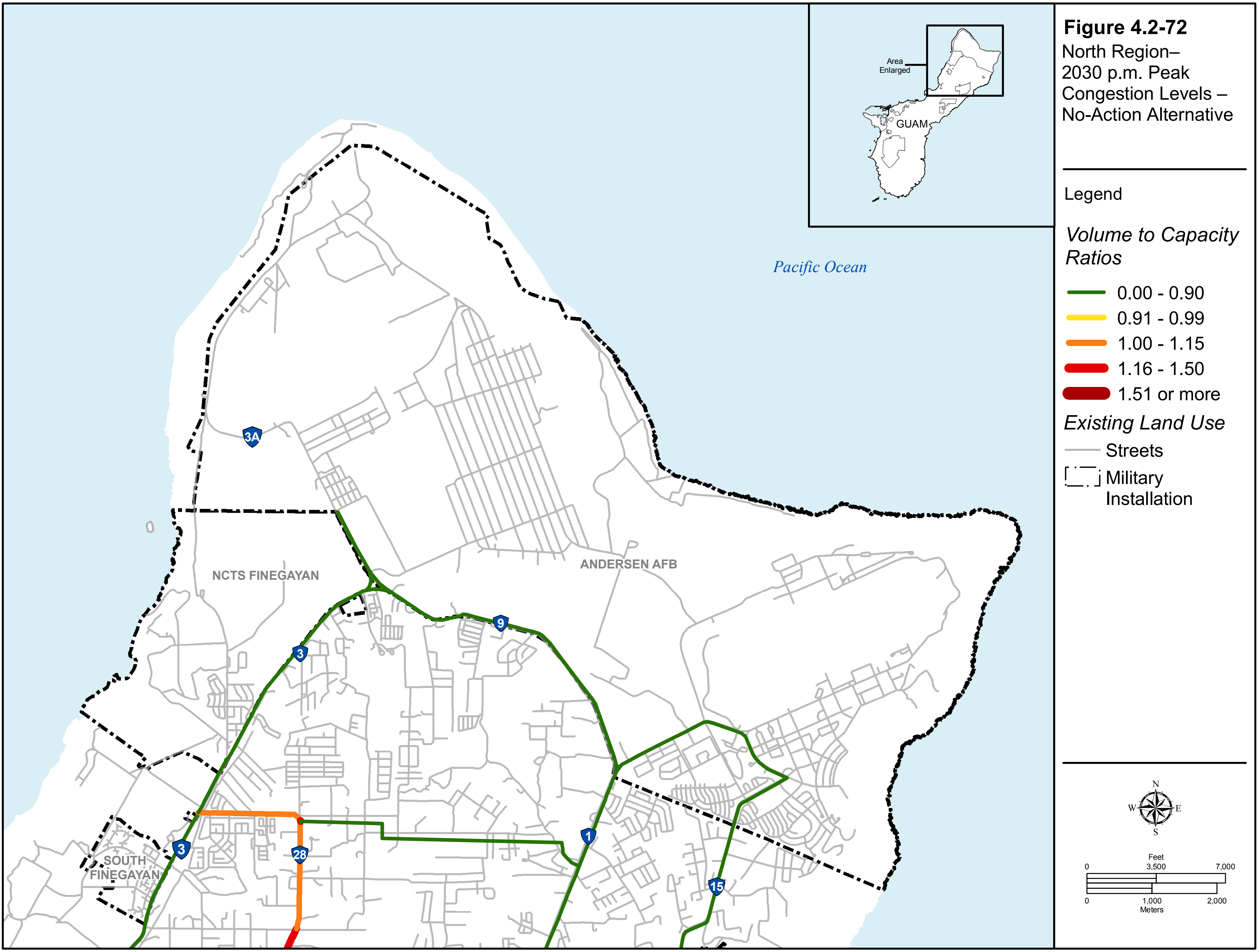


Figure 4.2-72
North Region–2030 p.m. Peak Congestion Levels – No-Action Alternative

Printing Date: April 2, 2010

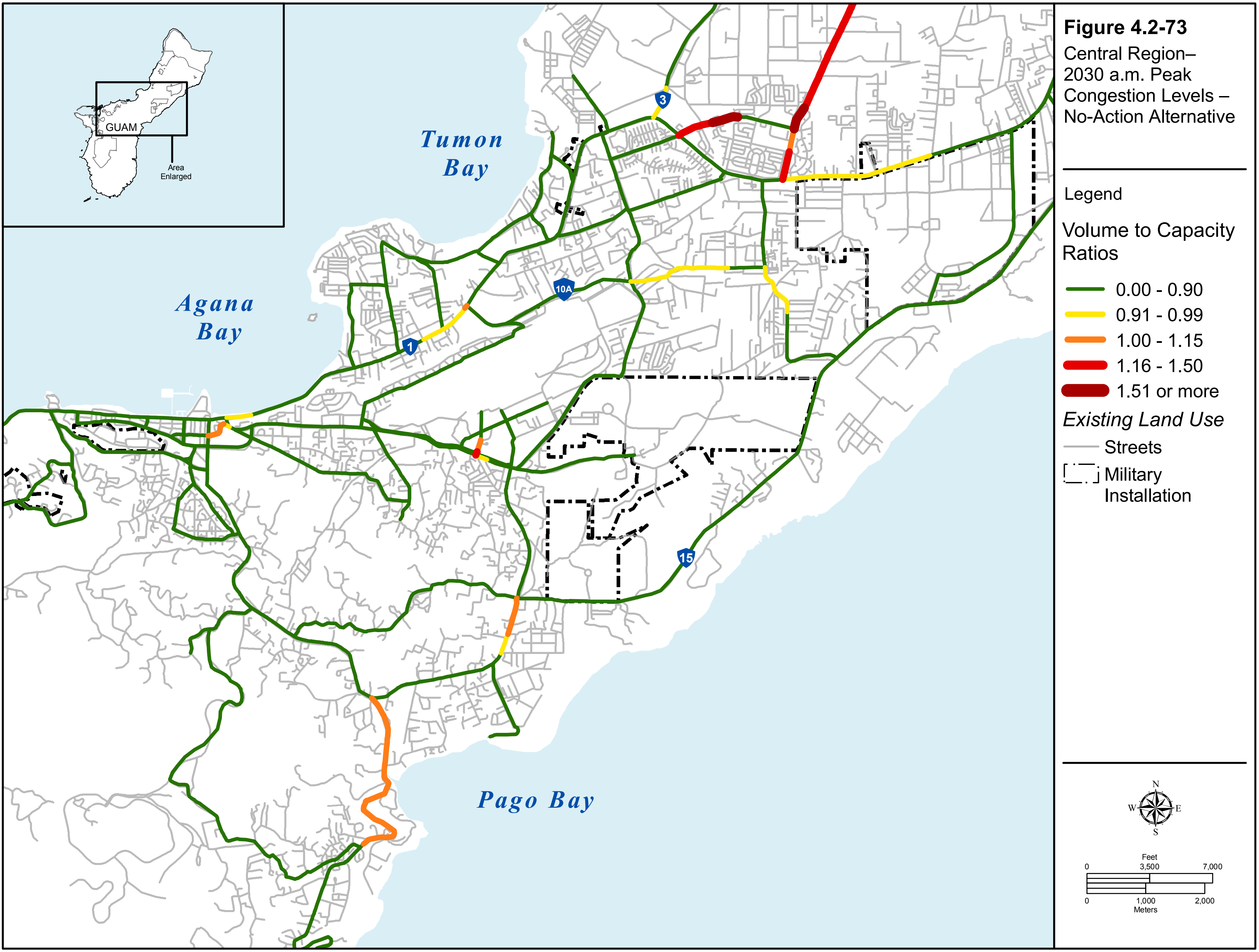
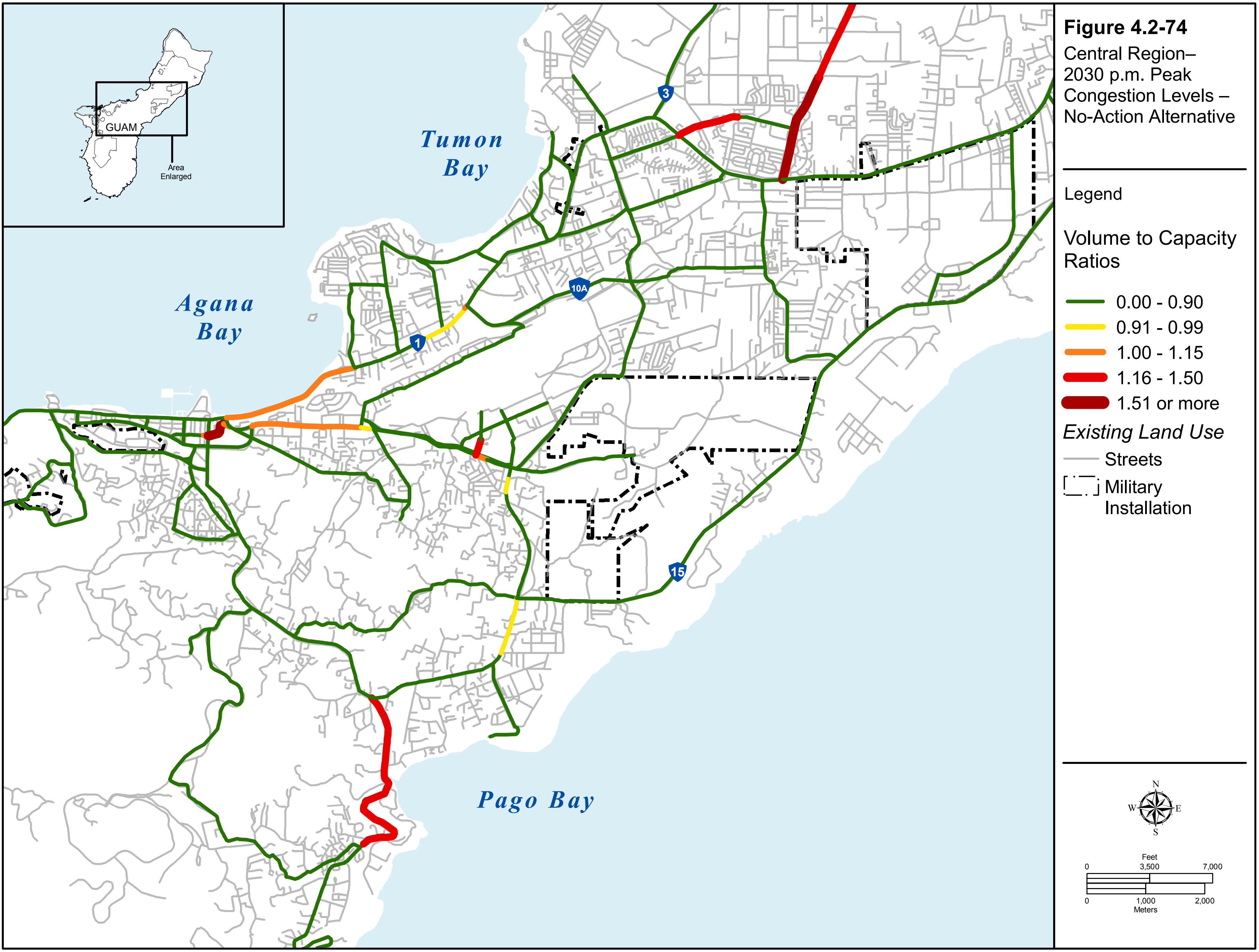


Figure 4.2-73
Central Region– 2030 a.m. Peak Congestion Levels – No-Action Alternative

Printing Date: April 2, 2010

Figure 4.2-74

Central Region–2030 p.m. Peak Congestion Levels – No-Action Alternative



Printing Date: April 2, 2010

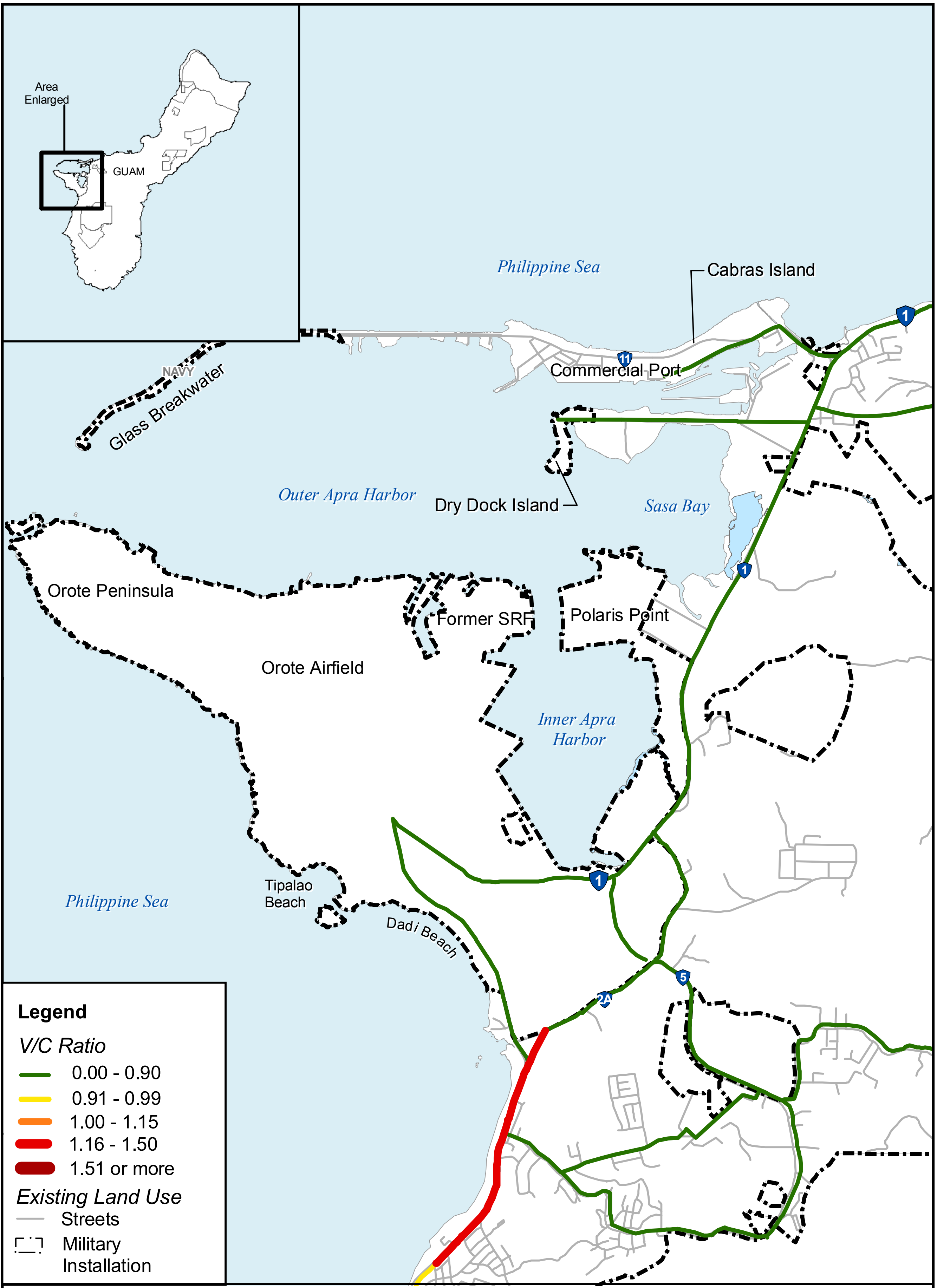
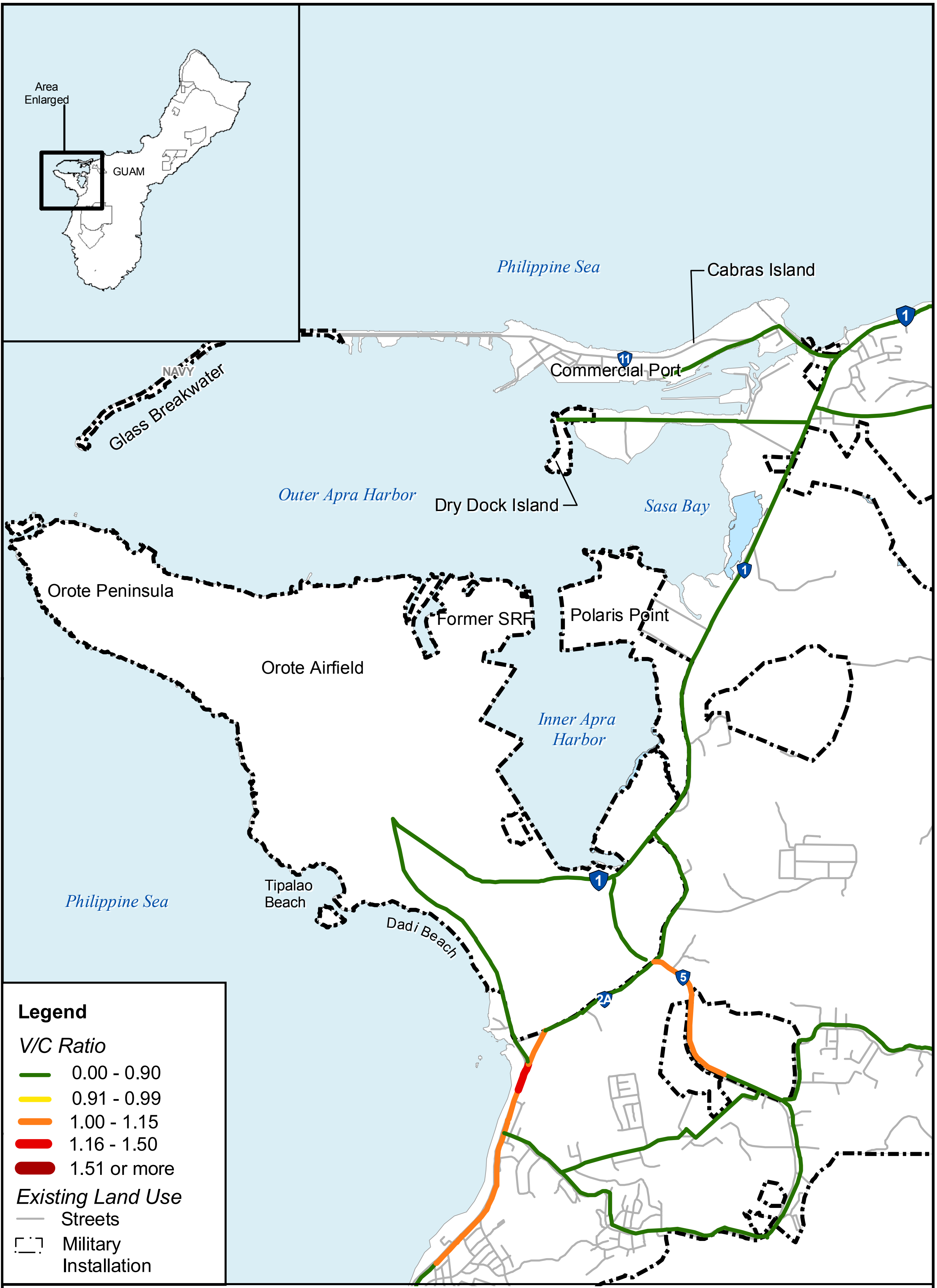


Figure 4.2-75
Apra Harbor Region - 2030 a.m. Peak Congestion Levels- No-Action Alternative

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4192_MXDs\Figure 4.2-75. Apra Harbor Region - 2030 a.m. Peak Congestion Levels- No-Action Alternative.mxd



Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4192_MXDs\Figure 4.2-76. Apra Harbor Region - 2030 p.m. Peak Congestion Levels- No-Action Alternative.mxd

Figure 4.2-76
Apra Harbor Region - 2030 p.m. Peak Congestion Levels- No-Action Alternative

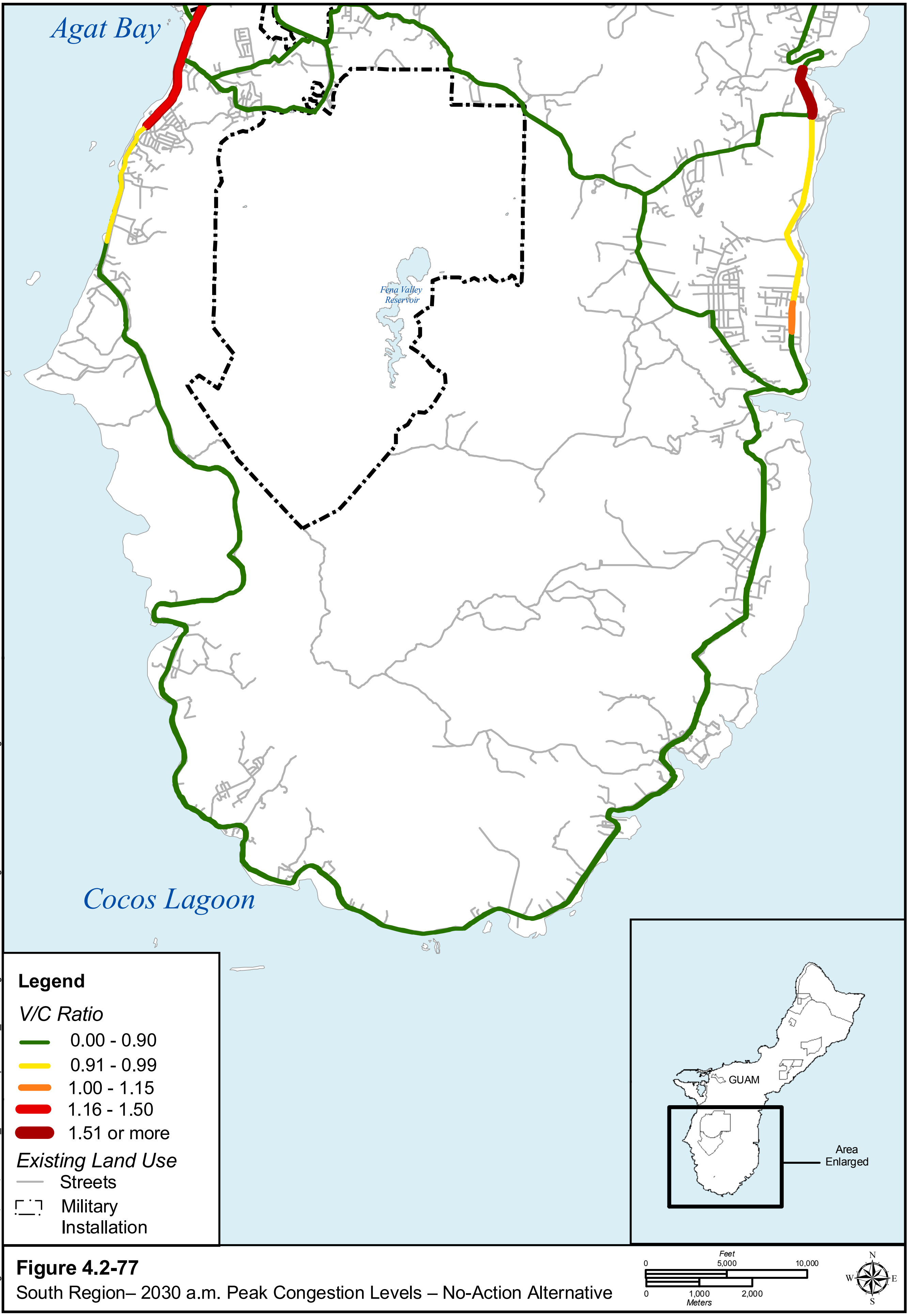


Figure 4.2-77
South Region– 2030 a.m. Peak Congestion Levels – No-Action Alternative

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-77. South Region– 2030 a.m. Peak Congestion Levels – No-Action Alternative.mxd

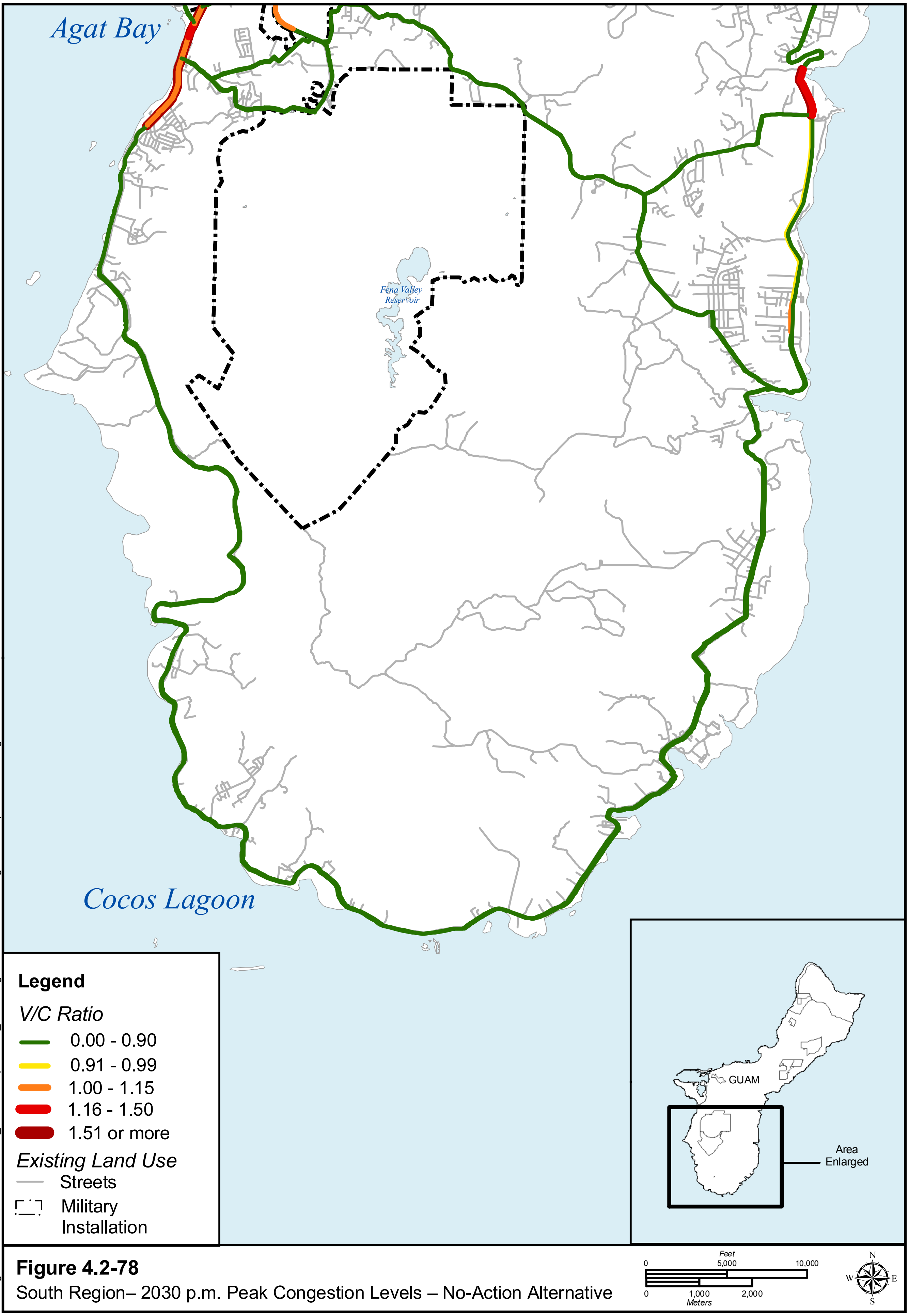


Figure 4.2-78

South Region– 2030 p.m. Peak Congestion Levels – No-Action Alternative

Printing Date: Oct 15, 2009, J:\Guam_Roads\Chapter 4\92_MXDs\Figure 4.2-78. South Region– 2030 p.m. Peak Congestion Levels – No-Action Alternative.mxd

Table 4.2-31. No-Action Alternative Future Level of Service and Delay Results

	2030			
	a.m. Peak Hour		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*				
Route 1/9	B	15.8	B	14.6
Route 1/29	F	87.6	E	60.5
Route 1/28	F	226.2	F	157.7
Route 1/26	E	75.8	F	229.8
Route 1/27	F	157.2	F	533.7
Route 1/27A	E	67.2	F	189.5
Route 1/3	F	158.4	F	306.9
Route 1/16	D	52.2	F	305.5
Route 1/14 (North San Vitores)	F	82.8	F	361.2
Route 1/14A	F	124.1	F	259.9
Route 1/10A	F	82.9	F	117.2
Route 1/14B	E	60.5	F	91.8
Route 1/14 (ITC)	F	93.3	F	212.5
Route 1/30	F	273.9	F	440.9
Route 1/8	F	107.6	F	94.1
Route 1/4	D	43.4	D	38.6
Route 1/6 (westerly)	A	7.8	B	15.6
Route 1/11	B	18.8	C	26.8
Route 1/6 (Adelup)	C	24.1	F	91.7
Route 1/Polaris Point	A	4.3	A	6.2
Route 1/2A	E	58.8	E	55.5
Route 5/2A	D	53.0	C	22.7
Route 2/12	F	83.1	C	25.4
Route 3/28	B	17.8	C	21.4
Route 4/7A	F	298.8	F	196.9
Route 4/10	F	95.5	F	115.9
Route 4/17	D	46.6	D	48.2
Route 8/33	C	31.2	F	147.3
Route 8/10	F	122.0	F	116.5
Route 10/15	D	49.7	F	101.1
Route 16/27A	C	24.3	C	26.4
Route 16/27	F	275.1	F	486.4
Route 16/10A	F	874.2	F	208.7
Route 26/25**	F	270.1	E	71.7
Unsignalized***				
Route 5/17	D	28.9	E	47.8
Route 3/3A/9	A	9.5	B	10.1
Route 4/4A	D	27.9	C	21.2
Route 7/7A	F	77.7	E	114.5
Route 15/29****	F	NA	F	NA
Route 17/4A	C	17.0	C	17.9
Route 26/15	F	134.8	F	2494.6
Route 28/27A	F	353.1	F	437.8
Military Access Points				
Route 3 - Main Cantonment/Commercial Gate	C	21.4	C	15.7
Route 3 – Main Cantonment/Residential Gate	D	32.1	C	20.7
Route 3 - South Finegayan/Residential Gate	C	22.1	F	51.4

	2030			
	a.m. Peak Hour		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*
Route 1 – South Andersen Main Gate/(Turner Street)	B	13.5	F	458.6
Route 16 – Navy Barrigada Residential Gate****	F	NA	F	NA
Route 15 – Barrigada Air Force/(Chada Street)	E	50.0	E	44.4
Route 5 – Naval Munitions Site/Harmon Road	A	9.7	A	9.8

Legend: ITC = International Trade Center; LOS = Level of Service; NA = Not Applicable.
Notes: *Signalized intersection LOS based on average delay for the overall intersection.
**Intersection would be signalized in future no action scenario.
***Unsignalized intersection LOS based on approach delay on STOP-controlled approach.
****Delay exceeded maximum calculated value.

4.2.2.6 On Base Roadways Summary of Impacts

A summary of potential impacts is described in Table 4.2-32.

Table 4.2-32. Summary of Potential Impacts by Alternative for On Base Roads

Potentially Impacted Resource	*Alternative 1*	*Alternative 2**	*Alternative 3*	*Alternative 8*
North				
Andersen: Construction	LSI	LSI	LSI	LSI
Andersen: Operation	LSI	LSI	LSI	LSI
Finegayan: Construction	LSI	LSI	LSI	LSI
Finegayan: Operation	LSI	LSI	LSI	LSI
Central				
Andersen South: Construction	LSI	LSI	LSI	LSI
Andersen South: Operation	LSI	LSI	LSI	LSI
Barrigada: Construction	LSI	LSI	LSI	LSI
Barrigada: Operation	LSI	LSI	LSI	LSI
South				
Naval Base Guam: Construction	LSI	LSI	LSI	LSI
Naval Base Guam: Operation	LSI	LSI	LSI	LSI
NMS: Construction	NI	NI	NI	NI
NMS: Operation	NI	NI	NI	NI

Legend: LSI = Less Than Significant Impact; NI= No Impact; SI = Significant Impact; *Preferred Alternative.

4.2.2.7 Off Base Roadways Summary of Impacts

Table 4.2-33 shows the LOS results for all of the intersections for the following:

- 2008 Existing Conditions
- 2014 No Action
- 2014 Alternative 1
- 2014 Alternative 3
- 2014 Alternative 8
- 2030 No Action
- 2030 Alternative 1
- 2030 Alternative 3
- 2030 Alternative 8

Table 4.2-33. Comparison of the No-Action Alternative, Alternatives 1 and 2, Alternative 3, and Alternative 8

Overall Intersection Level of Service Analysis Results - Existing Conditions and Alternatives Comparison

S.NO	INTERSECTION	Existing Conditions				2014 No Action				2014 Alternative 1/2				2014 Alternative 3				2014 Alternative 8				2030 No Action				2030 Alternative 1/2				2030 Alternative 3				2030 Alternative 8			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[1]	Delay[2]
1	ROUTE 1 AND ROUTE 9	C	25.8	D	46.1	B	11.6	B	11.9	C	27.6	D	39.8	C	25.9	D	38.2	C	25.8	D	38.2	B	16.8	B	14.6	C	22.5	D	52.2	C	24.4	D	53.0	C	23.3	D	50.0
2	ROUTE 1 AND ROUTE 29	F	87.4	C	24.0	D	62.2	C	32.5	F	256.2	F	128.7	F	347.0	F	278.8	F	338.4	F	192.3	F	87.6	E	60.5	E	65.5	E	67.7	F	85.3	F	90.5	E	73.2	E	67.7
3	ROUTE 1 AND ROUTE 28	C	30.0	D	40.6	F	227.3	F	120.7	F	300.8	F	301.0	F	255.0	F	275.0	F	275.4	F	252.3	F	226.2	F	157.7	F	216.0	F	104.5	F	190.5	F	139.5	F	215.5	F	115.3
4	ROUTE 1 AND ROUTE 26	C	33.8	E	58.5	C	21.0	F	84.1	F	103.0	F	278.1	F	136.1	F	279.1	F	164.6	F	358.3	E	76.8	F	229.8	E	75.8	F	166.5	F	99.4	F	209.1	F	146.9	F	250.6
5	ROUTE 1 AND ROUTE 27	E	74.6	D	51.8	F	1212.9	F	814.1	F	1830.9	F	928.9	F	1937.2	F	1013.1	F	210.5	F	627.3	F	187.2	F	533.7	F	127.4	F	274.3	F	181.1	F	399.6	F	179.0	F	229.4
6	ROUTE 1 AND ROUTE 27A	D	37.1	F	91.5	D	37.0	E	68.4	E	77.4	F	204.7	F	82.6	E	78.7	F	98.4	F	178	E	67.2	F	189.5	D	44.4	E	76.7	F	120.2	F	157.1	D	53.9	D	51.2
7	ROUTE 1 AND ROUTE 3	F	165.5	E	71.0	F	113.5	F	191.7	F	495.1	F	523.8	F	417.1	F	387.1	F	113.9	F	106.8	F	158.4	F	306.9	D	48.5	D	50.6	F	341.3	F	474.4	E	70.5	E	64.7
8	ROUTE 1 AND ROUTE 16	C	32.6	E	58.6	C	27.7	F	140.7	F	126.4	F	306.2	F	277.0	F	386.7	F	180.3	F	144.6	D	52.2	F	305.5	E	65.3	F	87.5	F	232.2	F	340.0	E	57.0	F	100.9
9	ROUTE 1 AND ROUTE 14 (North San Vitoris)	C	33.1	F	92.9	F	102.8	D	63.7	F	176.5	F	124.8	F	167.8	F	96.2	F	179.9	F	146.8	F	82.8	F	261.2	E	68.0	F	92.0	E	66.6	E	71.5	E	69.6	E	77.6
10	ROUTE 1 AND ROUTE 14A	D	52.1	E	69.6	F	226.8	F	155.4	F	313.6	F	326.8	F	307.3	F	338.1	F	312.4	F	309.2	F	124.1	F	289.9	F	112.2	F	131.8	E	71.0	F	112.3	E	74.2	F	126.0
11	ROUTE 1 AND ROUTE 10A	F	96.2	F	91.9	F	89.6	F	227.8	F	241.5	F	376.7	F	188.1	F	199.7	F	182.1	F	221.3	F	82.9	F	117.2	F	118.1	F	102.0	F	129.6	F	193.6	F	125.1	F	196.0
12	ROUTE 1 AND ROUTE 14B	D	43.3	C	30.6	E	77.6	D	44.3	F	168.4	F	159.1	F	149.4	F	144.0	F	153.4	F	146.2	E	60.5	F	91.8	F	83.9	E	78.2	E	79.8	E	78.5	F	90.4	E	79.5
13	ROUTE 1 AND ROUTE 14 (ITC)	D	51.4	F	116.2	E	70.3	F	171.3	F	234.7	F	428.6	F	127.0	F	294.6	F	155.9	F	318.3	F	93.3	F	212.5	F	182.5	F	275.1	F	176.8	F	315.8	F	112.6	F	267.2
14	ROUTE 1 AND ROUTE 30	E	67.8	D	51.5	F	271.7	F	262.5	F	408.1	F	560.6	F	348.3	F	495.2	F	365	F	308.6	F	273.9	F	440.9	F	104.7	F	267.2	F	140.5	F	250.3	F	146.2	F	285.3
15	ROUTE 1 AND ROUTE 8	B	19.3	C	34.1	C	29.0	D	46.4	F	216.2	F	143.5	F	162.2	F	164.3	F	200.1	F	199.7	F	197.6	F	94.1	F	97.6	F	127.5	F	162.7	F	186.5	E	77.8	F	180.4
16	ROUTE 1 AND ROUTE 4	C	23.2	C	20.4	C	27.1	C	30.1	C	24.3	D	44.6	C	24.8	D	40.1	C	26.4	D	36	D	43.4	D	38.6	C	32.4	F	140.2	C	30.5	F	107.2	C	33.6	D	35.8
17	ROUTE 1 AND ROUTE 6 (Adelup)	B	19.9	E	59.9	C	20.9	D	39.7	D	36.2	F	108.9	C	34.9	F	110.7	C	34.5	F	114	C	24.1	F	91.7	D	40.6	E	61.8	C	29.7	F	989.7	D	38.1	D	44.9
18	ROUTE 1 AND ROUTE 11	B	14.5	C	22.2	B	16.6	B	19.9	C	25.4	E	67.1	C	25.4	E	60.1	C	25.3	E	67.7	B	18.8	C	28.8	C	29.7	D	43.5	B	18.4	D	40.1	B	14.3	D	40.3
19	ROUTE 1 AND ROUTE 6 (Westerly)	B	10.0	C	23.1	B	10.5	B	12.0	D	53.2	C	23.6	D	50.7	B	17.1	D	49.5	C	24.1	A	7.8	B	15.6	B	18.4	C	22.0	C	27.4	C	23.0	B	10.4	C	22.0
20	ROUTE 1 AND POLARIS POINT	C	2.1	A	3.9	A	4.3	A	6.5	A	3.8	A	4.3	A	3.2	A	2.4	A	4.5	A	5.5	A	4.3	A	6.2	A	8.2	A	7.4	A	5.8	A	7.4	A	6.8	A	7.5
21	ROUTE 1 AND ROUTE 2A	B	15.9	C	29.1	F	92.1	E	70.6	F	94.1	F	82.1	F	88.7	E	68.3	F	89.4	E	59.8	E	58.8	E	66.5	E	66.8	E	57.2	E	67.5	D	54.1	E	67.6	E	67.5
22	ROUTE 5 AND ROUTE 2A	D	37.6	C	33.9	D	44.5	C	20.9	E	79.4	D	36.9	E	69.4	C	21.5	E	69.6	C	22.9	D	53.0	C	22.7	F	96.3	C	26.2	E	55.1	C	22.8	E	79.9	C	25.9
23	ROUTE 5 AND ROUTE 17	B	12.1*	B	11.0*	C	23.7*	C	15.9*	C	13.1*	C	29.2*	B	13.3*	C	18.3*	B	13.1*	C	17.1*	D	28.9*	E	47.8*	F	56.8*	F	149.6*	E	42.5*	F	128.5*	B	14.8*	E	42.4*
24	ROUTE 2 AND ROUTE 12	C	26.0	B	19.2	E	65.4	B	17.6	F	135.0	C	26.0	C	29.0	C	25.5	C	31.6	C	24.9	F	82.1	C	25.4	C	27.8	C	27.1	C	30.6	C	24.9	C	30.7	C	27.0
25	ROUTE 3 AND ROUTE 3A	B	10.1*	A	9.6*	B	11.9*	A	9.7*	C	19.7*	F	74.2	F	142.2*	F	565.9*	F	178.9*	F	561.5*	A	9.5*	B	10.1*	B	11.6*	F	79*	E	47.2*	F	100.7*	D	27.0*	F	149.7*
26	ROUTE 3 AND ROUTE 28	C	26.8	B	17.4	C	20.8	B	10.9	F	85.1	F	227.1	F	96.2	F	92.8	E	57.9	F	131.1	B	17.8	C	21.4	C	26.0	D	36.9	F	90.2	D	53.9	C	33.2	D	47.5
27	ROUTE 4 AND ROUTE 7A	C	23.2	E	57.8	F	106.0	F	181.3	F	270.6	F	989.8	F	274.6	F	1007.5	F	273.8	F	841.8	F	298.8	F	196.9	F	607.3	F	534.1	F	596.7	F	339.2	F	372.9	F	654.2
28	ROUTE 4 AND ROUTE 10	E	64.5	E	59.5	E	69.7	E	79.2	F	190.2	F	166.1	F	164.5	E	61.4	F	180.5	F	87.9	F	95.5	F	115.9	F	199.5	E	65.1	F	199.7	E	65.9	F	198.7	E	71.0
29	ROUTE 4 AND ROUTE 17	C	24.9	C	21.2	C	25.8	C	24.1	C	35.0	D	42.5	C	34.5	D	39.4	C	33.9	C	34.3	D	46.6	D	48.2	D	39.6	E	57.7	D	39.6	E	55.9	D	40.1	E	56.2
30	ROUTE 4 AND ROUTE 4A	C	16.9*	B	11.4*	C	16.7*	C	16.2*	C	23.9*	C	17.1*	C	21.7*	B	17.0*	C	23.3*	C	17.2*	D	27.9*	C	21.2*	E	49.7*	F	494.2*	E	44.3*	C	21.9*	E	47.4*	C	24.0*
31	ROUTE 7 AND ROUTE 7A	C	15.1*	C	19.9*	F	225.7*	F	127.7*	F	167.7*	F	238.7*	F	173.9*	F	290.6*	F	174.7*	F	290.0*	F	77.7*	E	114.5*	D	29.2*	F	105.1*	D	28.3*	F	87.7*	F	174.7*	F	200.8*
32	ROUTE 8 AND ROUTE 33	F	81.6	F	162.9	D	38.4	F	91.5	E	64.8	F	145.2	C	32.6	D	46.2	D	38.7	E	72.1	C	31.2	F	147.3	D	54.6	F	81.7	D	52.9	C	29.1	D	46.5	E	77.8
33	ROUTE 8 AND ROUTE 10	F	140.1	E	67.5	E	58.9	F	106.5	F	278.7	F	339.0	F	227.6	F	317.6	F	361.4	F	474.5	F	172.0	F	116.5	F	96.9	F	172.7	F	137.9	F	171.8	F	177.3	F	218.4
34	ROUTE 10 AND ROUTE 15	F	80.8	E	56.3	E	79.3	D	53.9	F	166.4	F	144.7	F	178.5	F	139.6	F	280.9	F	235.5	D	49.7	F	101.1	F	196.9	F	182.3	F	157.3	F	147.2	F	197.9	F	179.1
35	ROUTE 15 AND ROUTE 29	D	30.7*	C	18.3*	F	142.7*	F	220.9*	F	NA*	F	830.9*	C	27.0	C	22.8	C	22.9	C	24.1	F	Error	F	633.5*	C	27.7	C	25.4	F	161.4	C	26.2	C	32.9	C	30.0
36	ROUTE 16 AND ROUTE 27A	C	34.4	C	25.9	C	25.1	B	16.0	C	26.3	D	61.9	F	126.0	F	175.8	C	28.9	E	76	C	24.3	C	26.4	C	27.4	C	34.2	D	44.9	F	90.6	C	31.4	D	35.8
37	ROUTE 16 AND ROUTE 27	F	112.4	F	89.4	F	207.6	F	302.1	F	389.3	F	601.5	F	534.1	F	685.7	F	459.6	F	667.3	F	275.1	F	486.4	F	348.0	F	288.7	F	485.3	F	470.0	F	361.1	F	336.6
38	ROUTE 16 AND ROUTE 10A	F	125.4	F	89.3	F	540.8	F	674.4	F	290.1	F	566.1	F	232.4	F	149.5	F	668.5	F	494.6	F	874.2	F	209.7	F	123.1	F	123.5	F	210.3	F	692.7	F	582.9	F	488.7
39	ROUTE 17 AND ROUTE 4A	B	14.0*	B	11.4*	C	15.9*	C	15.6*	B	12.9*	B	14.0*	B	13.2*	B	14.0*	B	13.0*	B	14.0*	C	17.0*	C	17.9*	B	13.6*	C	18.7*	C	16.5*	C	18.5*	C	16.1*	C	18.6*
40	ROUTE 26 AND ROUTE 25	F	81.5*	F	400.4*	C	23.9	C	27.8	F	94.9	E	70.1	F	168.5	D	40.1	F	118.2	D	42.4	F	270.1	E	71.7	C	31.2	D	41.0	F	95.4	E	62.3	F	110.1	F	119.3
41	ROUTE 26 AND ROUTE 15	F	202.4*	E	39.5*	E	43.2*	E	46.2*	F	2554.1*	F	3440.9*	F	2444.6*	F	2416.0*	D	45	C	24.1	F	124.8*	F	2494.0*	C	27.9	C	32.1	C	30.2	C	25.4	F	184.9	F	160.2
42	ROUTE 28 AND ROUTE 27A	F	152.9*	E	37.4*	F	190.1*	F	237.3*	C	31.8	F	402.8	D	38.6	E	60.6	C	47.4	F	89.4	F	353.1*	F	437.8*	D	36.6	D	36.6	D	41.3	E	65.2	C	31.3	E	69.6
	Access Points - NCTS Finegayan					NOT APPLICABLE, DESIGN AND EVALUATION OF ACCESS POINTS COMPLETED USING 2030 TIME HORIZON																															
1	ROUTE 3 AND NORTH (COMMERCIAL) GATE**	C	21.4	C	15.7																	N/A	N/A	N/A	N/A	D	12.5	C	20.3	F	91.6	D	39.9	B	10.4	C	30.4
2	ROUTE 3 AND SOUTH (MAIN) GATE**	D	32.1	C	20.7																	N/A	N/A	N/A	N/A	C	33.5	E	58.6	D	61.5	F	158.9	D	41.0	E	56.7
	Access Points - South Finegayan																																				
3	ROUTE 3/CONTROL TREE DRIVE (RESIDENTIAL) GATE	C	22.1	F	51.4																	F	122.3*	F	74.2*	C	26.7	B	18.5	F	114.6	D	50.1	C	31.1	B	15.0
	Access Points - AAFB																																				
5	ROUTE 9/AAFB NORTH GATE**	N/A	N/A	N/A	N/A																	E	39.5*	D	36.1*	F	Error*	F	Error*	F	1031.0*	F	9081.1*	F	1031.0*	F	Error*
	Access Points - South Anderson																																				
6	ROUTE 1/TURNER STREET (MAIN GATE)	B	11.5*	D	34.9*																	B	13.5*	F	459.6*	C	32.4	E	79.1	C	32.4	E	79.5	C	32.4	E	78.8
7	ROUTE 15/ ROAD 1.36 m e/o ROUTE 26 (SECOND GATE)**	N/A	N/A	N/A	N/A																	N/A	N/A	N/A	N/A	C	22.1*	C	22.8*	C	22.1*	C	21.1*	C	22.1*	C	22.6*
	Navy Barrigada																																				
8	ROUTE 16 AND SABANA BARRIGADA	F	75.5*	F	62.4*																	F	Error*	F	Error*	N/A	N/A	N/A	N/A	D	37.1	F	84.5	N/A	N/A	N/A	N/A
9	ROUTE 8A/BARRIGADA CONNECTOR**	N/A	N/A	N/A	N/A																	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Barrigada AF																																				
10	ROUTE 15 AND CHADA STREET	E	37.4*	C	18.2*																	E	50.0*	E	44.4*	N/A	N/A	N/A	N/A	E	64.4	C	25.9	D	48.4	D	43.3
	Naval Ordinance Annex																																				
11	ROUTE 5 AND HARMON ROAD	A	9.8*	B	10.2*																	A	9.7*	A	9.8*	A	9.5*	A	10.5*	A	9.8*	A	10.6*	A	9.8*	A	10.6*

[1]Level of Service [2]Control Delay in Seconds Per Vehicle

NOTES: Signalized intersection LOS based on average delay for the overall intersection
*Unsignalized intersection LOS based on approach delay on STOP-controlled approach
**The intersections have not built in existing condition
Error = Delay exceeded maximum calculated value
🟥 Indicates LOS F

Source: Parsons Brinckerhoff

All of the LOS F listings are shown in red text. There is a considerable difference between the 2008 existing conditions and the future build conditions in both 2014 and 2030. Also important to note is the results for Alternative 3, which indicate worse intersection traffic conditions than Alternatives 1, 2, and 8. Table 4.2-34 lists the number of intersections for each alternative indicating LOS F in at least one peak hour and the number indicating LOS F in both the a.m. and p.m. peak hours.

Table 4.2-34. Comparison of Alternatives 1 and 2, Alternative 3, and Alternative 8

	No-Action Alternative 2014	*Alternatives 1 and 2 2014*	*Alternative 3 2014*	*Alternative 8 2014*	*No-Action Alternative 2030*	*Alternatives 1 and 2 2030*	*Alternative 3 2030*	*Alternative 8 2030*
LOS F in at least one peak hour	17 intersections	30 intersections	27 intersections	26 intersections	24 intersections 3 access points	22 intersections 1 access point	24 intersections 5 access points	18 intersections 1 access point
LOS F in both peak hours	12 intersections	24 intersections	23 intersections	22 intersections	17 intersections 1 access point	13 intersections 1 access point	16 intersections 1 access point	14 intersections 1 access point

Legend: LOS = Level of Service.

In both 2014 and 2030, Alternative 3 has slightly more intersections with LOS F, but the amount of delay at those intersections and other intersections is higher. For example, in 2030, the delay for the Route 16/10A intersection is 123.5 seconds in the p.m. for Alternative 1, 692.7 seconds in the p.m. for Alternative 3, and 488.7 seconds in the p.m. for Alternative 8. The comparisons in delay between alternatives can also be found in Table 4.2-33.

Table 4.2-35 summarizes the potential impacts of each action alternative and the no-action alternative. In general, the LOS are comparable or slightly better with the proposed roadway improvements than in the no-action alternative. Roadway capacity is generally better for all of the alternatives compared to the no-action alternative. The exceptions to this are Alternative 3 in the Central Region, which has more significant impacts than the no-action alternative. In addition, the most noticeable difference is in the north, where all alternatives appear to be more congested than the no-action alternative. In terms of intersection capacity, the results are more consistent than roadway capacity.

Table 4.2-35. Summary of Potential Impacts by Alternative on Roadway and Intersection Capacity**

Potentially Impacted Resource	*Alternative 1*	*Alternative 2**	*Alternative 3*	*Alternative 8*
Roadway Capacity				
North	SI	SI	SI	SI
Central	LSI	LSI	SI	LSI
Apra Harbor	LSI	LSI	LSI	LSI
South	LSI	LSI	LSI	LSI
Intersection Capacity				
North	LSI	LSI	LSI	LSI
Central	LSI	LSI	LSI	LSI
Apra Harbor	LSI	LSI	LSI	LSI
South	LSI	LSI	LSI	LSI

Legend: LSI = Less Than Significant Impact; SI = Significant Impact; *Preferred Alternative.
**Assumes all off base roadway widening and intersection improvement projects are constructed.

4.2.2.8 Off Base Roadways Summary of Proposed Mitigation Measures

Table 4.2-36 summarizes the proposed mitigation measures for impacts to traffic during construction and operation of off base roadways.

Table 4.2-36. Summary of Off Base Roadway Projects Proposed Mitigation Measures

Phase	*Mitigation Measure*
Construction	Traffic Management Plan to include the following: • Travel demand management • Encourage moped and motorcycle use • Develop transportation demand measures to discourage single-occupant vehicle use • Stagger work hours • Provide corporate shuttles for local circulation • Better delivery system for purchases • Flextime – compressed work weeks • Promote trip reduction planning • Traffic management to follow the Manual on Uniform Traffic Control Devices • Phase construction to allow two lanes of traffic to remain open whenever possible • Reduce traffic to one lane if two lanes of traffic are not permissible • Clearly sign detour routes when closing all lanes to traffic • Implement appropriate measures to maintain access to businesses • Notify business owners of construction activities and duration of road closure well in advance • Keep pedestrian routes open and clear of debris • Notify all emergency services of construction activities and provide relative detour routes so as not to affect response times
Operation	Traffic Management Plan to include the following: • Travel demand management • Encourage moped and motorcycle use • Develop transportation demand measures to discourage single-occupant vehicle use • Stagger work hours • Provide corporate shuttles for local circulation • Better delivery system for purchases • Flextime – compressed work weeks • Promote trip reduction planning • Traffic management to follow the Manual on Uniform Traffic Control Devices

Implementation of force flow and adaptive program management mitigation measures could further reduce impacts to roadways by lowering peak population levels during the construction period. As described in Volume 7, Chapter 2, Sections 2.3 and 2.4, the implementation of force flow and adaptive program management mitigation measures would result in a delay in force flow population changes and a slower construction tempo, respectively. The notional force flow mitigation scenario would result in a more gradual increase in the number of direct DoD personnel and dependents that move to Guam as well as the associated indirect employment and induced population growth over a 4-year period (2014 through 2017) instead of the planned total relocation of active duty military personnel and their dependents by the year 2014. Instead of 10,552 active duty Marine Corps personnel on Guam by 2014, the notional force flow mitigation scenario would result in the annual addition of 2,468 in 2014, 4,265 in 2015, 6,959 in 2016, and 10,552 in 2017 active duty Marine Corps personnel from 2014 through 2017. The force flow mitigation scenario presumes the same construction period as the Preferred Alternative.

While the notional force flow mitigation scenario would extend the relocation of military personnel and dependents over a 4-year period, the adaptive program management approach would modify the construction sequence to reduce the workforce population over a longer construction period (through 2020) with 2014 as the peak construction year. This longer construction period would result in fewer construction workers required each year.

DoD may implement the force flow mitigation measure as well as adaptive program management of construction sequencing to reduce work force impacts. As discussed in Volume 7, specific mitigation measures identified in the Record of Decision would be monitored and a Construction Management Council will be formed to monitor impacts and advise DoD on the tempo and sequencing of construction projects over the course of the project. In this regard, the specific population reductions associated with workforce may vary depending on the monitoring of impacts at various locations.

Based on population projections shown in Volume 7, Chapter 2, Table 2.3-1 (no mitigation) and Table 2.3-2 (force flow), the notional force flow scenario could represent a population reduction of approximately 27%[3] in the year 2014. A corresponding reduction in traffic congestion during this year would be expected under this scenario, although the specific reduction would be dependent on variables such as the sequence of construction projects, location of worker housing, number of drivers or vehicles per household, and status of roadway improvements completed by this time. Force flow reductions would result in dispersal of incremental increases in traffic over a 3-year period (2014 through 2016) and avoidance of the considerable 1-year increase in population that would occur between 2013 and 2014. By the year 2017, traffic congestion would be the same as estimated for the Preferred Alternative. Table 4.2-37 summarizes the annual percent reduction in population for the notional force flow scenario and adaptive program management.

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[3] Under the notional force flow scenario, there would be an estimated population increase of 57,593 persons on Guam in the year 2014, as compared to estimated population increase of 79,178 persons for the Preferred Alternative. This represents approximately 27% fewer persons than the Preferred Alternative.

Table 4.2-37. Comparison of Estimated Population Decreases on Guam from Off-Island (Direct, Indirect and Induced) from Force Flow Reduction and Adaptive Program Management

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Preferred Alternative	11,038	27,835	44,301	52,575	79,178	64,918	41,919	33,431	33,431	33,608	33,608
Notional Force Flow Scenario	1,742	14,580	25,262	50,492	57,593	59,173	52,230	33,431	33,431	33,608	33,608
Approximate Decrease (%)	84	48	43	4	27	9	None	None	None	None	None
Notional Adaptive Program Management	1,742	14,580	25,262	38,662	41,178	40,490	41,194	41,139	40,366	37,357	33,608
Approximate Decrease (%)	84	48	43	26	48	38	2	(increase)	(increase)	None	None
Approximate Decrease from Implementation of Force Flow Reduction and Adaptive program management (%) [a]	84	48	43	15	38	20	2	(increase)	(increase)	None	None

Legend: Gray-Shading. Based on updates (May 2010) to programmed construction budget for years 2010 through 2013, population numbers decreased with related decreases in subsequent years. This decrease is unrelated to the two mitigation measures, but provides a more realistic scenario of early construction population.

[a] Assumes an average reduction in population based on the estimated population increase shown in Tables 2.3-1 through 2.3-3 (Volume 7).

As shown in Table 4.2-37, annual decreases in population would result from force flow reduction and adaptive program management strategies. Given the population decreases, it is conceivable that corresponding reductions in traffic congestion could occur in 2014. It is expected that fewer vehicles on the roads would result in fewer intersections operating at LOS F and potential decrease in the duration of delays at many of these intersections in 2014. The year 2014 represents the year of the greatest potential reduction in traffic based on projected population increases, with reductions diminishing through 2018. Traffic congestion in the year 2030 are expected to be the same as the Preferred Alternative since population increases would be no different with implementation of force flow reductions and adaptive program management.

The potential decrease in the number of intersections operating at LOS F would be determined during the adaptive program management process of identifying problem areas during monitoring of impacts. Modifications to the construction tempo and sequencing would be made to directly influence work force levels. It is expected that force flow reductions and adaptive program management strategies would be most effective in reducing traffic impacts in the North Region due to potential concentration of population in the vicinity of Finegayan and the existing level of congestion on roadways in this area. It is expected that adaptive program management strategies to reduce traffic impacts would initiate as early as 2011 and be subject to the outlay of projects and roadway improvements scheduled at that time.

In summary, these two mitigation measures would be effective as follows:

- Force flow reductions could effectively reduce traffic congestion as a result of the 27% decrease in population in 2014 and 9% decrease in 2016. This mitigation could reduce traffic impacts over three of the seven construction years, with no effect on 2030 traffic.
- Adaptive program management strategies that slow the tempo of construction would increase the number of construction years from seven to nine. This mitigation could effectively reduce traffic congestion as a result of the decrease in population between 2011 and 2016. This mitigation could reduce traffic impacts over the construction years, with no effect on 2030 traffic.
- When force flow reductions are combined with adaptive program management strategies, traffic congestion can be reduced as a result of population decreases between 2011 and 2018. This mitigation could reduce traffic impacts over the construction years, with no effect on 2030 traffic.
- With implementation of force flow reductions and adaptive program management strategies, traffic congestion would not be affected as a result of population in 2019 and thereafter.
- The level of traffic congestion can be reduced over most of the construction period; however, the resultant level of congestion will continue to be greater than existing conditions as represented by the no-action alternative.

4.2.3 Additional Limited Traffic Analysis

The DoD, Federal Highway Administration, and Government of Guam continue to work cooperatively to develop a funding plan for the off base roadway and intersection capacity projects. As of February 2010, a limited number of off base projects had been identified as having funding or reasonable expectation of being funded. Additional traffic analysis was completed for the 17 roadways and 42 intersections, assuming that only a limited number of projects would be funded. These projects are either Defense Access Road (DAR)-certified or determined to be DAR-eligible at this time (see Volume 1, Chapter 1, Section 1.1.4 Project Location, Funding, and Setting). The evaluation of the remaining road projects for DAR eligibility and certification is continuing. The additional analysis that was performed for Alternative 2 (the preferred alternative) included only the following off base roadway and intersection projects:

- Route 3, Route 28 to Route 9; widen to five lanes
- Route 9, Route 3 to Andersen AFB North gate; widen to five lanes
- Route 9, Andersen AFB to Route 1; widen to three lanes
- Route 1/3 Intersection
- Route 1/8 Intersection
- Route 1/11 Intersection
- Route 3/3A Intersection
- Military Access points as described for preferred alternative (Alternative 2)

The purpose of analyzing the impacts of only these roadway improvements is to determine the impact of the housing and additional military base traffic on Guam roadways with only a select number of roadway improvement projects. Since the majority of the relocated military population will be residing in the Finegayan area, the roadways adjacent to this area, Routes 3 and 9, will receive the majority of the new traffic. The majority of the roadway projects that are expected to be funded are in the Finegayan area.

The methodology for assessing traffic impacts is the same as described in Section 4.2.1.1. Impacts for both 2014 and 2030 were analyzed in the models. The results are reported for all of the roadways included in the full Alternative 2 analysis; however, only the roadway improvements listed above were included in the modeling of the impacts.

North

Roadway Projects

Future Traffic Impacts. A summary of future ADT volumes and the v/c ratio for 2014 and 2030 for Alternative 2 with limited improvement projects can be found in Table 4.2-38. Generally, there is a substantial increase in volumes on roadways from 2008 to 2014, and then a modest decrease in volumes on roadways from 2014 to 2030. This can be attributed to the increase in construction traffic and coinciding military expansion during peak construction time, which is in 2014, and then a reduction in traffic once off-island construction workers leave the island. These changes are most noticeable on roadways with direct access to the Main Cantonment area located on Route 3.

Figure 4.2-79 through Figure 4.2-83 show existing levels of traffic congestion in the North Region for the a.m. and p.m. peak hours, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91–0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested. The roads serving the DoD lands are expected to be the most congested. During both the morning and afternoon peaks of 2014 and 2030, the roads with the greatest congestion levels in the North Region are Routes 3 and 28, south of the Main Gate. Route 28 has the highest level of congestion (v/c ratio greater than 1.50). They both have an LOS F in both the a.m. and p.m. peak hours, which is considered severely congested. The results of the future operational analysis are shown in Table 4.2-38 for both the 2014 a.m. and p.m. and 2030 a.m. and p.m. conditions.

For most of the intersections, the LOS in both 2014 and 2030 was below the minimum acceptable LOS E. It is important to note that in many cases, the proposed intersection improvements do not improve the LOS level; however, they do decrease the amount of delay a driver would experience at an intersection. As stated previously, each LOS has a range of seconds of delay. Anything greater than 80.0 seconds of delay at signalized intersections or 50.0 seconds of delay at unsignalized intersections is considered LOS F. There is no upper end for delay for LOS F, which is why an intersection could greatly decrease in the amount of delay while still being LOS F. For the North Region, there are two intersections, Route 1/29 and Route 3/28, for which the traffic is worse in 2014 than in 2030 in both the a.m. and p.m. peak hours. This can be attributed to an increase in traffic associated with construction activity and military personnel in 2014.

As shown in Table 4.2-39, there are four intersections and one access point with LOS F for at least one peak hour, which is considered unacceptable; and one of the intersections, Route 15/29 is operating at LOS F in both the a.m. and p.m. for 2014 and 2030. The worst intersection in the North Region is Route 15/29, which is operating at LOS F with heavy delays in the a.m. and p.m. peak hours in 2014.

Table 4.2-38. Alternative 2 (with Limited Projects) Future ADT and Volume to Capacity Ratio Summary – North Region

	2014		*2030*	
Roadway	*ADT Summary*	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 1	Route 1 ranges from 24,000 to 37,000 vpd. Traffic decreases as Route 1 approaches Andersen AFB.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.90, which indicates that the roadway is not congested.	Route 1 ranges from 23,000 to 37,000 vpd. Traffic decreases as Route 1 approaches Andersen AFB.	The v/c ratio in both the a.m. and p.m. peak is 0.00-0.90, which indicates the roadway is not congested.
Route 3	Route 3 ranges from 23,000 to 66,000 vpd. Traffic decreases north of the intersection with Route 28.	The portion of Route 3 south of the Residential Gate, as well as between Route 28 and the Main Gate, have a v/c ratio of 1.00-1.15 in the a.m. and p.m. peak. This portion of the roadway is considered congested. North of the Commercial Gate, Route 3 has a v/c ratio of 0.00-0.90 during peak hours, which indicates that this part of the roadway is not congested.	Route 3 ranges from 20,000 to 37,000 vpd. Traffic decreases north of the intersection with Route 28.	The portion of Route 3 south of the Residential Gate has a v/c ratio of 1.0-1.15 in the a.m. peak and 1.16-1.5 during the p.m. peak. Route 3 north of the Residential Gate has a v/c ratio of 0.00-0.9 during peak hours. The roadway is considered congested.
Route 9	Route 9 ranges from 11,000 to 20,000 vpd. There is a decrease in traffic east of the two residential developments on Route 9.	Route 9 has a v/c ratio of 0.00-0.90 in both the a.m. and p.m. peak hours. The roadway is not considered congested.	Route 9 ranges from 10,000 to 16,000 vpd. There is a decrease in traffic east of the two residential developments on Route 9.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.90, which indicates that the roadway is not congested.
Route 15	Route 15 has 7,300 vpd in the North.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.90, which indicates that the roadway is not congested.	Route 15 has 7,600 vpd in the North.	The v/c ratio in both the a.m. and p.m. peak conditions is 0.00-0.90, which indicates that the roadway is not congested.
Route 28	Route 28 ranges from 21,000 to 22,000 vpd. Traffic increases closer to the intersection with Route 1.	Route 28 has a v/c ratio greater than 1.51 in both the a.m. and p.m. peak hours, which indicates the roadway is congested.	Route 28 ranges from 16,000 to 17,000 vpd. Traffic increases closer to the intersection with Route 1.	In the a.m. peak, Route 28 has a v/c ratio greater than 1.16. The roadway is considered congested during peak hours.

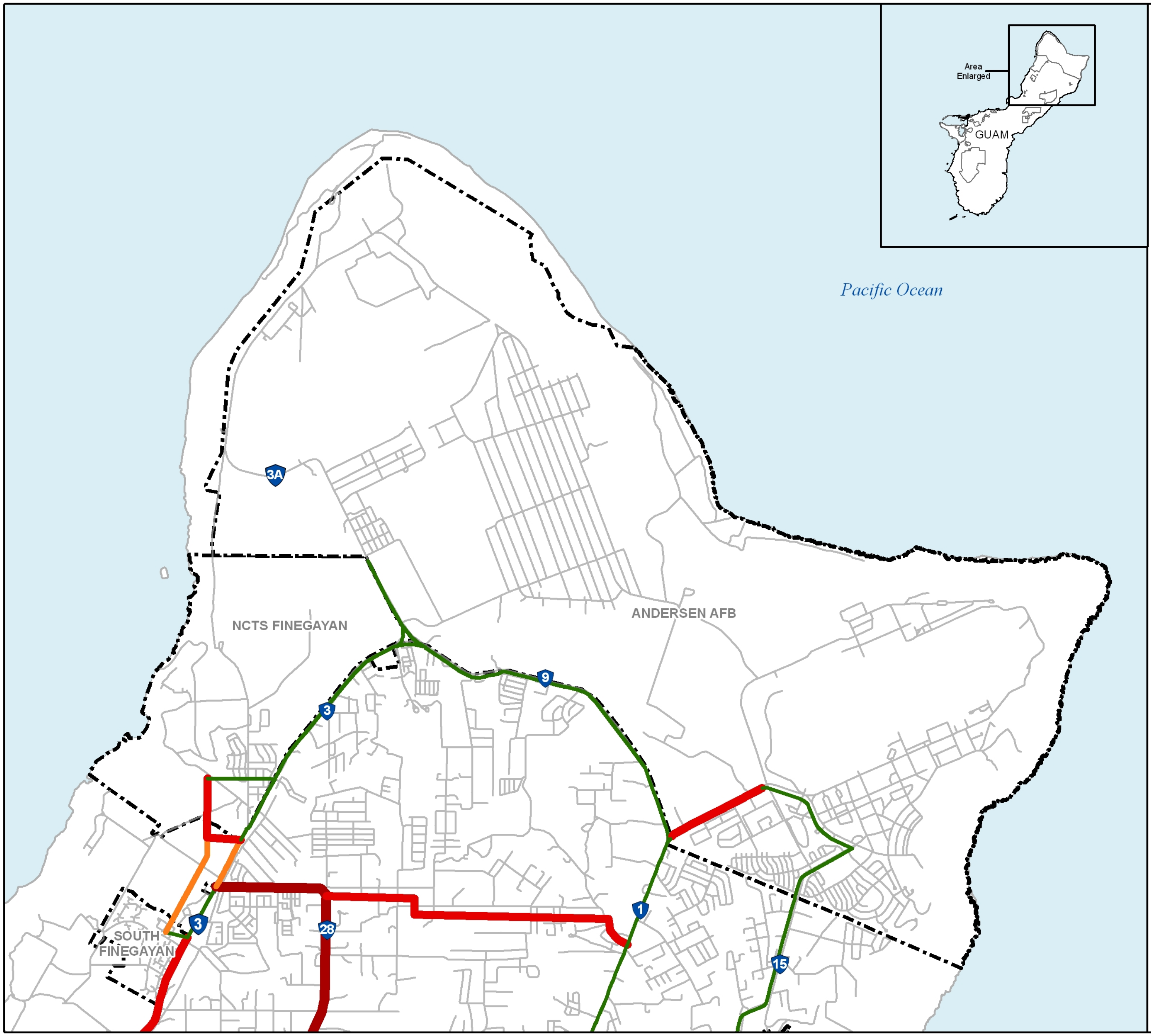
Legend: ADT = average daily traffic; AFB = Air Force Base; v/c = volume to capacity; vpd = vehicles per day.

Table 4.2-39. Alternative 2 (with Limited Roadway Projects) Future Level of Service and Delay Results – North Region

	2014				*2030*			
	a.m. Peak Hour		*p.m. Peak Hour*		*a.m. Peak Hour*		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*								
Route 1/9	C	27.6	D	39.8	C	22.5	D	52.2
Route 1/29	F	181.2	F	136.4	E	65.5	E	67.7
Route 3/28	F	104.4	F	235.9	C	33.9	F	226.5
Route 15/29**	F	****	F	827.8	F	****	F	****
Unsignalized***								
Route 3/3A/9	B	12.7	C	22.5	B	11.6	F	79.0
Military Access Points*								
Route 3 - Main Cantonment/Commercial Gate**	—	—	—	—	B	29.7	E	60.2
Route 3 - Main Cantonment/Main Gate**	—	—	—	—	C	23.1	E	67.2
Route 3 - South Finegayan/Residential Gate**	—	—	—	—	C	32.7	C	26.5
Route 9 – Andersen AFB/ Andersen AFB North Gate***	—	—	—	—	F	1,029.7	F	9,999.0

Legend: AFB = Air Force Base; LOS = Level of Service.
Notes: *Signalized intersection LOS based on average delay for the overall intersection.
**Intersection is proposed to be signalized in future build conditions.
***Unsignalized intersection LOS based on approach delay on STOP-controlled approach.
****Delay exceeded maximum calculated value.

Figure 4.2-79
North Region–
2014 a.m. Peak
Congestion Levels –
Alternative 2
Limited Roadway
Improvements



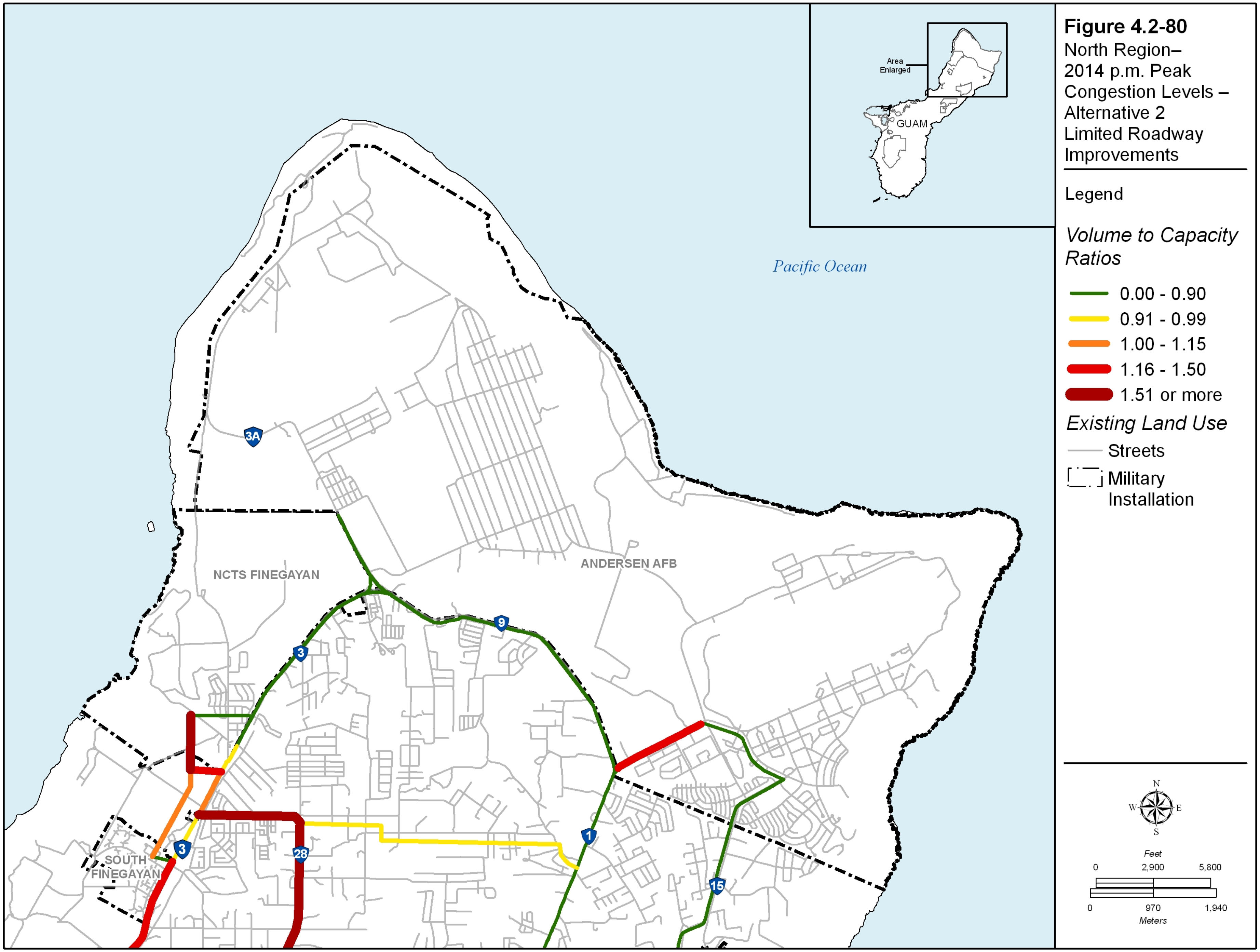


Figure 4.2-80
North Region–2014 p.m. Peak Congestion Levels – Alternative 2 Limited Roadway Improvements

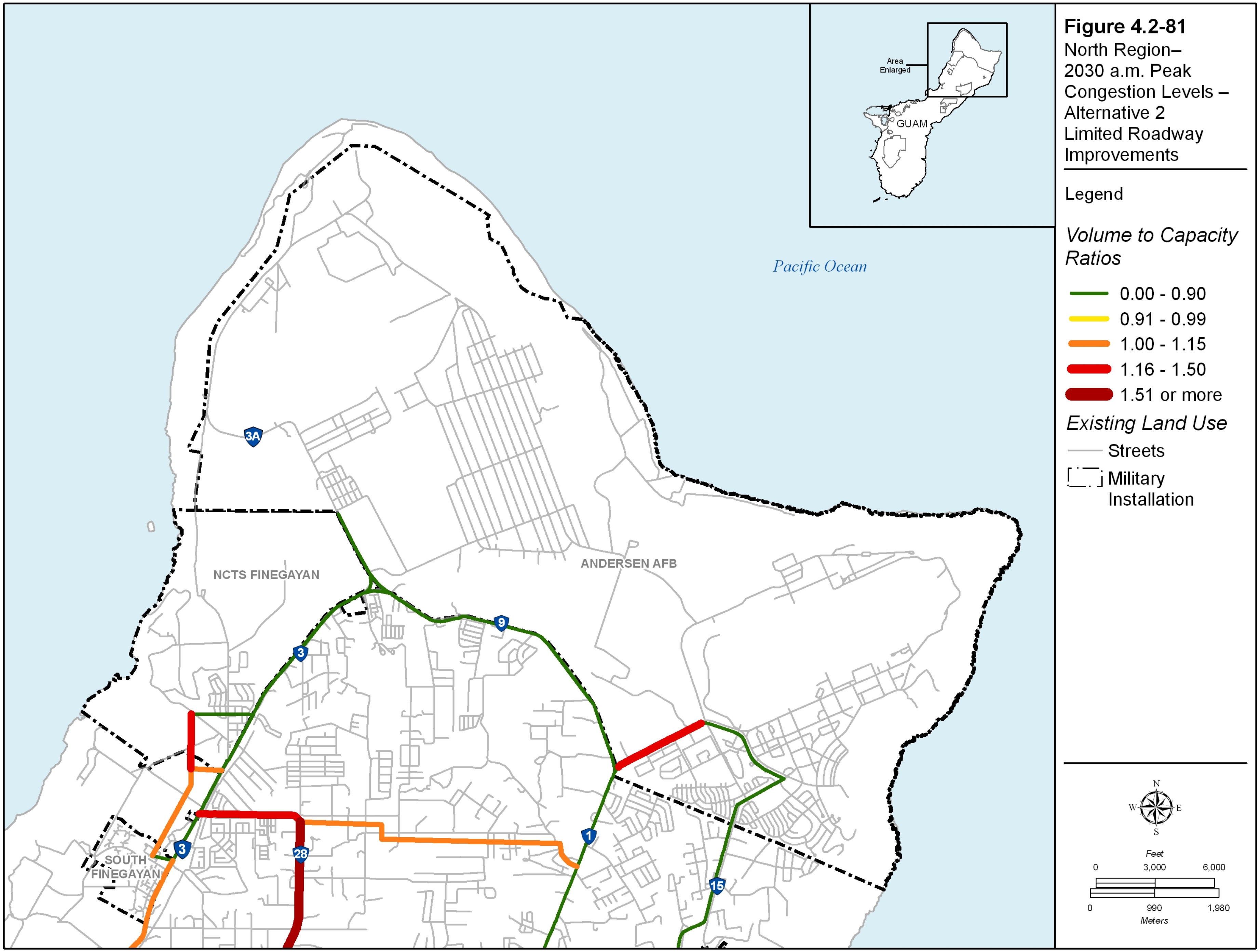
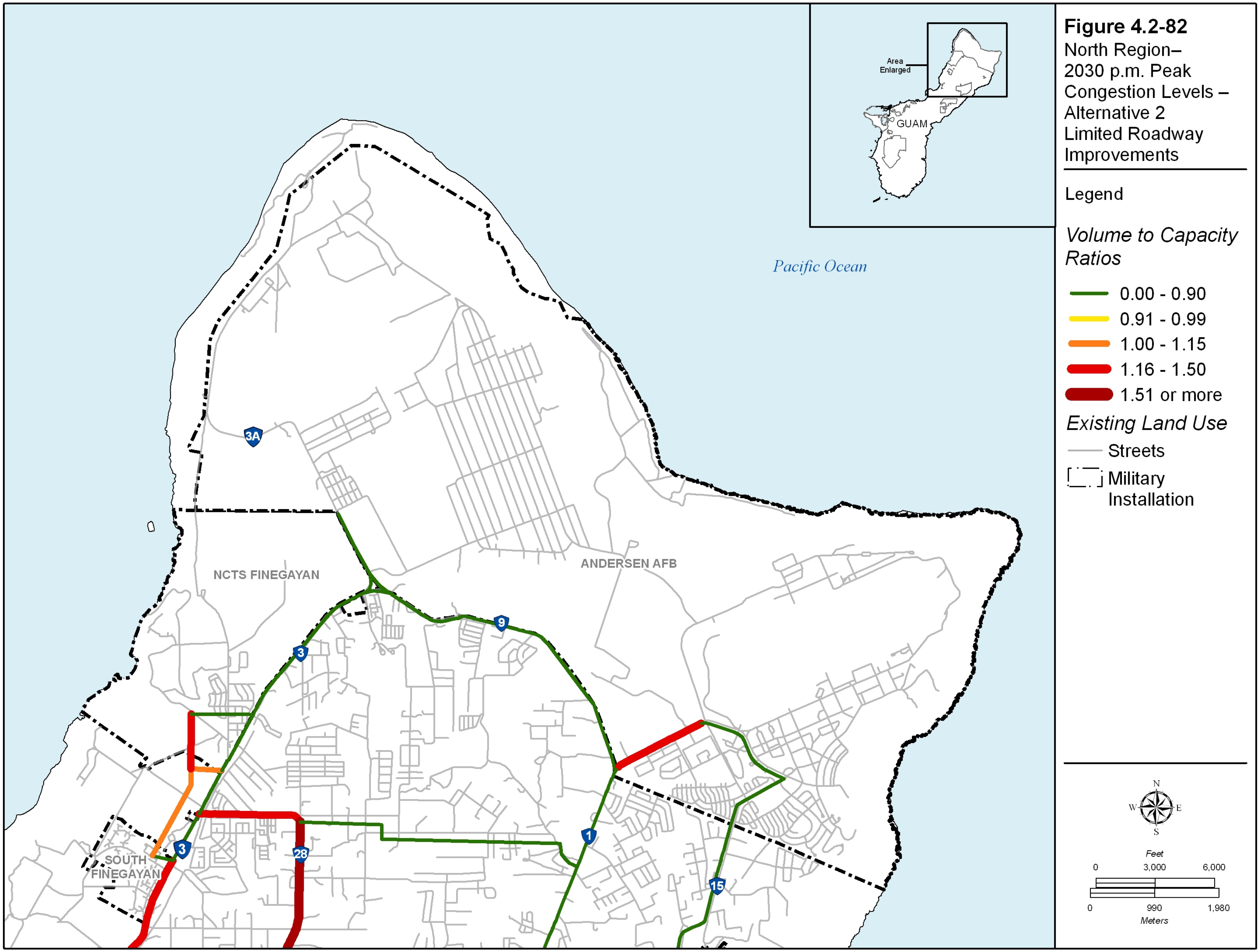


Figure 4.2-81
North Region–
2030 a.m. Peak
Congestion Levels –
Alternative 2
Limited Roadway
Improvements

Figure 4.2-82
North Region–
2030 p.m. Peak
Congestion Levels –
Alternative 2
Limited Roadway
Improvements



Public Transportation Impacts. Impacts to the public transportation system relate to the delays caused by increased levels of congestion on roadways and at intersections. This would affect the demand response and paratransit services, increasing passenger wait times and missed transfers. While there is no existing fixed-route service in the North Region, planning efforts have proposed new routes along Routes 1 and 3. Implementation of new transit services should take into consideration the impacts of the military relocation.

Pedestrian and Bicycle Impacts. Additional congestion on unimproved roadways will adversely affect pedestrian and bicycle facilities in the North Region. Along Route 1, future traffic volumes and congestion could affect the experience or safety of the pedestrian or cyclist using the shoulder as a running or biking lane. Any future planning for pedestrian and bicycle facilities needs to consider the impacts of the military relocation.

Central

Roadway Projects

Future Traffic Impacts. A summary of future ADT volumes and the v/c ratio for 2014 and 2030 for Alternative 1 can be found in Table 4.2-40. Generally, there is a substantial increase in volumes on roadways from 2008 to 2014, and then a modest decrease in volumes on roadways from 2014 to 2030. This can be attributed to the increase in construction traffic and coinciding military expansion during peak construction time, which is in 2014, and then a reduction in traffic once off-island construction workers leave the island. The magnitude of decrease is especially noticeable on Chalan Lujuna, which decreases from approximately 22,000 vpd to between 6,300 and 7,100 vpd. This can be attributed to the high volume of construction traffic.

Figure 4.2-83 through Figure 4.2-86 show existing levels of traffic congestion in the Central Region for the a.m. and p.m. peak hours, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested.

There are several areas of congestion in the Central Region, primarily on roads that serve the DoD lands to the north. During both the morning and afternoon peaks, the roads with the greatest congestion levels in the Central Region are Route 28, Route 3, and parts of Route 26 and Route 1. All have an LOS F in both the a.m. and p.m. peak hours, which is considered congested. Route 28 and portions of Route 26 have the highest level of congestion (v/c ratio greater than 1.50) in both the a.m. and p.m. peak hours for 2014 and 2030.

For most of the intersections, the LOS in both 2014 and 2030 was below the minimum acceptable LOS E. For the Central Region, there are eight intersections for which the traffic is worse in 2014 than in 2030 in both the a.m. and p.m. peak hours. This can be attributed to an increase in traffic associated with construction activity and military personnel in 2014.

Table 4.2-40. Alternative 2 (with Limited Roadway Projects) Future ADT and Volume to Capacity Ratio Summary – Central Region

Roadway	*2014*		*2030*	
	ADT Summary	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 1	Route 1 ranges from 37,000 to 101,000 vpd. Traffic decreases significantly south of the intersection of Route 4.	The v/c ratio is generally less than 1.00 in both the a.m. and p.m. however, there are small segments between the intersections 8 and 30 that have a v/c ratio of 1-1.5 in the a.m. and a v/c ratio greater than 1.5 in the p.m., which indicates the roadway is congested. Ratios of 1.0-1.15 are found east of Route 11, Finegayan St., Route 33and west of the Route 6 intersections.	Route 1 ranges from 38,000 to 95,000 vpd. Traffic decreases significantly south of the intersection with Route 4.	The v/c ratio is generally less than 1.00 in both the a.m. and p.m. however the segment east of Route 8 has a v/c ratio of 1-1.15, indicating congestion in these areas. South of the Route 33 intersection there is a small segment with a. v/c ratio of 1.0-1.15, indicating congestion.
Route 3	Route 3 ranges from 66,000 to 68,000 vpd. Traffic increases toward the Route 1 intersection.	The v/c ratio in both the a.m. and p.m. peak is 1.00-1.15. This indicates the roadway is congested.	Route 3 ranges from 47,000 to 54,000 vpd. Traffic increases toward the Route 1 intersection.	The v/c ratio is greater than 1.15, indicating that the roadway is congested at this location.
Route 8/8A	Route 8 ranges from 51,000 to 63,000 vpd. There is a decrease in traffic west of the intersection with Sunset Boulevard. Route 8A has 3,500 vpd.	During peak hours, the v/c ratio is less than 1.00 east of Tiyan Parkway however the intersection at Wall St. has a v/c ratio of 1.0-1.15. West of Tiyan Parkway during the a.m. and p.m. peaks the v/c ratio is greater than 1.00. This area is considered congested. Route 8A has a v/c ratio is 0.00-0.90 The roadway is not considered congested.	Route 8 ranges from 47,000 to 58,000 vpd. There is a decrease in traffic west of the intersection with Sunset Boulevard. Route 8A has 3,400 vpd.	The v/c ratio is less than 1 with exception of a small segment west of the Wall St. intersection with a v/c of 1.16-1.5. East of Tiyan Parkway the a.m. v/c ratio is less than 1, where the p.m. v/c ratio is greater than 1.16. The road is primarily congested in the p.m. peak.
Route 10	Route 10 ranges from 56,000 to 57,000 vpd between Routes 8 and 15.	In the a.m. peak, a small segment south of the intersection with Route 15 and south of Route 8 have a v/c ratio between 1.15-1.50. During the p.m. peak, Route 10 has a v/c ratio of 1.00-1.15 north of Route 32 to Route 8. The roadway is primarily congested during the p.m. peak.	Route 10 ranges from 36,000 to 64,000 vpd between Routes 8 and 15.	In the a.m. peak, Route 10 has a v/c ratio of 1.16-1.5 north of Route 32 to Route 15. During the p.m. peak, Route 10 has a v/c ratio of 1.00-1.15 north of Route 32 to Route 8. The roadway is primarily congested during the p.m. peak.

Roadway	*2014*		*2030*	
	ADT Summary	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 15	Route 15 ranges from 1,300 to 24,000 vpd. There is an increase in traffic south of the intersection with Route 26.	Route 15 has a v/c ratio less than 1, with a v/c ratio of 1.00-1.15 approaching Route 10. The roadway is only congested near the intersection with Route 10.	Route 15 ranges from 55,000 to 66,000 vpd. There is an increase in traffic south of the intersection with Route 26.	The v/c ratio is less than 1.00 during peak hours. The roadway is not considered congested.
Route 16	Route 16 ranges from 40,000 to 91,000 vpd. There is a decrease in traffic south of the residential developments south of Route 25.	The v/c ratio is less than 1.00 in the a.m. and p.m., except south of the intersection with Route 27 where the v/c ratio is 1.00-1.15. The roadway is considered congested at this location.	Route 16 ranges from 35,000 to 85,000 vpd. There is a decrease in traffic south of the residential developments south of Route 25.	The v/c ratio is less than 1.00 during peak hours. The roadway is not considered congested.
Route 25	Route 25 ranges from 24,000 to 28,000 vpd.	Route 25 has a v/c ratio greater than 1.50, indicating that the roadway is congested.	Route 25 ranges from 19,000 to 23,000 vpd.	The v/c ratio is greater than 1.5 during peak hours. The roadway is considered congested.
Route 26	Route 26 ranges from 10,000 to 25,000 vpd. There is a decrease in traffic south of the large residential development just north of the intersection with Route 15.	Route 26 primarily has a v/c ratio greater than 1.00 during both the a.m. and p.m. peak, increasing to a v/c ratio greater than 1.5 north of the Route 25 in the p.m. and south of Route 25 in the p.m. The roadway is considered congested.	Route 26 ranges from 10,000 to 21,000 vpd. There is a decrease in traffic south of the large residential development just north of the intersection with Route 15.	The v/c ratio is greater than 1.16 during peak hours, decreasing south of Route 25 where the v/c ratio is 0.91-0.99 during the a.m. peak. The roadway is considered congested north of Route 25.
Route 27	Route 27 ranges from 58,000 to 61,000 vpd between Routes 16 and 1.	The v/c ratio is 0.00-0.90 during peak hours, except for the portion between Routes 16 and 1, which has a v/c ratio of 0.91-0.99 during the a.m. peak. This roadway is not considered congested.	Route 27 ranges from 56,000 to 59,000 vpd between Routes 16 and 1.	The v/c ratio is 0.00-0.90 during peak hours, indicating the roadway is not congested.
Route 28	Route 28 ranges from 24,000 to 26,000 vpd. Traffic generally decreases south of the Route 27A intersection.	The v/c ratio is greater than 1.50 in both the a.m. and p.m. peak, indicating the roadway is congested.	Route 28 ranges from 22,000 to 23,000 vpd. Traffic generally decreases south of the Route 27A intersection.	The v/c ratio is greater than 1.50 in both the a.m. and p.m. peak; indicating the roadway is congested.
Chalan Lujuna	Chalan Lujuna has 22,000 vpd.	The v/c ratio is 1.16-1.5, indicating the road is congested.	Chalan Lujuna ranges from 6,300 to 7,100 vpd.	The v/c ratio is 0.00-0.90 during peak hours, indicating the roadway is not congested.

Legend: ADT = average daily traffic; v/c = volume to capacity; vpd = vehicles per day.

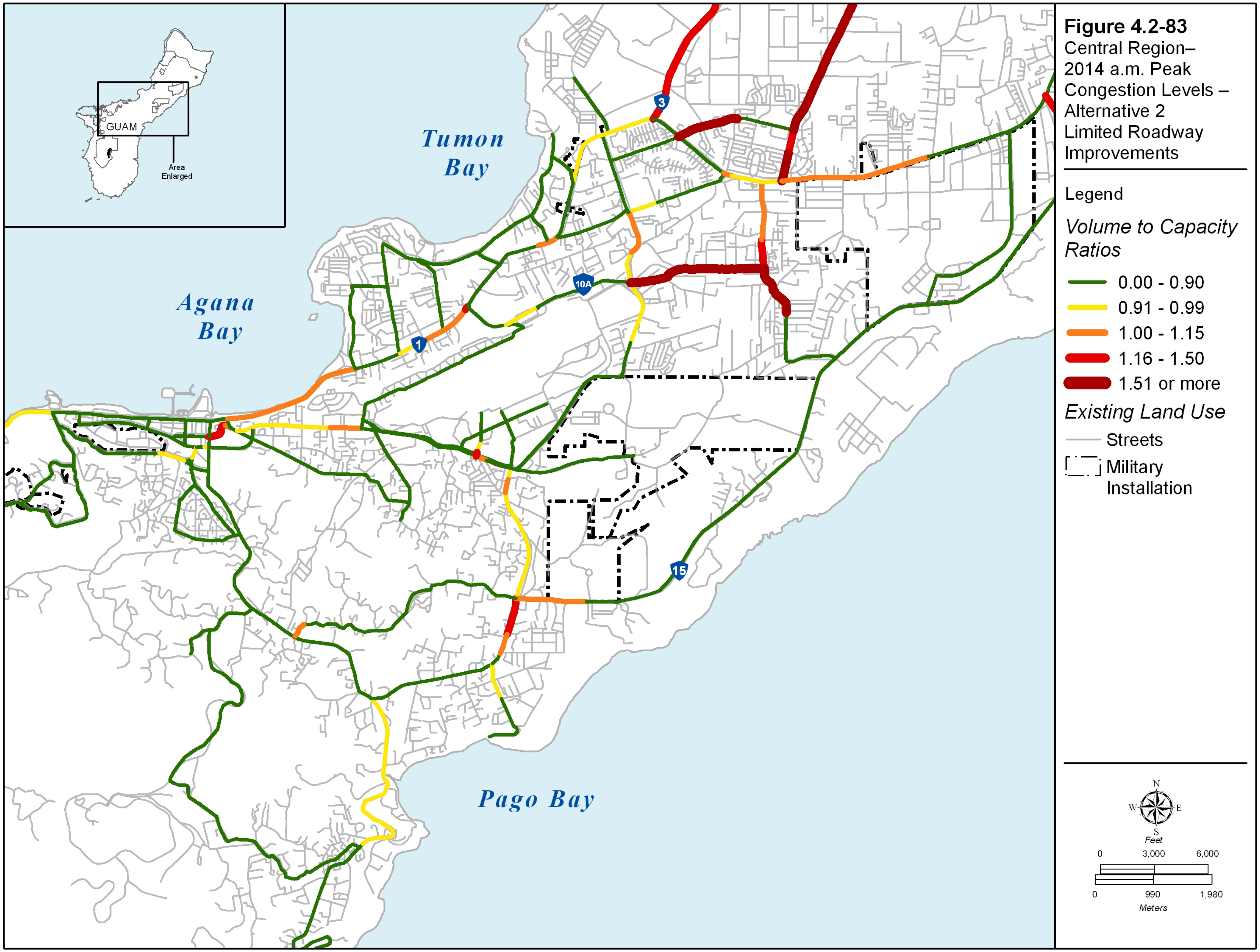


Figure 4.2-83
Central Region–2014 a.m. Peak Congestion Levels – Alternative 2 Limited Roadway Improvements

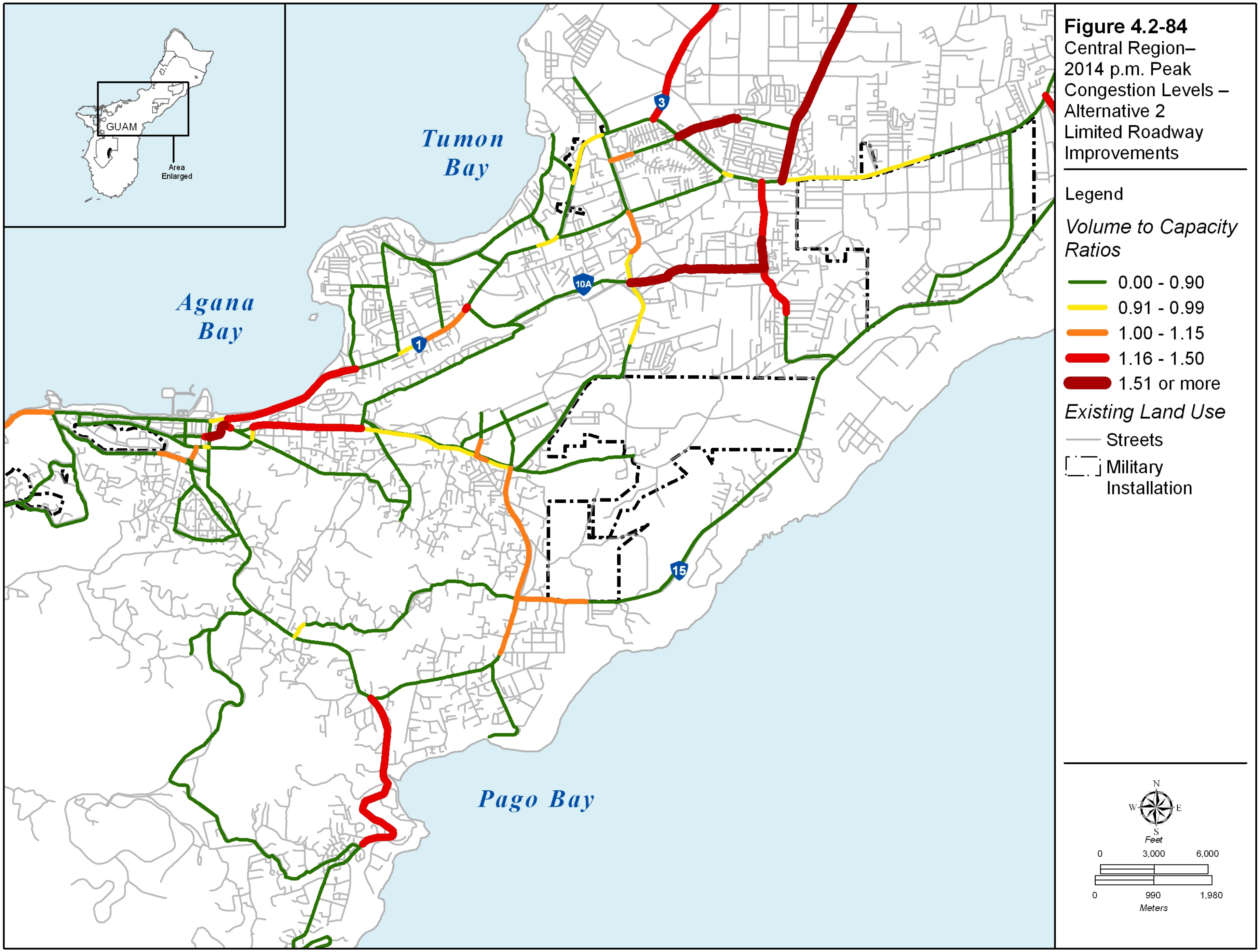


Figure 4.2-84 Central Region–2014 p.m. Peak Congestion Levels – Alternative 2 Limited Roadway Improvements

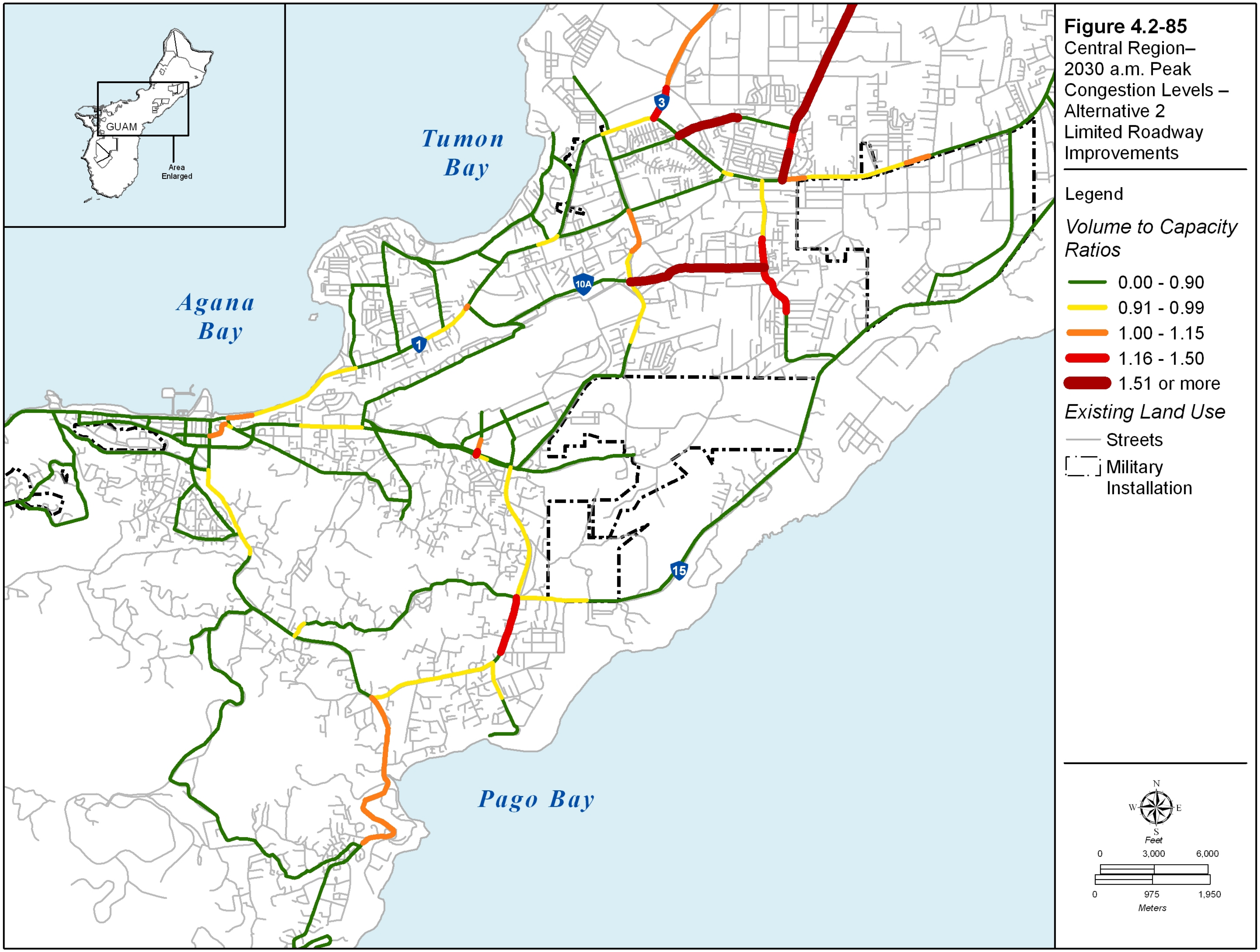


Figure 4.2-85
Central Region–2030 a.m. Peak Congestion Levels – Alternative 2 Limited Roadway Improvements

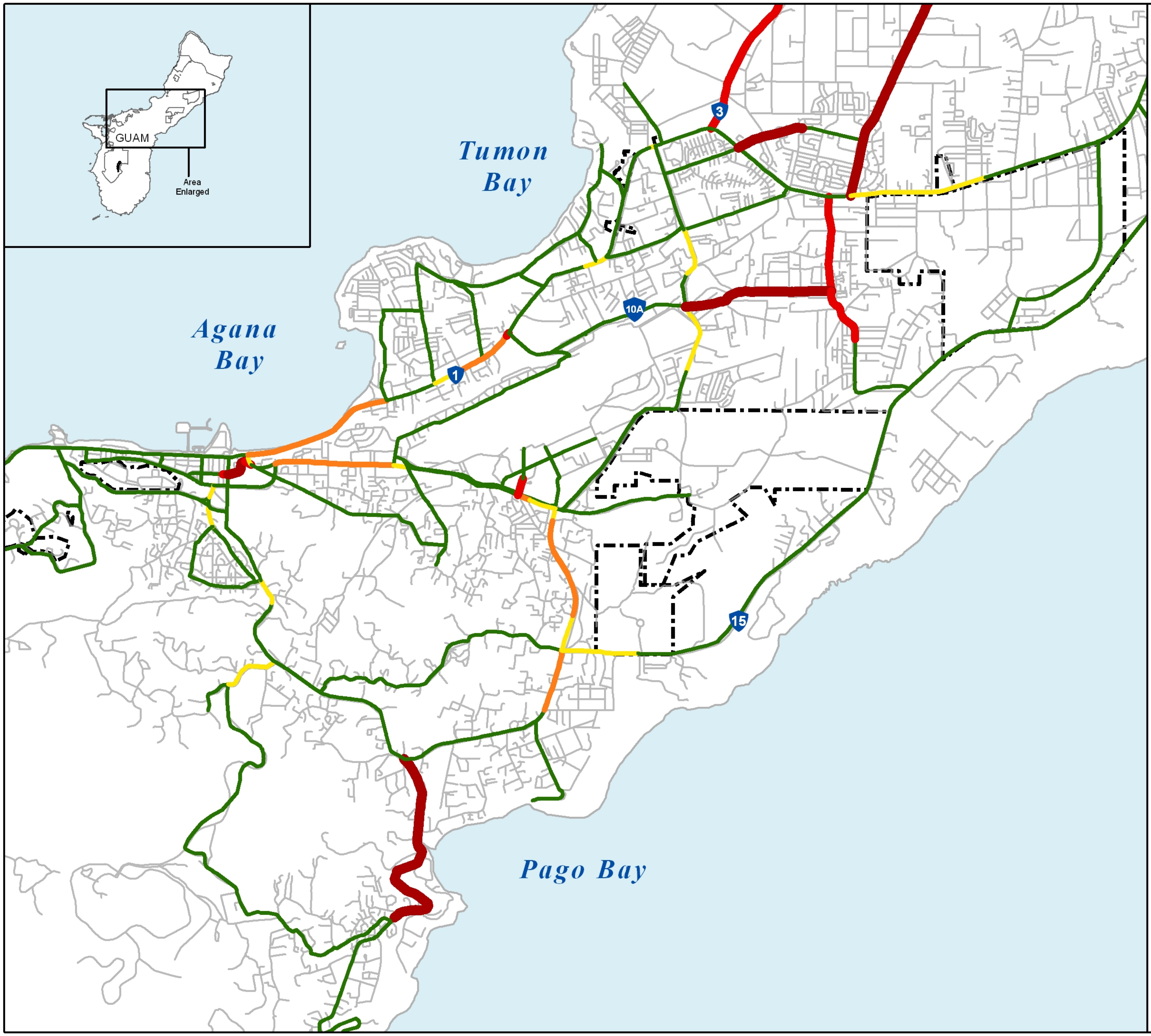


Figure 4.2-86
Central Region–2030 p.m. Peak Congestion Levels – Alternative 2 Limited Roadway Improvements

As shown in Table 4.2-41, 26 out of 29 intersections have LOS F for at least one peak hour, which is normally considered unacceptable. The following intersections are operating at LOS F in the a.m. and p.m. peak hours in both 2014 and 2030:

- Route 1/28
- Route 1/27
- Route 1/3
- Route 1/16
- Route 1/14
- Route 1/14A
- Route 1/10A
- Route 1/14 (ITC)
- Route 1/30
- Route 1/8
- Route 4/7A
- Route 4/10
- Route 8/10
- Route 10/15
- Route 16/27
- Route 16/10A
- Route 26/15
- Route 28/27A

Table 4.2-41. Alternative 2 (with Limited Roadway Projects) Future Level of Service and Delay Results – Central Region

	2014				*2030*			
	a.m. Peak Hour		*p.m. Peak Hour*		*a.m. Peak Hour*		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*								
Route 1/28	F	358.3	F	3331.4	F	244.9	F	206.3
Route 1/26	F	129.2	F	248.1	E	61.9	F	251.5
Route 1/27	F	831.3	F	658.5	F	304.6	F	1091.6
Route 1/27A	F	94.7	F	205.3	D	42.7	F	211.4
Route 1/3	F	271.6	F	302.9	F	145.6	F	157.2
Route 1/16	F	146.5	F	335.4	F	98.6	F	407.5
Route 1/14 (North San Vitores)	F	197.8	F	136.8	F	113.3	F	476.1
Route 1/14A	F	210.3	F	238.2	F	151.5	F	298.8
Route 1/10A	F	184.5	F	279.3	F	101.7	F	149.4
Route 1/14B	F	160.0	F	159.0	E	79.0	F	119.9
Route 1/14 (ITC)	F	180.5	F	335.1	F	187.0	F	275.1
Route 1/30	F	518.0	F	559.6	F	270.1	F	489.8
Route 1/8	F	134.5	F	213.1	F	97.6	F	123.8
Route 1/4	C	30.4	D	44.7	C	32.4	F	140.2
Route 1/6 (Adelup)	D	38.4	F	114.2	D	41.5	F	125.3
Route 4/7A	F	202.1	F	288.5	F	244.4	F	286.4
Route 4/10	F	185.4	F	100.7	F	199.6	F	103.5
Route 4/17	C	35.0	D	42.6	D	39.6	E	61.9
Route 8/33	E	60.0	F	143.6	D	48.3	F	162.0
Route 8/10	F	224.7	F	304.1	F	96.9	F	172.7
Route 10/15	F	166.4	F	144.7	F	196.9	F	152.3
Route 16/27A	C	25.7	D	51.2	C	27.4	C	34.2
Route 16/27	F	516.6	F	602.9	F	442.7	F	764.2
Route 16/10A	F	324.8	F	482.0	F	469.1	F	123.5
Route 26/25**	F	84.9	D	41.1	E	75.3	D	53.0
Route 26/15**	F	2541.3	F	3412.4	F	2757.5	F	3327.3
Route 28/27A**	F	525.0	F	472.6	F	320.4	F	441.4
Unsignalized* **								
Route 7/7A	F	167.7	F	285.7	D	29.2	F	105.1

	2014				*2030*			
	a.m. Peak Hour		*p.m. Peak Hour*		*a.m. Peak Hour*		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*
Military Access Points								
Route 1 - South Andersen Main Gate/(Turner Street)*	—	—	—	—	C	32.4	E	78.8
Route 15 - South Andersen/Second Gate*	—	—	—	—	C	22.1	C	22.6
Route 16 - Navy Barrigada Residential Gate	—	—	—	—	NA	NA	NA	NA
Route 8A - Navy Barrigada/(Residential Gate)	—-	—	—	—	NA	NA	NA	NA
Route 15 - Barrigada Air Force/(Fadian Point Drive)***	—	—	—	—	NA	NA	NA	NA

Legend: ITC = International Trade Center; LOS = Level of Service; NA = Not Applicable.
Notes: *Signalized intersection LOS based on average delay for the overall intersection.
**Intersection is proposed to be signalized in future build conditions.
***Unsignalized intersection LOS based on approach delay on STOP-controlled approach.

Public Transportation Impacts. Impacts to the public transportation system relate to the increased delays caused by severe levels of congestion on roadways and at intersections. In the Central Region, this would affect the fixed-route service along Routes 1 and 10, as well as the demand response and paratransit services. Delays on the roadways increase passenger travel times, with longer headways and missed transfers. This would also affect the fixed-route services proposed for Routes 16 and 26. Implementation of new transit services should take into consideration the impacts of the military relocation.

Pedestrian and Bicycle Impacts. There are limited impacts to the pedestrian and bicycle facilities in the Central Region. Along Routes 1 and 10, future traffic volumes and congestion should not negatively affect the experience or safety of the pedestrian using the existing sidewalk; however, it could impact a cyclist wanting to use the outside lane when unable to use the sidewalk. Future improvements to Routes 8 and 26 would also impact the intermittent sidewalk along these roadways and provide an opportunity to fully complete the facility. In addition, any future planning for pedestrian and bicycle facilities needs to consider the impacts of the military relocation.

Apra Harbor

Roadway Projects

Future Traffic Impacts. A summary of future ADT volumes and the v/c ratio for 2014 and 2030 for Alternative 1 can be found in Table 4.2-42. Generally, there is a substantial increase in volumes on roadways from 2008 to 2014, and then a modest decrease in volumes on roadways from 2014 to 2030. This can be attributed to the increase in construction traffic and coinciding military expansion during peak construction time, which is in 2014, and then a reduction in traffic once off-island construction workers leave the island. The magnitude of decrease is especially noticeable on Route 11, which decreases from approximately 14,000 vpd to 8,900 vpd. This can be attributed to the high volume of construction traffic.

Table 4.2-42. Alternative 2 (with Limited Roadway Projects) Future ADT and Volume to Capacity Ratio Summary – Apra Harbor Region

	2014		*2030*	
Roadway	*ADT Summary*	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 1	Route 1 ranges from 46,000 to 63,000 vpd. The traffic decreases into the entrance of Naval Base Guam, which is at the Route 1/2A intersection.	East of Route 11, the v/c ratio is between 1-1.15 and the v/c ratio is less than 1 south of Route 11. The area to the east of Route 11 is considered to be congested.	Route 1 ranges from 46,000 to 63,000 vpd. The traffic decreases into the entrance of Naval Base Guam, which is at the Route 1/2A intersection.	The v/c ratio is less than 1, indicating the roadway is not congested.
Route 2A	Route 2A ranges from 22,00 to 35,000 vpd. The traffic decreases after the intersection with Route 5.	The v/c ratio is 0.00-0.90, indicating the roadway is not congested.	Route 2A ranges from 22,00 to 35,000 vpd. The traffic decreases after the intersection with Route 5.	With exception of a small segment at the south end of the route with a v/c ratio greater than 1.5; the v/c ratio is 0.00-0.90, indicating the majority of the roadway is not congested.
Route 11	Route 11 has 14,000 vpd.	The v/c ratio is 0.00-0.90, indicating the roadway is not congested.	Route 11 has 8,900 vpd.	The v/c ratio is 0.00-0.90, indicating the roadway is not congested.

Legend: ADT = average daily traffic; v/c = volume to capacity; vpd = vehicles per day.

Figure 4.2-87 through Figure 4.2-90 show future levels of traffic congestion in the Apra Harbor Region for the a.m. and p.m. peak hours, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested. Portions of Route 5 have a v/c ratio greater than 1.00, which is LOS F, in both the 2014 and 2030 p.m. peak hour.

As shown in Table 4.2-43, Route 1/2A would operate at LOS F in the a.m. and p.m. peak hours for 2014 and the p.m. peak hour for 2030, which is considered unacceptable. The intersection would operate more efficiently in terms of delay in 2030, with LOS E in the a.m. This change can be attributed to a decrease in construction traffic in 2030. Route 5/2A is operating at LOS F in the a.m. peak hour for 2030, which is considered unacceptable.

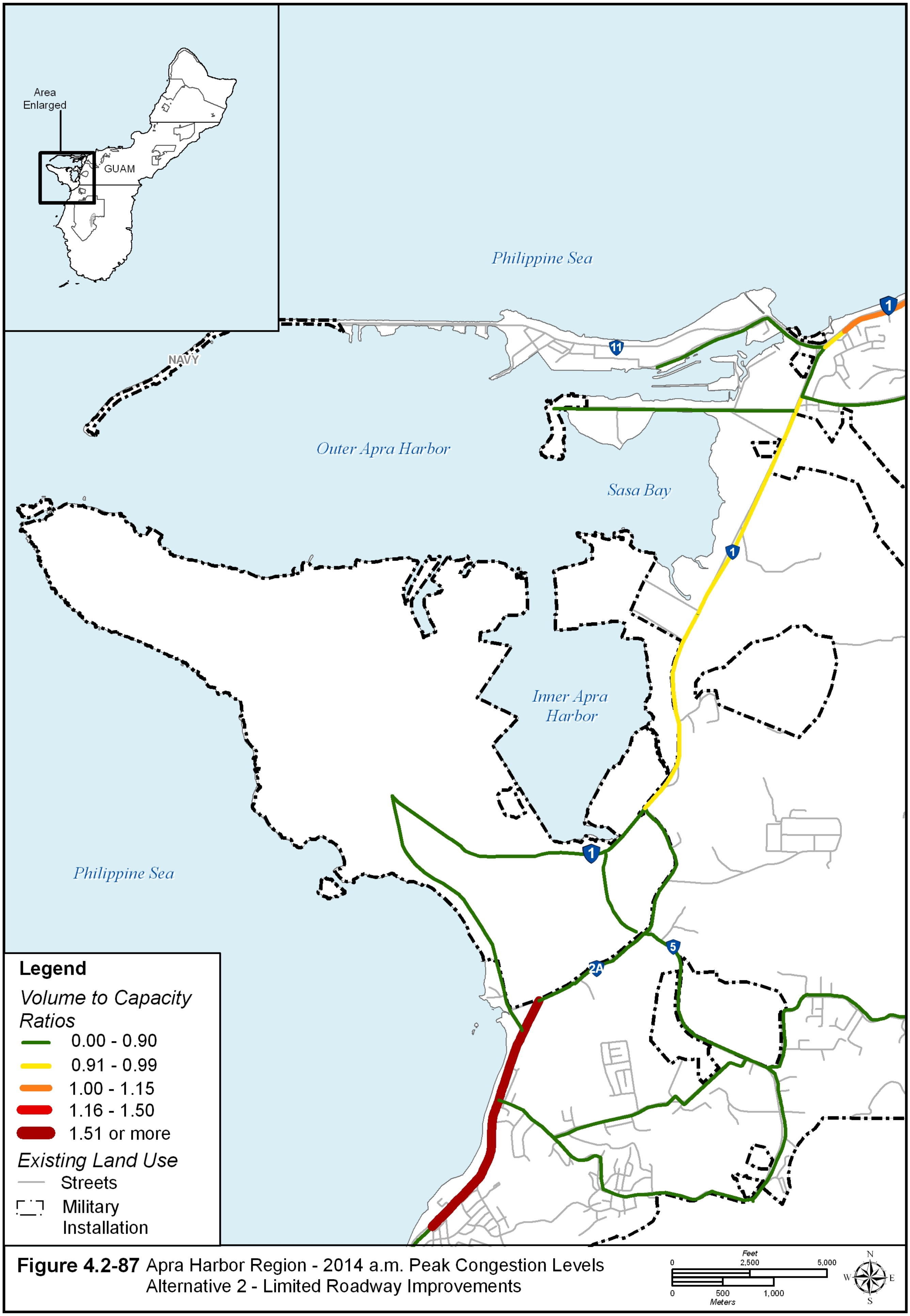


Figure 4.2-87 Apra Harbor Region - 2014 a.m. Peak Congestion Levels Alternative 2 - Limited Roadway Improvements

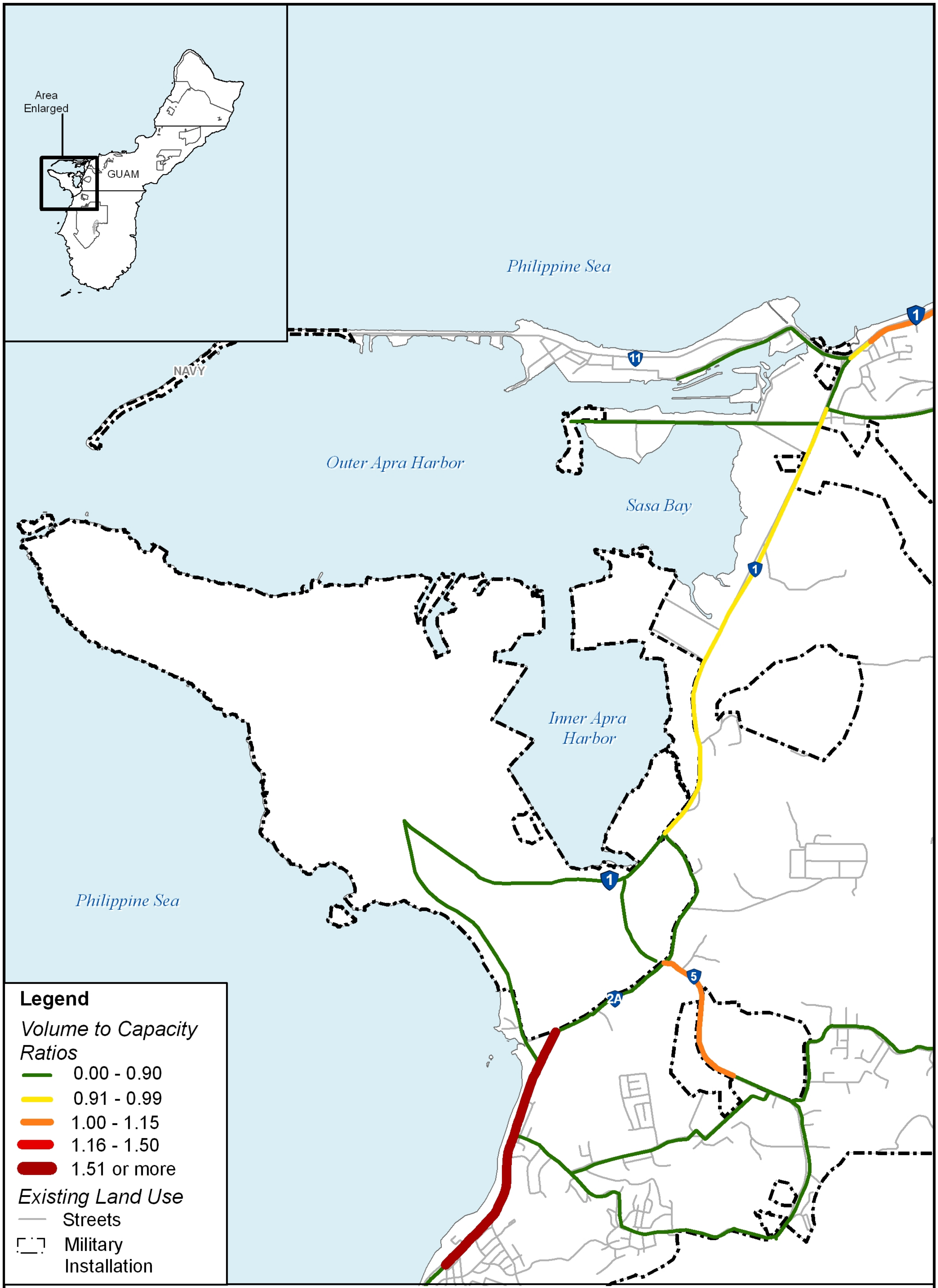


Figure 4.2-88 Apra Harbor Region - 2014 p.m. Peak Congestion Levels
Alternative 2 - Limited Roadway Improvements

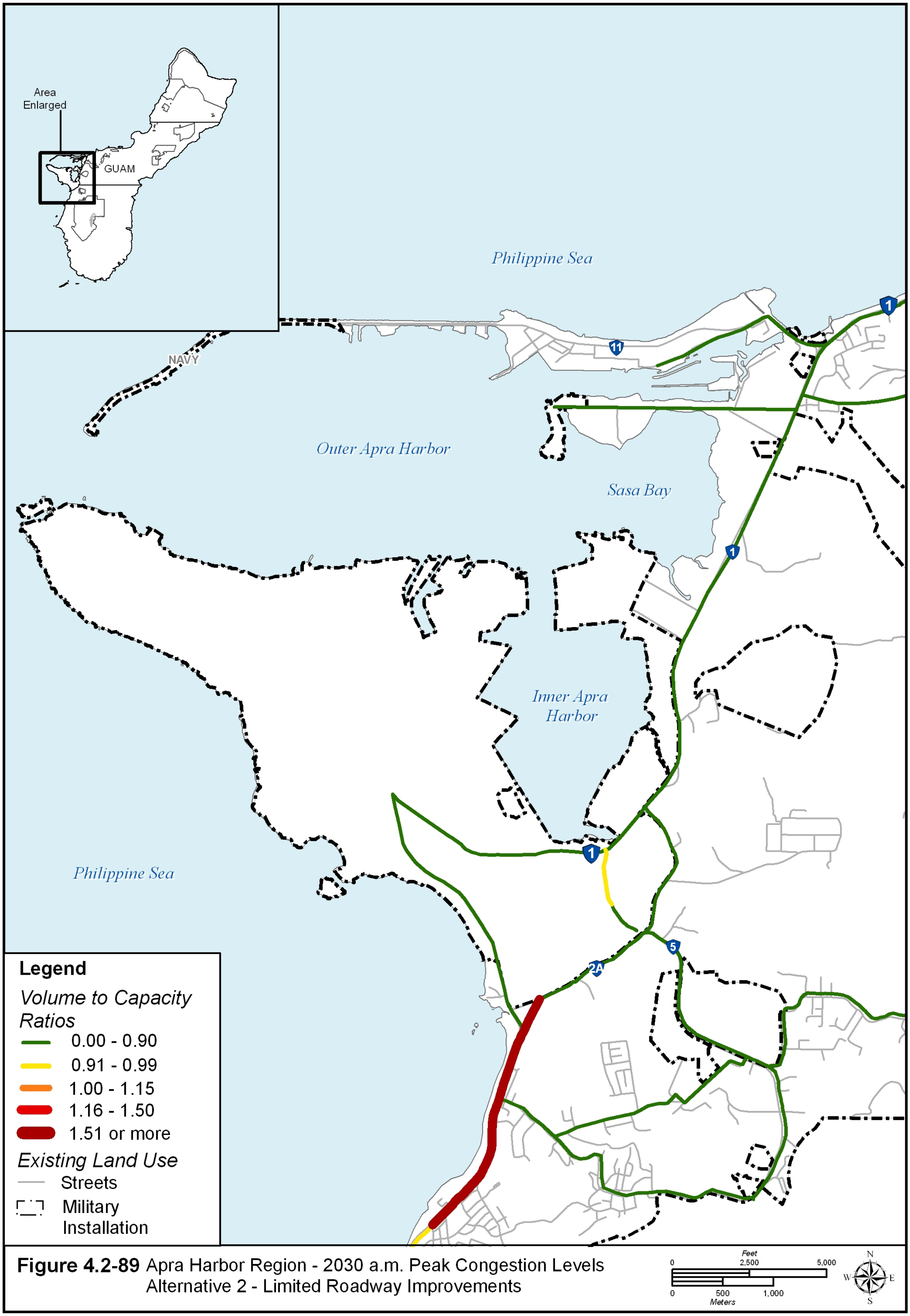


Figure 4.2-89 Apra Harbor Region - 2030 a.m. Peak Congestion Levels Alternative 2 - Limited Roadway Improvements

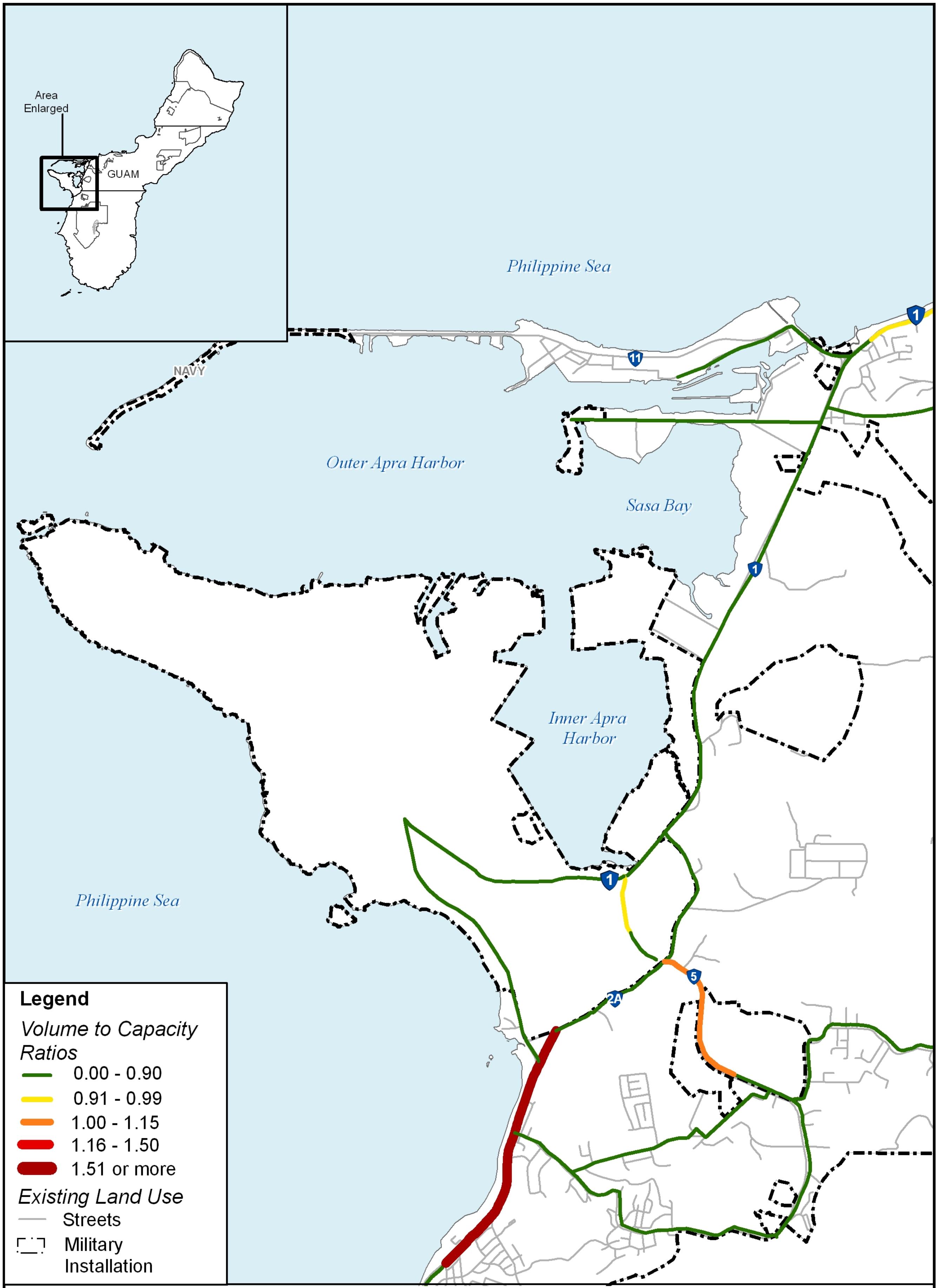


Figure 4.2-90 Apra Harbor Region - 2030 p.m. Peak Congestion Levels
Alternative 2 - Limited Roadway Improvements

Table 4.2-43. Alternative 2 (with Limited Roadway Projects) Future Level of Service and Delay Results – Apra Harbor Region

	2014				*2030*			
	a.m. Peak Hour		*p.m. Peak Hour*		*a.m. Peak Hour*		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*								
Route 1/11	B	17.9	D	36.7	C	20.7	C	25.3
Route 1/6 (west)	D	54.3	C	23.7	B	18.4	C	22.0
Route 1/2A	F	94.6	F	82.2	E	69.5	F	84.0
Route 5/2A	E	70.5	D	36.9	F	96.3	C	26.2

Legend: LOS = Level of Service.
Notes: *Signalized intersection LOS based on average delay for the overall intersection.

Public Transportation Impacts. Impacts to the public transportation system in the Apra Harbor Region should be minimal and would relate to the delays caused by increased levels of congestion on Route 5 or at intersections near DoD lands. This would possibly affect the fixed-route service along Route 1, as well as any demand response and paratransit services. Implementation of new transit services should take into consideration the impacts of the military relocation.

Pedestrian and Bicycle Impacts. There are no impacts to the pedestrian and bicycle facilities in the Apra Harbor Region. Along Route 1, future traffic volumes and congestion should not negatively affect the experience or safety of the pedestrian and cyclist using the shoulder as a running or biking lane. Any future planning for pedestrian and bicycle facilities needs to consider the impacts of the military relocation.

South

Roadway Projects

Future Traffic Impacts. A summary of future ADT volumes and the v/c ratio for 2014 and 2030 for Alternative 1 can be found in Table 4.2-44. Route 12 decreases in volume from 2014 to 2030. This can be attributed to the increase in construction traffic and coinciding military expansion during peak construction time, which is in 2014, and then a reduction in traffic once off-island construction workers leave the island.

Figure 4.2-91 through Figure 4.2-94 show future levels of traffic congestion in the South Region for the a.m. and p.m. peak hours, respectively. The v/c ratio directly correlates to the LOS for each roadway. The color of the roadways corresponds to the LOS on the road. The green roads that have a v/c ratio of 0.00-0.90 have an LOS of A, B, C, or D; the yellow roads that have a v/c ratio of 0.91-0.99 have an LOS of E; and the orange and red roads that have a v/c ratio above 1.00 have an LOS of F, with red being the most severely congested.

Table 4.2-44. Alternative 2 (with Limited Roadway Projects) Future ADT and Volume to Capacity Ratio Summary – South Region

	2014		*2030*	
Roadway	*ADT Summary*	*v/c Ratio*	*ADT Summary*	*v/c Ratio*
Route 5	Route 5 ranges from 2,700 to 17,000 vpd. Traffic decreases as Route 5 approaches the intersection with Route 17.	The v/c ratio is 0.91-0.99 in the a.m. peak and 1.00-1.15 south of 2A intersection in the p.m. peak. This area of the roadway is congested during the p.m. peak hours.	Route 5 ranges from 3,400 to 18,000 vpd. Traffic decreases as Route 5 approaches the intersection with Route 17.	The v/c ratio is 0.91-0.99 in the a.m. peak and 1.00-1.15 in the p.m. peak. The roadway is congested during the p.m. peak hours.
Route 12	Route 12 ranges from 1,800 to 5,600 vpd. The traffic increases toward the intersection with Route 2.	The v/c ratio is 0.00-0.90 during both the a.m. and p.m. peak, indicating the roadway is not congested.	Route 12 ranges from 2,300 to 6,000 vpd. The traffic increases toward the intersection with Route 2.	The v/c ratio is 0.00-0.90 during both the a.m. and p.m. peak, indicating the roadway is not congested.

Legend: ADT = average daily traffic; v/c = volume to capacity; vpd = vehicles per day.

The roads in the South Region do not exhibit high levels of congestion. During both the afternoon peaks, Route 5 between Naval Base Guam and the NMS has an LOS F.

As shown in Table 4.2-45, three intersections have LOS F for at least one peak hour, which is considered unacceptable: Route 2/12 and Route 5/17. Route 5/17 has fairly free-flowing conditions in 2014 and becomes significantly more congested in 2030.

Table 4.2-45. Alternative 2 (with Limited Roadway Projects) Future Level of Service and Delay Results – South Region

	2014				*2030*			
	a.m. Peak Hour		*p.m. Peak Hour*		*a.m. Peak Hour*		*p.m. Peak Hour*	
	LOS	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*	*LOS*	*Delay Seconds*
Signalized*								
Route 2/12	F	134.9	C	26.0	F	114.2	C	33.6
Unsignalized**								
Route 5/17	C	23.5	C	29.3	E	46.6	F	149.6
Route 4/4A	C	19.4	C	14.3	D	34.4	C	19.4
Route 17/4A	B	12.9	B	14.0	B	13.6	C	18.7
Military Access Points								
Route 5 - Naval Munitions Site/Harmon Road.**	—	—	—	—	A	9.6	A	10.6

Notes: *Signalized intersection LOS based on average delay for the overall intersection.
**Unsignalized intersection LOS based on approach delay on STOP-controlled approach.
Legend: LOS = Level of Service.

Public Transportation Impacts. Impacts to the demand response and paratransit that service the South Region are minimal. Implementation of new transit services should take into consideration the impacts of the military relocation.

Pedestrian and Bicycle Impacts. There are no impacts to pedestrian and bicycle facilities in the South Region. Any future planning for pedestrian and bicycle facilities needs to consider the impacts of the military relocation.

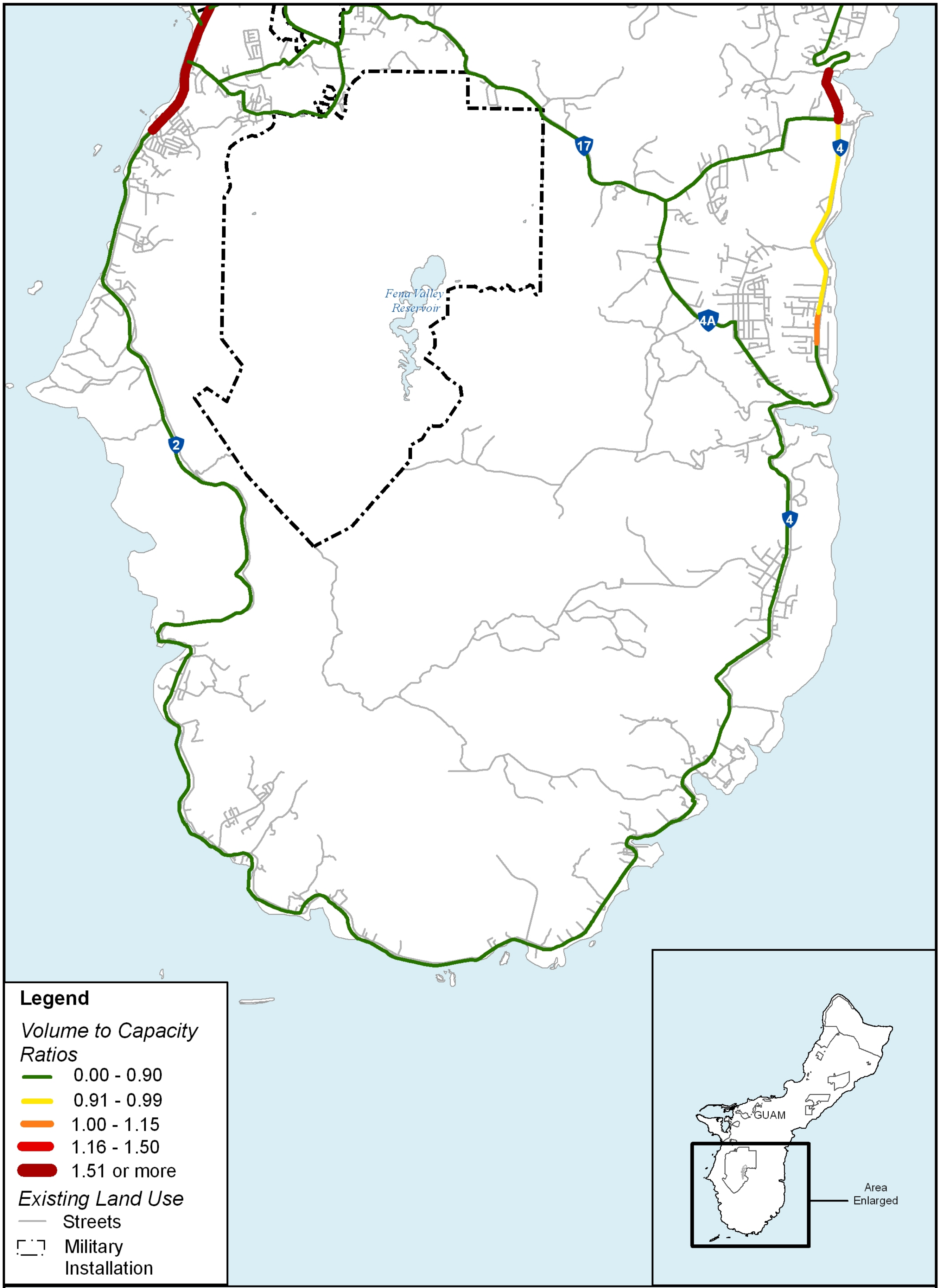


Figure 4.2-91 South Region - 2014 a.m. Peak Congestion Levels Alternative 2 - LimitedRoadway Improvements

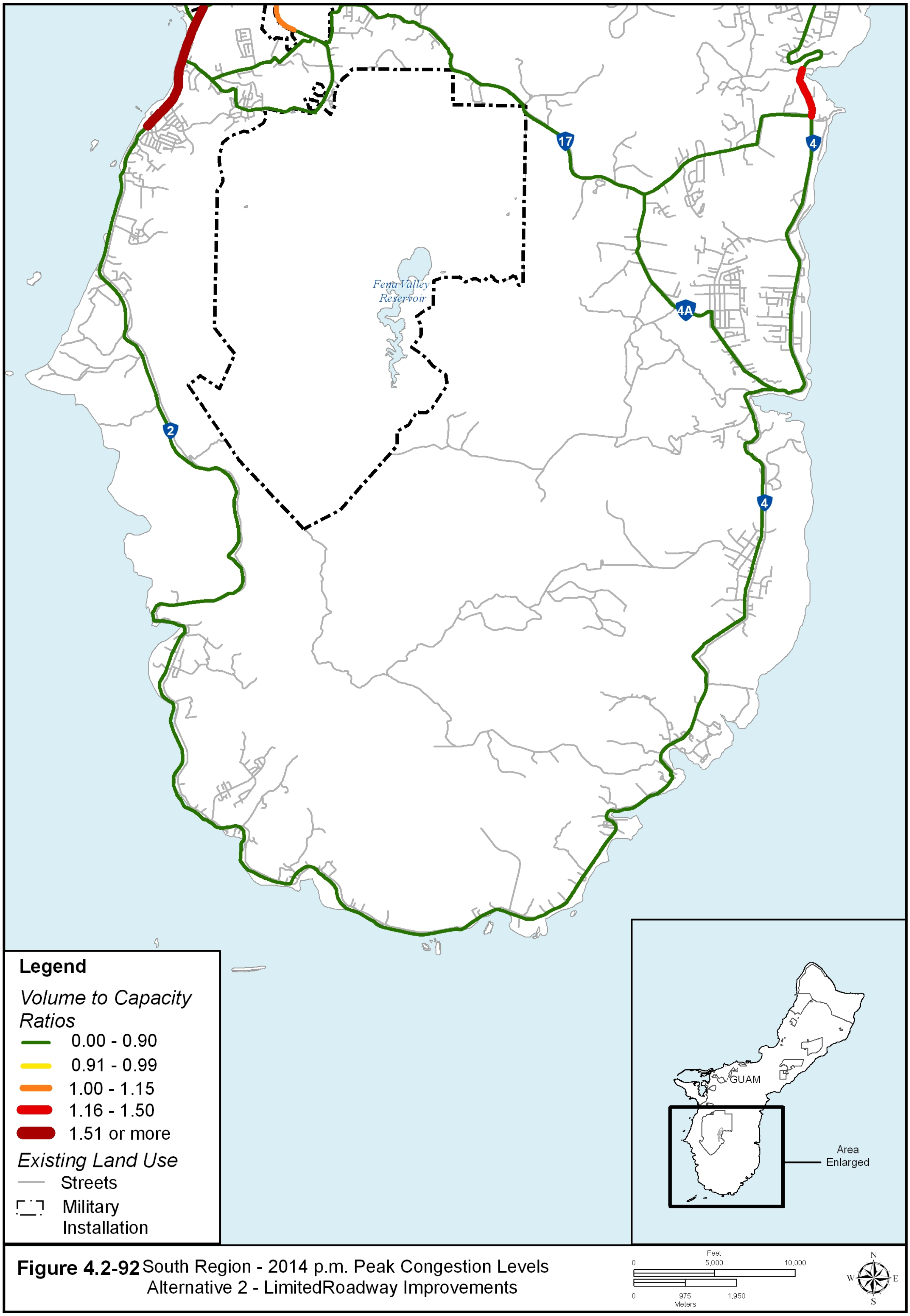


Figure 4.2-92 South Region - 2014 p.m. Peak Congestion Levels
Alternative 2 - LimitedRoadway Improvements

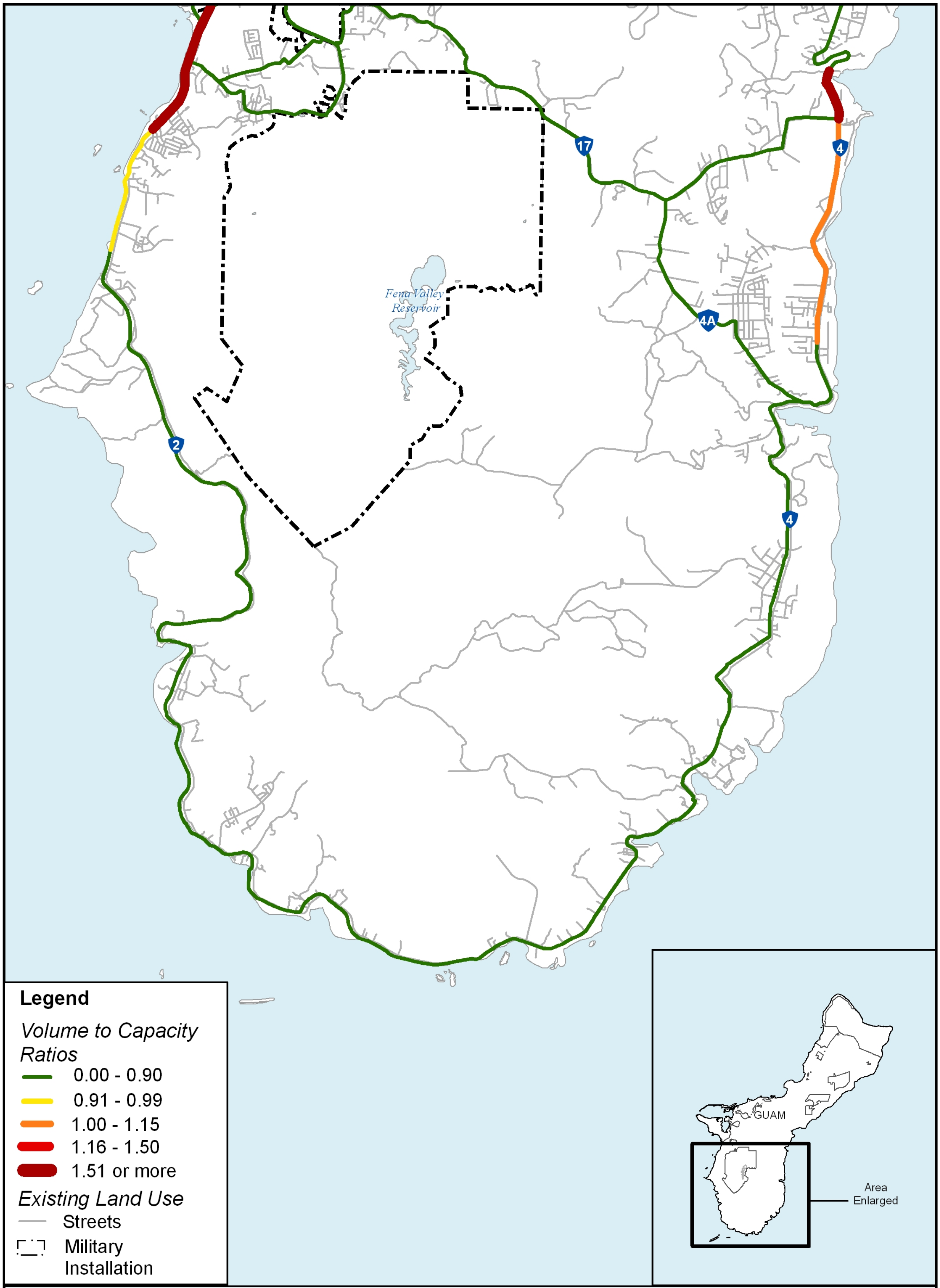


Figure 4.2-93 South Region - 2030 a.m. Peak Congestion Levels
Alternative 2 - LimitedRoadway Improvements

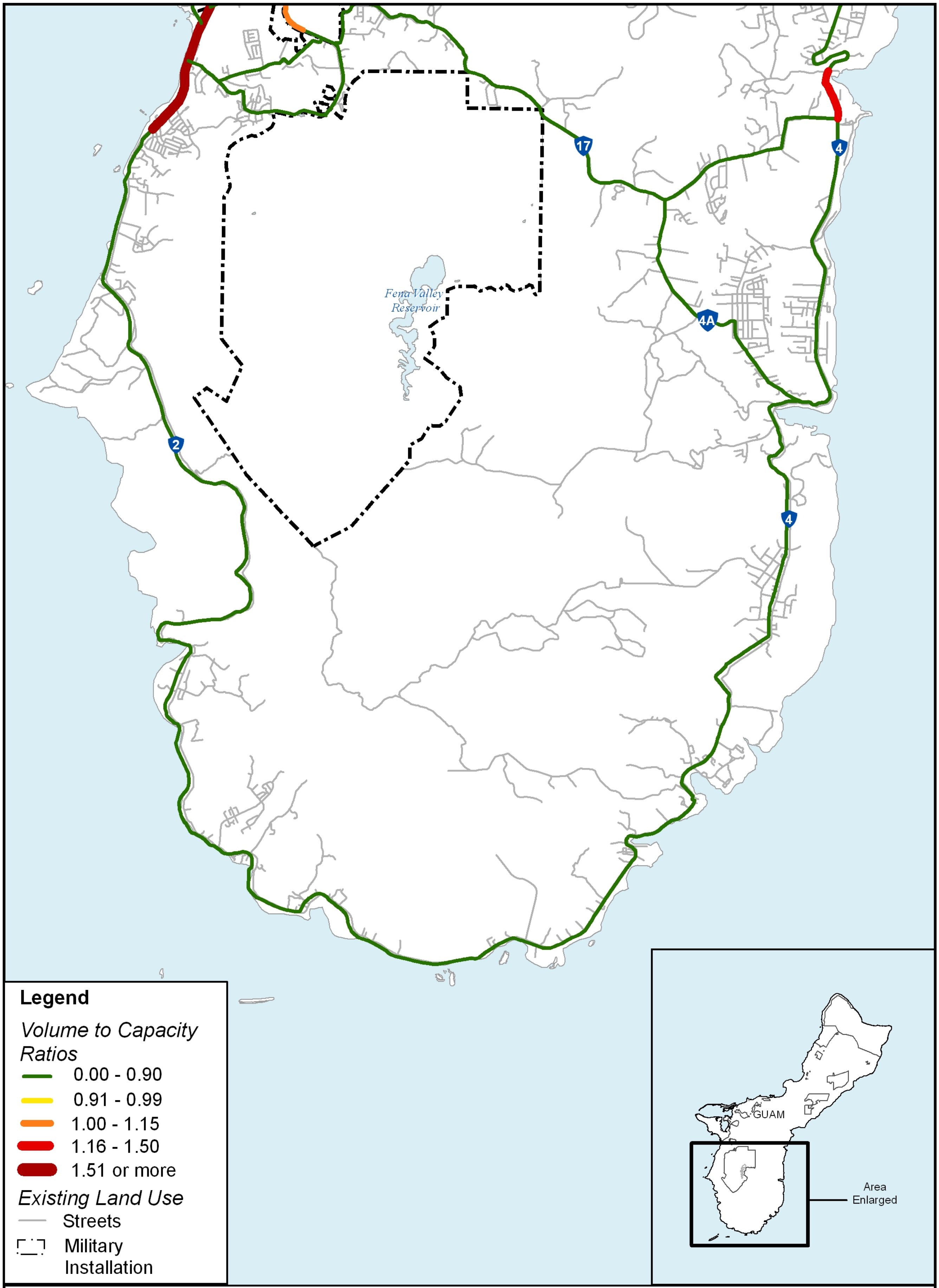


Figure 4.2-94 South Region - 2030 p.m. Peak Congestion Levels
Alternative 2 - LimitedRoadway Improvements

As shown in Table 4.2-46, in 2014 and 2030, Alternative 2 with limited roadway improvements has more intersections with LOS F in both peak hours and the amount of delay at those intersections and other intersections is substantially higher. For example, in 2030, the delay for the Route 1/27 intersection is 137.4 seconds in the a.m. and 374.3 seconds in the p.m. for Alternative 2 and 304.6 seconds in the a.m. and 1091.6 seconds in the p.m. for Alternative 2 with limited roadway improvements. While both alternatives have LOS F at the intersection in 2030, the seconds of delay for Alternative 2 with limited roadway improvements is significantly greater. The comparison in the number of intersections that would experience an LOS F between Alternative 2 and Alternative 2 with limited roadway improvements is shown in Table 4.2-45. The comparison in delay between Alternative 2 and Alternative 2 with limited roadway improvements can also be found in Table 4.2-47.

Table 4.2-46. Comparison of Alternative 2 and Alternative 2 with Limited Roadway Projects

	Alternative 2 2014	*Alternative 2 2030*	*Alternative 2 with Limited Roadway Projects 2014*	*Alternative 2 with Limited Roadway Projects 2030*
LOS F in at least one peak hour	30 intersections	22 intersections 1 access point	30 intersections	31 intersections
LOS F in both peak hours	24 intersections	13 intersections 1 access point	26 intersections	19 intersections 1 access point

Legend: LOS = Level of Service.

Table 4.2-47 and Table 4.2-48 summarize the potential impacts of Alternative 2 and Alternative 2 with limited roadway improvements. In general, LOS will worsen to severely congested levels on several roadways and at many intersections without implementation of all off base roadway projects to offset the traffic impacts associated with the housing and military base.

4.2.4 Qualitative Comparison of Alternatives – Limited Roadway Improvements

The analysis for Alternative 2 with limited roadway improvements showed that there would be significant, unmitigated congestion resulting from traffic associated with the additional housing and base activities without the full recommended off base roadway improvements. Specifically, v/c ratios were higher and there was a reduction in LOS as compared to those if all off base roadway improvements were completed. The limited roadway improvements would be similar for Alternatives 1, 3, and 8, with similar unmitigated traffic impacts. Further impacts to roadways connecting Navy Barrigada and Air Force Barrigada, such as Route 16, would occur if Alternative 3 or 8 were carried forward.

Table 4.2-47. Summary of Potential Impacts on Roadway and Intersection Capacity - Comparison of Alternative 2 and Alternative 2 with Limited Roadway Improvements**

Potentially Impacted Resource	*Alternative 2**	*Alternative 2 with Limited Roadway Improvements*
Roadway Capacity		
North	LSI	SI
Central	LSI	SI
Apra Harbor	LSI	LSI
South	LSI	LSI
Intersection Capacity		
North	LSI	SI
Central	LSI	SI
Apra Harbor	LSI	LSI
South	LSI	LSI

Legend: LSI = Less Than Significant Impact; SI = Significant Impact; *Preferred Alternative.

**Assumes only limited number of off base roadway widening and intersection improvement projects are constructed.

Table 4.2-48. Comparison of Alternatives 2 and Alternative 2 with Limited Roadway Projects

Overall Intersection Level of Service Analysis Results - Alternative 2 and Alternative 2 with Limited Roadway Improvements Comparison

S.NO	INTERSECTION	2014 Alternative 2				2014 Alternative 2 with Limited Roadway Improvements				2030 Alternative 2				2030 Alternative 2 with Limited Roadway Improvements			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[3]	Delay[4]	LOS[3]	Delay[4]	LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[1]	Delay[2]	LOS[1]	Delay[2]
1	ROUTE 1 AND ROUTE 9	C	27.6	D	39.8	C	27.6	D	39.8	C	22.5	D	52.2	C	22.5	D	52.2
2	ROUTE 1 AND ROUTE 29	F	256.2	F	138.7	F	181.2	F	136.4	E	65.5	E	67.7	E	65.5	E	67.7
3	ROUTE 1 AND ROUTE 28	F	360.8	F	331.8	F	358.3	F	331.4	F	216.8	F	104.5	F	244.9	F	206.3
4	ROUTE 1 AND ROUTE 26	F	108.0	F	278.1	F	129.2	F	248.1	E	75.8	F	156.6	E	61.9	F	251.5
5	ROUTE 1 AND ROUTE 27	F	1830.9	F	928.9	F	831.3	F	658.5	F	137.4	F	374.3	F	304.6	F	1091.6
6	ROUTE 1 AND ROUTE 27A	E	77.4	F	204.7	F	94.7	F	205.3	D	44.4	E	75.7	D	42.7	F	211.4
7	ROUTE 1 AND ROUTE 3	F	495.1	F	523.8	F	271.6	F	302.9	D	48.5	D	50.6	F	145.6	F	157.2
8	ROUTE 1 AND ROUTE 16	F	126.4	F	336.2	F	146.5	F	335.4	E	65.3	F	87.5	F	98.6	F	407.5
9	ROUTE 1 AND ROUTE 14 (North San Vitoris)	F	176.5	F	134.8	F	197.8	F	136.8	E	68.0	F	82.0	F	113.3	F	476.1
10	ROUTE 1 AND ROUTE 14A	F	313.6	F	326.8	F	210.3	F	238.2	F	112.2	F	131.5	F	151.5	F	298.8
11	ROUTE 1 AND ROUTE 10A	F	241.5	F	376.7	F	184.5	F	279.3	F	118.1	F	102.0	F	101.7	F	149.4
12	ROUTE 1 AND ROUTE 14B	F	168.4	F	159.1	F	160.0	F	159.0	F	83.9	E	78.2	E	79.0	F	119.9
13	ROUTE 1 AND ROUTE 14 (ITC)	F	234.7	F	428.6	F	180.5	F	335.1	F	182.5	F	275.1	F	187.0	F	275.1
14	ROUTE 1 AND ROUTE 30	F	488.1	F	568.6	F	518.0	F	559.6	F	134.7	F	267.2	F	270.1	F	489.8
15	ROUTE 1 AND ROUTE 8	F	216.2	F	143.5	F	134.5	F	213.1	F	97.6	F	127.5	F	97.6	F	123.8
16	ROUTE 1 AND ROUTE 4	C	24.3	D	44.6	C	30.4	D	44.7	C	32.4	F	140.2	C	32.4	F	140.2
17	ROUTE 1 AND ROUTE 6 (Adelup)	D	36.2	F	108.9	D	38.4	F	114.2	D	40.6	E	61.8	D	41.5	F	125.3
18	ROUTE 1 AND ROUTE 11	C	25.4	E	67.1	B	17.9	D	36.7	C	20.7	D	43.5	C	20.7	C	25.3
19	ROUTE 1 AND ROUTE 6 (Westerly)	D	53.2	C	23.6	D	54.3	C	23.7	B	18.4	C	22.0	B	18.4	C	22.0
20	ROUTE 1 AND POLARIS POINT	A	3.8	A	4.3	A	4.3	A	6.5	A	8.2	A	7.4	A	7.1	A	7.4
21	ROUTE 1 AND ROUTE 2A	F	94.1	F	82.1	F	94.6	F	82.2	E	66.8	E	57.2	E	69.5	F	84.0
22	ROUTE 5 AND ROUTE 2A	E	79.4	D	36.9	E	70.5	D	36.9	F	96.3	C	26.2	F	96.3	C	26.2
23	ROUTE 5 AND ROUTE 17	C	13.1*	C	29.2*	B	23.5*	C	29.3*	F	56.8*	F	149.6*	E	46.6*	F	149.6*
24	ROUTE 2 AND ROUTE 12	F	135.0	C	26.0	F	134.9	C	26.0	C	27.8	C	27.1	F	114.2	C	33.6
25	ROUTE 3 AND ROUTE 3A	C	19.7*	F	74.3	B	12.7*	C	22.5*	B	11.6*	F	79*	B	11.6*	F	79.0*
26	ROUTE 3 AND ROUTE 28	F	85.1	F	227.1	F	104.4	F	235.9	C	26.0	D	36.9	C	33.9	F	226.5
27	ROUTE 4 AND ROUTE 7A	F	270.5	F	989.8	F	202.1	F	288.5	F	607.3	F	534.1	F	244.4	F	286.4
28	ROUTE 4 AND ROUTE 10	F	190.2	F	165.1	F	185.4	F	100.7	F	199.5	E	65.1	F	199.6	F	103.5
29	ROUTE 4 AND ROUTE 17	C	35.0	D	42.6	C	35.0	D	42.6	D	39.6	E	57.7	D	39.6	E	61.9
30	ROUTE 4 AND ROUTE 4A	C	23.9*	C	17.1*	C	19.4*	C	14.3*	E	49.7*	F	484.3*	D	34.4*	C	19.4*
31	ROUTE 7 AND ROUTE 7A	F	167.7*	F	285.7*	F	167.7*	F	285.7*	D	29.2*	F	105.1*	D	29.2*	F	105.1*
32	ROUTE 8 AND ROUTE 33	E	64.8	F	145.2	E	60.0	F	143.6	D	54.6	F	81.7	D	48.3	F	162.0
33	ROUTE 8 AND ROUTE 10	F	278.7	F	335.0	F	224.7	F	304.1	F	96.9	F	172.7	F	96.9	F	172.7
34	ROUTE 10 AND ROUTE 15	F	166.4	F	144.7	F	166.4	F	144.7	F	196.9	F	152.3	F	196.9	F	152.3
35	ROUTE 15 AND ROUTE 29	F	NA*	F	838.9*	F	Error*	F	827.8*	C	27.7	C	25.4	F	Error*	F	Error*
36	ROUTE 16 AND ROUTE 27A	C	26.3	D	51.9	C	25.7	D	51.2	C	27.4	C	34.2	C	27.4	C	34.2
37	ROUTE 16 AND ROUTE 27	F	389.3	F	601.5	F	516.6	F	602.9	F	345.0	F	288.7	F	442.7	F	764.2
38	ROUTE 16 AND ROUTE 10A	F	260.1	F	566.1	F	324.8	F	482.0	F	123.1	F	123.5	F	469.1	F	123.5
39	ROUTE 17 AND ROUTE 4A	B	12.9*	B	14.0*	B	12.9*	B	14.0*	B	13.6*	C	18.7*	B	13.6*	C	18.7*
40	ROUTE 26 AND ROUTE 25	F	94.9	E	70.1	F	84.9	D	41.1	C	31.2	D	41.0	E	75.3	D	53.0
41	ROUTE 26 AND ROUTE 15	F	2554.1*	F	3440.9*	F	2541.3*	F	3412.4*	C	27.9	C	32.1	F	2757.5*	F	3327.3*
42	ROUTE 28 AND ROUTE 27A	C	31.8	F	402.8	F	525.0*	F	472.6*	D	35.6	D	36.6	F	320.4*	F	441.4*
	Access Points - NCTS Finegayan	NOT APPLICABLE, DESIGN AND EVALUATION OF ACCESS POINTS COMPLETED USING 2030 TIME HORIZON															
1	ROUTE 3 AND NORTH (COMMERCIAL) GATE**									B	12.5	C	28.3	B	29.7	E	60.2
2	ROUTE 3 AND SOUTH (MAIN) GATE**									C	33.5	E	58.6	C	23.1	E	67.2
	Access Points - South Finegayan																
3	ROUTE 3/CONTROL TREE DRIVE (RESIDENTIAL) GATE									C	26.7	B	18.5	C	32.7	C	26.5
	Access Points - AAFB																
5	ROUTE 9/AAFB NORTH GATE**									F	Error*	F	Error*	F	1029.7*	F	9999.0*
	Access Points - South Anderson																
6	ROUTE 1/TURNER STREET (MAIN GATE)									C	32.4	E	79.1	C	32.4	E	78.8
7	ROUTE 15/ ROAD 1.16 m e/o ROUTE 26 (SECOND GATE)**									C	22.1*	C	22.6*	C	22.1*	C	22.6*
	Navy Barrigada																
8	ROUTE 16 AND SABANA BARRIGADA									N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	ROUTE 8A/BARRIGADA CONNECTOR**									N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Barrigada AF																
10	ROUTE 15 AND CHADA STREET									N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Naval Ordinance Annex																
11	ROUTE 5 AND HARMON ROAD									A	9.5*	A	10.6*	A	9.6*	A	10.6*

[1]Level of Service [2]Control Delay in Seconds Per Vehicle

NOTES: Signalized Intersection LOS based on average delay for the overall intersection
*Unsignalized intersection LOS based on approach delay on STOP-controlled approach
**The intersections have not built in existing condition
Error = Delay excedeed maximum calculated value

Source: Parsons Brinckerhoff

CHAPTER 5.
GEOLOGICAL AND SOIL RESOURCES

5.1 INTRODUCTION

This chapter discusses the potential environmental impacts to geological and soil resources associated with implementing the proposed action within the region of influence (ROI) as they relate to utilities. The geology and soils ROI includes all the geologic resources on Guam that are subject to construction and operation activities. Because geology and soils relate to the physical foundation of Guam, the proposed land uses would affect characteristics of erosion and surface changes, such as land clearing and slope cuts, but not the overall geologic and soil conditions. Instead, geology and soils are more likely to affect the placement or location of land use.

For a description of the affected environment for all resources, refer to the respective chapter of Volume 2. The chapters are presented in the same order as the resource areas contained in Volume 6. The locations described in Volume 2 include the ROI for the utilities and roadway projects. Analysis of long-term alternatives was not done because those alternatives are not yet adequately developed for project-specific analysis.

5.2 ENVIRONMENTAL CONSEQUENCES

5.2.1 Approach to Analysis

5.2.1.1 Methodology

<u>Utilities</u>

The methodology for identifying, evaluating, and mitigating impacts to geology and soil resources was established through review of geological and soil studies and reports, federal laws and regulations, state and local building codes, and grading ordinances. The assessment of geologic and soils impacts was conducted, in part, by reviewing available literature, such as previously published National Environmental Policy Act documents for actions in the Mariana Islands Range Complex and surrounding area. A site-specific geotechnical investigation was not undertaken for this Environmental Impact Statement.

Light Detection and Ranging Contour Data was used to identify potential sinkholes on proposed sites. Analysis of topography, soil, and vegetation was completed during site characterization using Light Detection and Ranging Contour Data, geotechnical reports, and site visits to ensure minimal impacts to geological and soil resources.

Geologic and soil impacts include any resulting effects that the proposed action would have on the geological and soil resources of each geographic area as described in the affected environment section. Effects can occur during construction or operations, and may include:

- Cut and fill activities leading to soil erosion
- Removal of vegetation and landscaping leading to soil erosion
- Use of heavy equipment resulting in soil compaction
- Impacts to karst topography (surface collapse)
- Impervious surface increase resulting in increased runoff and soil erosion
- Vehicle movements on unpaved surfaces resulting in increased soil erosion and compaction

- Fires resulting in reduced vegetation and increased soil erosion
- Increased vulnerability to a geologic hazard (e.g., seismic activity, tsunami, liquefaction), and the probability that such an event could result in injury

The potential effects of these activities and their significance within the areas of occurrence under the alternative actions are described below. The analysis of potential impacts to geological and soil resources consider both direct and indirect impacts. Such disturbance may cause increased erosion and loss of productive soil. Direct impacts result from physical soil disturbances or topographic alterations. Indirect impacts include risks to individuals from geologic hazards, as well as impacts to water or marine biological resources occurring away from the construction/operation site or at a later time, after construction or operations. Factors considered in determining whether an impact would be significant include the potential for substantial changes in soil or slope stability. An impact to geological resources would be considered significant if the action could disrupt geologic features, or if actions were to be affected by potential geologic hazards.

Increases in runoff due to the removal of ground cover may increase sedimentation into surface waters.

Indirect groundwater impacts associated with the construction and operational activities include direct contamination of groundwater resources through percolation for surface runoff. Stormwater runoff can contribute to groundwater contamination. Water impacts are addressed in Volume 6, Chapter 6.

Construction activities are major sources of karst collapse, which can occur as a result of excavation, change of drainage patterns, or lowering the groundwater table (Islam 2005). Soil disturbance from construction can cause deposits to form in openings near the bedrock surface, which get heavier when saturated, causing the underlying structure to collapse.

Potential geology and soil impacts addressed in this chapter are limited to elements of the proposed actions that could affect onshore land forms or that could be affected by geologic hazards. Potential soil contamination issues are addressed in Volume 6, Chapter 18. Increased soil erosion also may indirectly impact water quality and aquatic ecosystems. Potential impacts to these resources are described in Volume 6, Chapter 6 and Chapter 13.

Applicable Regulatory Standards

The United States Environmental Protection Agency (USEPA) Region 9 gives the Guam Environmental Protection Agency (GEPA) the authority to enforce portions of federal statutes via a Memorandum of Agreement. Under this Memorandum of Agreement, the Safe Drinking Water Program, Water Resources Management Program, and the Water Pollution Control Program are administered by GEPA. The GEPA Water Pollution Control Program is responsible for protecting Guam's resources from point and non-point source pollution, including administration of the National Pollutant Discharge Elimination System (NPDES) program. NPDES permits are required for large and small construction activities. Requirements include a Notice of Intent, a Notice of Termination, and a construction site Stormwater Pollution Prevention Plan (SWPPP). Permits are required for projects that disturb greater than 1 acre (ac) of soil, including lay-down, ingress, and egress areas. Phase I regulates construction activity disturbing 5 ac (2 hectares [ha]) or more of total land area and Phase II regulates "small" construction activity disturbing between 1 and 5 ac (0.4 and 2 ha) of total land area. Erosion and sediment control would be covered under the stormwater general permit included in NPDES permits for construction projects greater than 1 ac (0.4 ha).

An Environmental Protection Plan (EPP) is required for projects at the discretion of the GEPA Administrator**.** EPPs are specifically identified in 22 Guam Annotated Regulations, Division II, Chapter 10, Section (§) 10103.C.5(d). EPPs would include nonpoint source control management measures including erosion and sedimentation control, vegetation, wildlife resource protection measures, fugitive dust control, solid and hazardous waste management and disposal procedures, nutrient management plan, integrated pest management strategy/plan, confined animal facilities management plan, irrigation water management plan, personnel safety procedures, work site maintenance, and typhoon contingency plans, as necessary, depending on the work, project, activity and facility function.

Military construction projects are required to follow Unified Facilities Criteria (UFC) 3-310-04 Seismic Design for Buildings, which contains specifications for limiting seismic, liquefaction and ground shaking effects (U.S. Army Corps of Engineers [USACE] 2007). Government of Guam (GovGuam) has established a Soils and Water Conservation Program as defined in Chapter 26 of Title 17 of the Guam Code Annotated, as authorized by Public Law 28-179. The program is administered by the University of Guam. This regulation promotes the Territory of Guam’s soil and water conservation policy in an effort to prevent erosion and water management problems; conserves and improves the use of the Territory's land and water resources; establishes Soil and Water Conservation Districts; and affirms the University of Guam's role as the Territory's lead soil conservation agency. Conservation programs are also administered by the Public Utility Agency of Guam and GEPA (Commander Navy Region Marianas 2008).

Effects of seismic, liquefaction, and ground shaking are reduced by following UFC 3-31-04, that provides the Department of Defense (DoD) requirements for:

- Creating earthquake-resistant design for new buildings.
- Evaluating and rehabilitating existing buildings for earthquake resistance.
- Applying seismic design principles to specialized structural and non-structural elements.

The new UFC adopts the seismic design provisions of the 2003 International Building Code for use in DoD building design. GovGuam regulations regarding solid waste landfills adhere to Rules and Regulations for the GEPA Solid Waste Disposal (Guam Code Annotated Title 22, Div. 4, Chapter 23). These regulations are no less stringent than the U.S. Environmental Protection Agency standards. These requirements are common to all sites:

- Access Control
- Office and Maintenance Facilities
- Base Liner System
- Leachate Collection
- Stormwater Control
- Landfill Operation
- Landfill Closure/Post-Closure
- Landfill Gas Collection and Monitoring

In addition, soil at all municipal landfills must cover disposed solid waste with six inches (15 centimeters) of earthen material at the end of the work day (Guam Department of Public Works 2005).

<u>Off Base Roadways</u>

The affected environment for geological and soil resources for the proposed roadway improvement projects on Guam is described in the Volume 2, Chapter 3.

Each of the action alternatives would result in construction and operation of a set of individual roadway improvement projects on the island of Guam, as defined in Volume 6, Chapter 2. Implementation of each alternative would result in construction activities in each of the four geographic regions shown in that chapter.

Construction activities would consist of intersection improvements, bridge/culvert replacements, pavement strengthening, road relocation, road widening, and construction of a new road. Typical activities associated with each of these types of projects are described in Table 5.2-1. While many projects would involve construction work in developed and paved areas, some roadway projects could result in alteration of topography and disturbance to soils. A preliminary screening of project types and potential effects on geologic resources is provided in Table 5.2-1.

Table 5.2-1. Typical Effects of Guam Road Network Roadway Project Construction Activities on Geological and Soil Resources

Item	*Project Type*	*Description*	*Potential Effect on Geological and Soil Resources*
1	Intersection Improvement (including military access points)	Installation of new traffic loop sensors, extending lanes through the intersection, striping and paving to include new approach or turn lanes, reconfiguring intersection shapes (i.e., from Y-intersection to T-intersections), combining lanes, creating shared lanes, restriping, signalization modifications or upgrades, and grade separations.	Generally, intersection improvement work would not result in contact with subsurface soils or any changes in topography. Geological resources would be affected only when reconfiguration or grade separations include excavation, trenching, or grading into the subsoil.
2	Bridge/Culvert Replacement	Bridge/culvert replacement would be conducted in phases. The new bridge/culvert structure would be lengthened or widened to adequately accommodate the hydraulic flow of the river. The width of the new structure would accommodate more or wider lanes and a median, with sidewalks and barriers on each side.	Bridge/culvert replacement can include excavation, trenching, or grading into the subsoil. Geological resources would be affected when foundation work requires excavation beneath the existing bridge/culvert structure, utility work requires new trenching, or when new structures require expansion of the footprint of the existing bridge/culvert.
3	Pavement Strengthening	Existing asphalt pavement sections would be strengthened by rehabilitating the existing pavement materials in place and placing an asphalt overlay or by reconstructing with new materials. Pavement strengthening may include widening or adding impervious surface. The widened pavement section would be constructed of residual material from the existing pavement rehabilitation, new material, or a combination thereof, and an asphalt overlay. Pavement strengthening would also include matching existing access connections, pavement striping, signing, intelligent traffic systems, and safety lighting. The project would match existing horizontal and vertical alignment as required. Minor realignment of the road may be necessary to accommodate design elements.	Physical disturbance to soils from pavement strengthening would only occur when pavements are widened, new traffic systems or devices are installed, or minor road realignment occurs in previously undisturbed ground. Most activities associated with pavement strengthening would not require soil intrusion.

Item	*Project Type*	*Description*	*Potential Effect on Geological and Soil Resources*
4	Road Relocation (Route 15 only)	Route 15 would be realigned to accommodate the location of military firing ranges. New asphalt pavement would be constructed on the new alignment. The roadway cross section would consist of one lane in each direction, outside shoulders and inside shoulders, with an unpaved median that would accommodate future widening. Bicycles would be accommodated in the outside shoulders of the shared roadway. Alternatively, future widening would be accommodated to the outside, and the roadway cross section would consist of two lanes and outside shoulders with a paved median. Realignment would also include construction of new bridges to grade separate Route 15 and the frontage roads, obliterating existing Route 15 pavement, building removal, connecting to existing roadways or other access roads, utility relocation, pavement striping, signing, property fence, and guardrail installation.	Realignment into previously undisturbed soils may be required to accommodate design of the roadway. This activity would require building removal and relocation of existing utilities.
5	Road Widening	New lanes would be added to an existing roadway to accommodate predicted increased traffic volumes and to relieve congestion caused by increase in traffic volumes due to relocation activities. Widening would result in rebuilding the entire roadway, including removing the existing roadway segment. A new sub-base, base course, asphalt, and friction course layers would be constructed.	Road widening activities would affect previously undisturbed soil and topography of affected areas.
6	Construction of New Road	The Finegayan Connection would be constructed on a new alignment with new asphalt pavement on a compacted base or engineered fill.	New road construction would affect previously undisturbed soil and topography of affected areas.
7	Other	Temporary placement of equipment laydown areas may be required.	Equipment laydown areas associated with any of the above project types may require clearing and other disturbance of soils.

Potential impacts to geological and soil resources can occur during cut and fill operations, removal of vegetation, use of heavy equipment, and as a result of leaks and spills onto soils. Direct impacts that result in physical soil loss would occur during construction, while indirect impacts can result from the completed project (e.g., geologic hazards, increased erosion, or contaminants leach into soils). To evaluate the geologic resource impacts of each project, physical activities associated with each project type were identified, as shown in Table 5.2-2.

Table 5.2-2. Activities Associated with Guam Road Network Roadway Project Types

Item	*Project Type*	*Minor Grading*	*Vegetation Removal*	*Excavation and/or Cut and Fill*	*Heavy Equipment Use*	*Leaks and Spills of Contaminants*
1	Intersection Improvement (including military access points)	●			●	●
2	Bridge/Culvert Replacement		●	●	●	●
3	Pavement Strengthening	●		●	●	●
4	Road Relocation (Route 15 only)		●	●	●	●
5	Road Widening	●	●	●	●	●
6	Construction of New Road		●	●	●	●
7	Temporary placement of equipment laydown areas or storage areas for road demolition material	●	●		●	●

Based on the anticipated activities associated with each project type, it was determined that:

- Intersection improvements and pavement strengthening projects represented the project types with the lowest potential for impacts to geological and soil resources. These projects would involve the least amount of physical soil disturbance because most work would occur on existing pavements or developed areas.
- The placement of temporary equipment laydown areas at any of the Guam Road Network (GRN) project work sites would represent a moderate potential for impacts to geological and soil resources only when the use of previously undisturbed areas are selected. To avoid this impact, previously disturbed (e.g., paved) areas adjacent to the work site would be selected for use as temporary construction staging areas or storage for roadway demolition materials whenever possible. The use of heavy equipment would occur, and leaks or spills of contaminants could occur at equipment staging areas.
- Bridge/culvert replacement, road relocation, road widening, and construction of the new road would represent the greatest potential for impacts to geological and soil resources because vegetation removal, excavation, and/or cut and fill operations would be required at various locations. These projects would result in changes in topographic features, exhibit the greatest degree of soil disturbance, and have the most potential for erosion.

For roadway projects that would not require road widening, all proposed improvements would occur within the existing impervious cover footprint. These projects would not directly or indirectly affect geological resources. Intersection improvement projects associated with Military Access Points would require removal of vegetation and soil intrusion; therefore, they were not eliminated from evaluation.

Indirect impacts from the roadway projects could also occur. Indirect impacts would be associated with geologic hazards, increased erosion, or contaminants leaching into soils. Projects with the most potential for increased vulnerability to geologic hazards would be those located in areas of high liquefaction potential and those in or near karst geologic formations (nearest to known sinkholes or caves). In general, the potential vulnerability to effects from seismic activity is consistent throughout the island because of known and inferred earthquake faults that transect Guam. Increased erosion from the operation of new roadways and bridges would not be expected due to improved design features and proper maintenance. The potential for contaminants leaching into the soil would be prevented or managed through implementation of spill prevention and emergency spill response procedures.

5.2.1.2 Determination of Significance

For geological and soil resources, the significance of potential project impacts is determined by subjective criteria, as well as by regulatory standards. An impact to geologic resources would be considered significant if the action could disrupt geologic features, or if actions were to be affected by potential geologic hazards. The following factors are considered in determining the importance of the impacts:

- An increase in rate of erosion and soil loss from physical disturbance
- Reduced amounts of productive soils
- Alteration of surrounding landscape and effect on important geologic features (including soil or rock removal that would adversely affect site drainage)
- Diminished slope stability
- Increased vulnerability to a geologic hazard (e.g., seismic activity, tsunami, liquefaction), and the probability that such an event could result in injury

5.2.1.3 Issues Identified during Public Scoping Process

The following analysis focuses on possible effects to the geological and soil resources that could be impacted by the proposed alternatives. As part of the analysis, concerns relating to geological and soil resources mentioned by the public, including regulatory stakeholders, during scoping meetings were addressed. These include:

- Implementing erosion control measures for construction and post construction phases.
- Ensuring that proper permitting and local government clearances are sought, where applicable.

5.2.2 Power

5.2.2.1 Basic Alternative 1: Recondition up to 5 Existing Guam Power Authority Permitted Facilities to Provide Peaking Power/Reserve Capacity

Basic Alternative 1 would recondition existing Combustion Turbines (CTs) and upgrade and install new Transmission and Distribution (T&D) systems. This work would be undertaken by the Guam Power Authority on its existing permitted generation facilities. Reconditioning would be made to existing permitted facilities at the Marbo, Yigo, Dededo (2 units), and Macheche CTs. These CTs are hardly being used and upon reconditioning would have the necessary reliability to serve as peaking and reserve units to ensure system reliability. T&D system upgrades and new installations would include above ground and underground transmission lines and modifications to existing substations. This alternative supports Main Cantonment Alternatives 1 and 2. Main Cantonment Alternatives 3 and 8 would require additional upgrades and new additions to the T&D system.

Development under Basic Alternative 1 would disturb soil during construction associated with T&D upgrades and new installations within current utility corridors, but would not require enlargement of the footprint of the power facilities. Underground transmission lines would be placed along roadways and in existing utility corridors. There is a risk of increased rate of erosion, compaction, and soil loss from physical disturbance caused by construction activity. Land disturbing activities would trigger the requirement to seek coverage under the Construction General Permit. A site-specific SWPPP would be prepared and implemented in accordance with the Construction General Permit. The SWPPP would identify site-specific Best Management Practices (BMPs) (Volume 2, Chapter 4, Table 4.2.1) that would be implemented as part of Basic Alternative 1 to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts. Standard operating procedures (SOPs) and BMPs would be implemented to control and minimize impacts. The following measures are current SOPs for activities that could impact geological and soil resources in the project area:

- Locate ground-disturbing roadwork on previously disturbed sites whenever possible.
- Restrict vehicular activities to designated/previously identified areas.
- Prohibit off-road vehicle use except in designated off-road areas or on established trails.
- Monitor erosion and drainage at select locations.
- Comply with existing policies and management activities to conserve soils.
- Implement standard erosion control measures (i.e., temporary and permanent soil stabilization; location of temporary soil piles; placement of sediment barriers around storm sewer inlets; sediment controls such as filter fabric fences, straw bales, or vegetative barriers; timely disposal of construction material wastes) during ground-disturbing activities (e.g., excavation and grading).
- Place any topsoil removed from the site in the immediate area and reuse it for re-compaction purposes (if appropriate, in accordance with geotechnical recommendations).
- Dispose of any contaminated topsoil from the site in an approved landfill in accordance with applicable regulatory requirements.
- Plan and conduct any earthwork in such a manner as to minimize the duration of exposure of unprotected soils.
- Install berms and plastic sheeting for soil disturbance activities that occur during the rainy season.
- Locate temporary equipment laydown areas on previously disturbed or developed (i.e., paved) areas whenever possible to avoid the need for vegetation removal or grading.
- Use proper storage and containment of contaminants at all temporary equipment staging areas.
- Prepare and implement erosion control plans for roadway work in construction plans and practices to the maximum extent practicable, including but not limited to:
- the area of land to be graded shall be kept to a minimum, stabilized, or receive temporary covering if delays exceeding 2 months of exposure occur;
- critical areas shall be protected during construction with the use of temporary ditches, dikes, vegetation, and/or mulching;
- all disturbed areas, slopes, channels, ditches, and banks shall be stabilized as soon as possible after final grading has been completed;
- stormwater runoff from disturbed areas would be collected and diverted for removal of sediment before discharge to any surface or marine waters; and
- all erosion and sedimentation control facilities would be maintained until stabilization of the site is complete.
- Ensure that all construction work areas are clearly identified or marked on contractor drawings. Restrict vehicular activities to designated/previously identified areas within the construction work zone only.
- Prohibit off-road vehicle use except in designated off-road areas or on established trails.
- Ensure that contaminants (i.e., oils, greases, lubrication fluids for heavy equipment) are properly stored at the work site to avoid spills and leaks.

Erosion potential of soils found at facilities proposed for reconditioning and in the areas underlying T&D upgrades under Basic Alternative 1 is shown in Table 5.2-3.

Table 5.2-3. Erosion Potential at Power Alternative Sites

Soil Type	*Location*	*Erosion Potential*
Guam Yigo Complex at 0-7% slope	Marbo, Yigo, and Dededo	slight
Guam Cobbly Clay Loam at 3-7% slope	Marbo, Yigo, Macheche, and Dededo, Andersen AFB, Potts Junction	slight
Guam Cobbly Clay Loam at 3-7% slope	Harmon/Yigo and Dededo/Andersen, Andersen AFB	slight
Guam Urban Land Complex at 0-3% slope	Orote Point, Potts Junction	slight
Urban Land-Ustorthents complex at 0% slope	Cabras/Piti	slight

Legend: AFB = Air Force Base.
Source: Young 1988.

Construction activities under Basic Alternative 1 would include clearing, grading and grubbing, trenching, and demolition of existing earthwork and grass. Direct impacts include temporary loss of vegetation. Installation of underground T&D lines would permanently displace soil; however, the volume of soil moved would result in less than significant impacts to soil resources. Therefore, Basic Alternative 1 would result in less than significant impacts to topography.

There are no known sinkholes near Basic Alternative 1 construction. A survey by a licensed geologist is required prior to construction to ensure that all sinkholes have been identified. If additional sinkholes are discovered, the project would be designed to minimize any impacts associated with sinkholes. Any sinkholes discovered would be avoided and buffer zones of vegetation would be left around them to prevent further erosion or expansion. Therefore, Basic Alternative 1 would result in less than significant impacts to unique geologic resources.

Construction areas are in a potentially active seismic zone. Hazards associated with earthquakes, fault rupture, slope instability and liquefaction would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). Therefore, Basic Alternative 1 would result in less than significant impacts associated with geologic hazards during construction and operation.

Soil types disturbed would not be agriculturally productive soils. Construction SOPs and BMPs would be followed to control and minimize soil erosion. The construction SOPs would include requirements for stormwater compliance, and with BMPs implementation, would ensure that all aspects of the project construction would be performed in a manner to minimize direct and indirect impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7. Implementation of measures noted in the geological and soil resources column would prevent erosion; therefore, the impacts from soil erosion would be less than significant. A more detailed explanation of regulatory permitting requirements is available in Volume 8.

Proposed Mitigation Measures

Implementation of Basic Power Alternative 1 would have less than significant impacts to geological and soil resources. Therefore, no mitigation measures are proposed. Implementation of SOPs and BMPs including erosion and sedimentation controls and stormwater management would minimize impacts to geological and soil resources.

5.2.2.2 Summary of Impacts

Table 5.2-4 summarizes the potential impacts of Basic Power Alternative 1. A text summary is provided below.

Table 5.2-4. Summary of Potential Power Impacts

Basic Alternative 1
Construction (direct and indirect impacts are the same)
Topography – LSI Geology – NI Soil – LSI Geologic Hazards – LSI
Operation (direct and indirect impacts are the same)
Topography – LSI Geology – NI Soil – LSI Geologic Hazards – LSI

Legend: LSI = Less than significant impact; NI = No impact.

Relocation of Marines to Guam would require construction and reconditioning that would potentially disturb soil, increase erosion, and change the landscape of Guam in multiple areas. Reconditioning of existing generation facilities and trenching for underground transmission line upgrades are required to support the increase in population.

Rates of erosion and soil loss from physical disturbance due to construction would temporarily increase during construction and renovation associated with the alternative for power infrastructure improvements. With implementation of BMPs, less than significant impacts from soil erosion would occur. The soil types that would be lost are not agriculturally productive soils. The topographic and landscape features would not be substantially changed by proposed construction activities. Some areas contain karst geologic features that would be of concern during the construction and operation of the facilities.

5.2.3 Potable Water

5.2.3.1 Basic Alternative 1 (Preferred Alternative)

Basic Alternative 1 would provide additional water capacity of 11.3 MGd (42.8 MLd), which is anticipated to be met by an estimated 22 new wells at Andersen Air Force Base (AFB), rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 2.5 MG (9.5 ML) water storage tanks would be constructed at ground level at NCTS Finegayan. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint. Basic Alternative 1 would affect the following areas of Guam:

- North (water supply wells)
- Central (rehabilitation of Navy Regional Medical Center well)

The estimated 22 new water wells (including one contingency well) at AFB would be drilled through the limestone plateau into the Northern Guam Lens Aquifer. Total well depths would be from 512 to 577 feet (156 to 175 meters). The two new 2.5 MG (9.5 ML) water storage tanks would be placed on the ground on site at Finegayan and would be connected to the new and existing system. Two new 1 MG (3.8 ML) elevated water storage tanks would be constructed at Finegayan and connected to the new distribution system. New underground water transmission lines would be placed along roadways and existing utility corridors.

Generally, soil erosion is a concern primarily for discharge into surface or nearshore waters that are not located near the proposed wells. However, potential sediment contamination of groundwater may result from drilling new wells. Erosion potential for soils found at proposed upgrade sites is shown in Table 5.2-5. The two new ground-level 2.5 MG (9.5 ML), up to two elevated 1 MG (3.8 ML) storage tanks, and new underground transmission lines are proposed on Naval Computer and Telecommunications Station Finegayan. Development under Alternative 1 would disturb soil, but SOPs and BMPs would be implemented to control and minimize direct and indirect impacts. Therefore, Alternative 1 well-drilling would not result in significant soil erosion, compaction, or loss of agriculturally productive soil.

Table 5.2-5. Erosion Potential at Potable Water Sites

Soil Type	*Location*	*Erosion Potential*
Guam Cobbly Clay Loam at 3-7% slope	Andersen AFB	slight
Guam Cobbly Clay Loam at 7-15% slope	Andersen AFB	slight
Guam Urban Land Complex at 0-3% slope	Andersen AFB	slight
Guam Urban Land Complex at 0-3% slope	NCTS Finegayan	slight
Guam Cobbly Clay Loam at 7-15% slope	Andersen South	slight
Guam Cobbly Clay Loam at 7-15% slope	Andersen South	slight
Guam Urban Land Complex at 0-3% slope	Andersen South	slight
Guam Cobbly Clay Loam at 3-7% slope	Air Force Barrigada	slight
Chacha Clay at 0-5% slope	Air Force Barrigada	slight
Pulantat-Kagman Clays at 0-7% slope	Air Force Barrigada	slight
Inaranjan Clay at 0-4% slope	NMS	slight
Akina Silty Clay at 7-15% slope	NMS	severe
Akina-Urban Land Complex at 0-7% slope	NMS	slight

Legend: AFB = Air Force Base; NCTS = Naval Computer and Telecommunications Station; NMS = Naval Munitions Site.
Source: Young 1988.

Construction of wells and water distribution lines under Basic Alternative 1 would include minor clearing, grading, and grubbing, and demolition of existing earthwork and grass. Direct impacts to topography include temporary loss of vegetation. Landscape changes under Basic Alternative 1 would result in minimal impacts to topography by changing the landscape of the affected area.

Known sinkholes would be avoided and buffer zones of vegetation would be left around them as a mitigation measure to prevent further erosion or expansion. A survey by a licensed geologist is required prior to construction to ensure that all sinkholes have been identified. If additional sinkholes are discovered, the project would be designed to minimize any impacts associated with sinkholes. Sinkholes would be fenced off and educational signs would be put in place to warn of their potential danger. Alternative 2 would not result in impacts associated with geologic resources or hazards.

Therefore, with mitigation, Alternative 1 would result in less than significant impacts to unique geologic resources.

Construction areas are in a potentially active seismic zone. Effects associated with earthquakes, fault rupture, slope instability and liquefaction would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). Therefore, Alternative 1 would result in less than significant impacts associated with geologic hazards during construction and operation.

Soil types disturbed would not be agriculturally productive soils. Construction SOPs would be followed to minimize soil erosion. The construction SOPs would include requirements for stormwater compliance, with BMPs to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7. Implementation of measures noted in the geological and soil resources column would prevent erosion; therefore, the impacts from soil erosion would be less than significant. A more detailed explanation of regulatory permitting requirements is available in Volume 8.

Potential upgrades to the GWA system to meet indirect population growth demand would have similar impacts to those of the direct DoD impacts described above, including less than significant impacts from landscape alteration, from geologic hazards, and erosion.

To reduce significant impacts during construction under Basic Alternative 1, the following measures are suggested for implementation in accordance with site-specific geotechnical reports produced for project planning and construction:

- Revegetation would occur as soon as possible after any ground disturbance or grading.
- Construction and grading would be minimized during times of inclement weather.

Construction and operation impacts from seismic activity and associated liquefaction and ground shaking would be reduced by following UFC 3-310-04 Seismic Design for Buildings (USACE 2007).

Proposed Mitigation Measures

Known sinkholes would be avoided and a buffer zone of vegetation would be left around them as a mitigation measure to prevent further erosion or expansion. If additional sinkholes are discovered, the project would be designed to minimize any impacts associated with sinkholes. Sinkholes would be fenced off and educational signs would be put in place to warn of their potential danger as a mitigation measure. Therefore, with mitigation, less than significant impacts to a unique geologic resources would occur.

5.2.3.2 Basic Alternative 2

Basic Alternative 2 would provide additional water capacity of 11.7 MGd (44.3 MLd), which is anticipated to be met by an estimated 20 new wells at Andersen Air Force Base (AFB) and 11 new wells at Air Force Base Barrigada, rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 1.8 MG (6.8 ML) water storage tanks would be constructed at ground level at NCTS Finegayan and one 1 MG (3.8 ML) water storage tank would be construction at Air Force Base Barrigada. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

Impacts to soil and geological resources at Andersen AFB are identical to those under Basic Alternative 1.

At Navy Barrigada, installation of up to 11 new wells, as well as replacement and upgrades to water distribution lines, would include minor clearing, grading and grubbing, and demolition of existing earthwork and grass. Direct impacts to topography include temporary loss of vegetation. If additional sinkholes are discovered, the project would be designed to minimize any impacts associated with sinkholes. Any sinkholes discovered would be avoided and a buffer zone of vegetation would be left around them as a mitigation measure to prevent further erosion or expansion Sinkholes would be fenced off and educational signs would be put in place to warn of their potential danger. Therefore, Basic Alternative 2 would result in less than significant impacts to unique geologic resources.

Construction areas are in a potentially active seismic zone. Effects associated with earthquakes, fault rupture, slope instability and liquefaction would be minimized by adherence to UFC 3-310-04 Seismic

Design for Buildings (USACE 2007). Therefore, Basic Alternative 2 would result in less than significant impacts associated with geologic hazards to construction or operations.

Soil types disturbed would not be agriculturally productive soils. Construction SOPs would be followed to minimize soil erosion as stated in Alternative 1 impacts.

Potential upgrades to the GWA system to meet indirect population growth demand would have similar impacts to those of the direct DoD impacts described above, including less than significant impacts from landscape alteration, from geologic hazards, and erosion.

Impacts from seismic activity and associated liquefaction and ground shaking would be reduced by following UFC 3-310-04 Seismic Design for Buildings (USACE 2007).

Proposed Mitigation Measures

Potential mitigation measures are the same as those for Basic Alternative 1.

5.2.3.3 Summary of Impacts

Table 5.2-6 summarizes the potential impacts of each action alternative. A text summary is provided below.

Table 5.2-6. Summary of Potential Potable Water Impacts

*Basic Alternative 1**	*Basic Alternative 2*
Construction (direct and indirect impacts are the same)	
Topography – LSI Geology – SI-M Soil – LSI Geologic Hazards – LSI	Topography – LSI Geology – SI-M Soil – LSI Geologic Hazards – LSI
Operation (direct and indirect impacts are the same)	
Topography – LSI Geology – SI-M Soil – LSI Geologic Hazards – LSI	Topography – LSI Geology – SI-M Soil – LSI Geologic Hazards – LSI

Legend: LSI = Less than significant impact; SI-M= Significant impact mitigable to less than significant
* Preferred Alternative.

Relocation of Marines to Guam would require construction and renovation that would potentially disturb soil, increase erosion, and change the landscape of Guam in multiple areas. Buildup of the potable water infrastructure is required to support the increase in population.

Temporarily increased rates of erosion, compaction, and soil loss due to physical disturbance from construction would occur during construction and renovation associated with all of the alternatives for the potable water infrastructure improvements. With implementation of BMPs, less than significant impacts from soil erosion would occur. The soil types that would be lost are not agriculturally productive soils. The topographic and landscape features would not be substantially changed by construction activities. Some areas contain karst geologic features that are of concern during construction and operation of the facilities. Known sinkholes would be avoided and a buffer zone of vegetation would be left around them as a mitigation measure to prevent further erosion or expansion. A survey by a licensed geologist is required prior to construction to ensure that all sinkholes have been identified. If additional sinkholes are discovered, the project would be designed to minimize any impacts associated with sinkholes. Sinkholes would be fenced off and educational signs would be put in place to warn of their potential danger as a mitigation measure to prevent significant impacts to operations. With mitigation, less than significant impacts to sinkholes. would occur. Details regarding potential upgrades to the GWA system would have similar impacts to those of the DoD impact, including less than significant impacts from landscape alteration, from geologic hazards, and erosion.

5.2.4 Wastewater

5.2.4.1 Basic Alternative 1a (Preferred Alternative) and 1b

Basic Alternative 1 (1a supports Main Cantonment Alternatives 1 and 2; and 1b supports Main Cantonment Alternatives 3 and 8) combines upgrade to the existing primary treatment facilities and expansion to secondary treatment at the Northern District Wastewater Treatment Plant (NDWWTP). Upgrades include new underground sewer lines. The difference between Alternatives 1a and 1b is a requirement for a new sewer line from Barrigada housing to NDWWTP for Alternative 1b.

The action areas are located in northern Guam, an area with karst geologic features that would require consideration when planning new construction. The proposed upgrade to the facilities does not include enlargement of the plant footprint. Expansion of the NDWWTP outfall would require a laydown area.

Generally, soil erosion is a concern primarily for discharge into surface or nearshore waters, none of which are found near Alternative 1 construction. Erosion potential for soils found at proposed upgrade sites is shown in Table 5.2-7. Soil types disturbed would not be agriculturally productive soils.

Table 5.2-7. Erosion Potential at Wastewater Alternative Sites

Soil Type	*Location*	*Erosion Potential*
Guam Cobbly Clay Loam at 3-7% slope	NDWWTP	Slight
Guam Yigo Complex at 0-7% slope	Proposed Sewer Line	Slight
Guam Cobbly Clay Loam at 3-7% slope	Proposed Sewer Line	Slight

Legend: NDWWTP = Northern District Wastewater Treatment Plant.
Source: Young 1988.

Construction under Basic Alternatives 1a and 1b would include minor clearing, grading, and grubbing, and demolition of existing earthwork and grass. Temporary loss of vegetation would occur. Changes to the landscape associated with Basic Alternatives 1a and 1b would result in less than significant impacts to topography. Therefore, Alternative 1 would result in minimal impacts to topography by changing the landscape of the affected area.

A survey by a licensed geologist is required prior to construction to ensure that all sinkholes have been identified. If additional sinkholes are discovered, the project would be designed to minimize any impacts associated with sinkholes. Any sinkholes discovered would be avoided and buffer zones of vegetation would be left around them as a mitigation measure to prevent further erosion or expansion. Sinkholes would be fenced off and educational signs would be put in place to warn of their potential danger. as a mitigation measure to prevent significant impacts to operations. Therefore, with mitigation, Basic Alternative 1 would result in less than significant impacts to unique geologic resources.

Construction areas are in a potentially active seismic zone. Effects associated with earthquakes, fault rupture, slope instability and liquefaction would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). Therefore, Basic Alternative 1 would result in less than significant impacts associated with geologic hazards.

Standard construction BMPs would be included in the Regional SWPPP as part of the Construction Stormwater Management Program for the military relocation. As part of an integrated approach to stormwater management, construction managers and contractors would be required to follow this Regional SWPPP for development of their site specific SWPPP. To prevent soil erosion, erosion and sediment control measures would be included as part of the Regional SWPPP, and required for inclusion in the Contractor's Site Specific SWPPP under NPDES Construction Permit Compliance Program for the military relocation. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7. Implementation of measures noted in the geological and soil resources column would prevent erosion, thus the impacts from soil erosion would be less than significant. A more detailed explanation of regulatory permitting requirements is available in Volume 8.

To reduce significant impacts during construction under Basic Alternative 1, the following measures are suggested for implementation in accordance with site-specific geotechnical reports produced for project planning and construction:

- Revegetation would occur as soon as possible after any ground disturbance or grading.
- Construction and grading would be minimized during times of inclement weather.

Impacts from seismic activity and associated liquefaction and ground shaking would be reduced by following UFC 3-310-04 Seismic Design for Buildings (USACE 2007).

Proposed Mitigation Measures

Sinkholes would be avoided and buffer zones of vegetation would be left around them as a mitigation measure to prevent further erosion or expansion. As a result of mitigation, the sinkholes would not be affected by construction activities. If additional sinkholes are discovered, significant impacts to these sinkholes would be determined and projects would be designed in consideration of these sinkholes as appropriate. Sinkholes would be fenced off and educational signs would be put in place to warn of their potential danger as a mitigation measure to prevent significant impacts to operations. With mitigation, less than significant impacts to sinkholes would occur. No proposed mitigation measures.

5.2.4.2 Summary of Impacts

Table 5.2-8 summarizes the potential impacts of each action alternative. A text summary is provided below.

Table 5.2-8. Summary of Wastewater Impacts

Basic Alternative 1a and 1b* (direct and indirect impacts are the same)
Construction (direct and indirect impacts would be the same)
Topography – LSI Geology – SI-M Soil – LSI Geologic Hazards – LSI
Operation (direct and indirect impacts would be the same)
Topography – LSI Geology – SI-M Soil – LSI Geologic Hazards – LSI

Legend: LSI = Less than significant impact; SI-M= Significant impact mitigable to less thansignificant;
* Preferred Alternative.

Relocation of Marines to Guam would require construction and renovation that would potentially disturb soil, increase erosion, and change the landscape of Guam in multiple areas. Buildup of wastewater treatment infrastructure is required to support the increase in population.

Rates of erosion and soil loss from physical disturbance due to construction would temporarily increase during construction and renovation associated with all of the alternatives for wastewater treatment infrastructure improvements. With implementation of BMPs, less than significant impacts from soil erosion would occur. The soil types that would be lost are not agriculturally productive soils. The topographic and landscape features would not be substantially changed by proposed construction activities. Some areas contain karst geologic features that would be of concern during the construction and operation of the facilities. Known sinkholes would be avoided and buffer zones of vegetation would be left around them as a mitigation measure to prevent further erosion or expansion. As a result of mitigation, the sinkholes would not be affected by construction activities. A survey by a licensed geologist is required prior to construction to ensure that all sinkholes have been identified. If additional sinkholes are discovered, the project would be designed to minimize any impacts associated with sinkholes. There would be less than significant impacts to sinkholes with proposed mitigation measures.

5.2.5 Solid Waste

5.2.5.1 Basic Alternative 1 (Preferred Alternative)

The Preferred Alternative would be to continue to use the Navy landfill at Apra Harbor for municipal solid waste (MSW) until the new GovGuam Layon Landfill at Dandan is available for use. Disposal of other waste streams excluded from Layon Landfill would continue at the Navy landfill. Construction and demolition (C&D) debris would continue to be disposed at the Navy hardfill.

Though no construction or upgrades to utilities occur, geological and soil resources need to be analyzed for impact from increased amounts of solid waste at current facilities. An increase in the volume of solid waste would potentially impact the daily soil-covering routines at the existing plant. More soil would potentially be required to cover greater amounts of solid waste. Impact to soils and geological resources would be minimal, because soil is used at the landfill for the purpose of covering solid waste and more soil is available to use as pressure on the existing facility increases. There are no sinkholes or unique karst features found in the area. There would be no impacts from construction, and less than significant impacts from operation.

Proposed Mitigation Measures

No mitigation measures are required.

5.2.5.2 Summary of Impacts

Table 5.2-9 summarizes the potential impact of the Preferred Alternative. A text summary is provided below.

Table 5.2-9. Summary of Potential Solid Waste Impacts

Basic Alternative 1(direct and indirect impacts are the same)*
Construction
Topography – NI Geology – NI Soil – NI Geologic Hazards – NI
Operation
Topography – LSI Geology – LSI Soil – LSI Geologic Hazards – NI

Legend: LSI = Less than significant impact; NI=No impact; * Preferred Alternative.

Solid waste Basic Alternative 1 would not involve new or expanded facilities. It would involve higher generation of solid waste. Therefore, the impacts of solid waste to geological and soil resources would be less than significant.

5.2.6 Off Base Roadways

5.2.6.1 Alternative 1

Alternative 1 would result in direct impacts to geologic resources as a result of construction. Impacts to geologic resources could include soil disturbance and the suspension of soil, soil loss, and localized erosion. Ground disturbance for roadway improvements would be conducted in accordance with construction SOPs listed in Section 5.2.2.1 and below and BMPs listed in Volume 7:

- Individual roadway projects would be designed and constructed in accordance with recommendations of the project- and site-specific geotechnical investigation and applicable geotechnical code requirements. Each project would be designed and constructed in accordance with recommendations from a registered professional geologist for the following aspects, as applicable, and included in the project-specific geotechnical investigation: liquefaction, erosion, site grading, excavation and utility trenches, foundations, mitigation of soil corrosivity on concrete and seismic design criteria. Approval by a licensed Geotechnical Engineer would be required for placement and compaction of fill, backfilling of trenches, and testing of soils.
- Earthwork would be conducted using BMPs to minimize erosion during demolition and road or bridge construction including, but not limited to, watering for dust control during earthwork to minimize soil loss; and establishing grass or other landscaping in disturbed areas immediately after construction is completed.
- Material from demolition of existing road pavements shall be stored in previously disturbed areas whenever possible.
- For projects involving military access, control erosion through the Site Approval Process, whereby each proposed project is reviewed for its erosion potential. Obtain concurrence of the designated installation Natural Resource Specialist in the process.
- Manage erosion in accordance with the applicable SWPPPs at each roadway project location.
- 141,542 tons of aggregate for roadway construction would be imported from Japan. Local rules and regulations for importing would be followed to prevent significant impacts.

<u>North</u>

Thirteen GRN projects would occur in the North Region as a result of Alternative 1:

- One intersection improvement project (GRN #117) and two pavement strengthening projects (GRN #s 8 and 23) would not require road widening or road realignment in previously undisturbed ground. No impacts to geologic and soil resources would occur.
- Four intersection improvement projects involving modifications to Military Access Points (MAPs) (GRN #s 38A, 39A, 41A, and 42) would be required. To construct new access gates, removal of vegetation and disturbance to Limestone Upland soils would be required.
- Five road widening projects (GRN #s 9, 10, 22, 22A, and 57) would require removal of vegetation and disturbance to Limestone Upland soils.
- Construction of the Finegayan Connection, a new road (GRN #124), would require removal of vegetation and disturbance to Limestone Upland soils.

Soil disturbances from the latter three project groups described above could result in an increased rate of erosion and soil loss. Soil erosion would be a concern for discharge into any nearby surface waters. With implementation of construction SOPs and BMPs, impacts from soil erosion would be prevented or minimized. Alternative 1 would result in less than significant impacts to unique geologic resources and would not result in significant soil erosion. Therefore, impacts to soils would be less than significant.

Central

Twenty-seven GRN projects would occur in the Central Region as a result of Alternative 1:

- Three intersection improvement projects (GRN #s 1, 2, and 113) and 16 pavement strengthening projects (GRN #s 6, 7, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 30, 31, 32, and 33) would not require road widening or road realignment in previously undisturbed ground. No impacts to geological and soil resources would occur.
- Two intersection improvement projects involving modifications to MAPs (GRN #s 44 and 46) would be required. Both projects would occur in previously developed areas, and minimal soil disturbance would be required.
- Two bridge/culvert replacement projects (GRN #s 3 and 35) would require clearing and excavation of soil, as well as construction activities adjacent to, and over water.
- Three road widening projects (GRN #s 16, 28, and 29) would require removal of vegetation and disturbance to Limestone Upland soils.
- The relocation of Route 15 (GRN #36) would require removal of vegetation and disturbance to Limestone Upland soils.

Soil disturbances from the latter three project groups described above could result in an increased rate of erosion and soil loss. Soil erosion would be a concern for discharge into any nearby surface waters. With implementation of appropriate SOPs and BMPs, impacts from soil erosion would be prevented or minimized. Therefore, impacts to soils would be less than significant.

Apra Harbor

Five GRN projects would occur in the Apra Harbor Region as a result of Alternative 1:

- One intersection improvement project (GRN #5) and three pavement strengthening projects (GRN #4, #24, and #26) would be required. While GRN #4, #24, and #26 would not require road widening or realignment, GRN #5 would require removal of vegetation for road widening and would result in limited soil disturbance.
- One intersection improvement project involving modification to a MAP (GRN #50) would be required. This access point would be constructed on previously cleared ground, and soil disturbance would be minimal.

Soil disturbances from projects GRN #5 and GRN #50 could result in an increased rate of erosion and soil loss. Soil erosion would be a concern for discharge into any nearby surface waters. With implementation of appropriate SOPs and BMPs, impacts from soil erosion would be prevented or minimized. Therefore, impacts to soils would be less than significant.

South

Four GRN projects would occur in the South Region as a result of Alternative 1:

- One intersection improvement project (GRN #110) and two pavement strengthening projects (GRN #25 and 27) would not require road widening. No impacts to geological and soil resources would occur.
- One intersection improvement project involving modification to a MAP (GRN #52) would be required. This access point would be constructed on previously cleared ground, and soil disturbance would be minimal.

Soil disturbances from the GRN #52 project could result in an increased rate of erosion and soil loss. Soil erosion would be a concern for discharge into any nearby surface waters. With implementation of appropriate SOPs and BMPs, impacts from soil erosion would be prevented or minimized. Therefore, impacts to soils would be less than significant.

Proposed Mitigation Measures

No mitigation measures would be required.

5.2.6.2 Alternative 2

North

Thirteen GRN projects would occur in the North Region as a result of Alternative 2:

- One intersection improvement project (GRN #117) and two pavement strengthening projects (GRN #8 and 23) would not require road widening or road realignment in previously undisturbed ground. No impacts to geological and soil resources would occur.
- Four intersection improvement projects involving modifications to MAPs (GRN #s 38, 39, 41, and 42) would be required. To construct new access gates, removal of vegetation and disturbance to Limestone Upland soils would be required.
- Five road widening projects (GRN #s 9, 10, 22, 22A and 57) would require removal of vegetation and disturbance to Limestone Upland soils.
- Construction of the Finegayan Connection, a new road (GRN #124), would require removal of vegetation and disturbance to Limestone Upland soils.

Soil disturbances from the MAP intersection improvements and road widening project groups described above could result in an increased rate of erosion and soil loss. Soil erosion would be a concern for discharge into any nearby surface waters. With implementation of construction SOPs and BMPs, impacts from soil erosion would be prevented or minimized. Alternative 2 would result in less than significant impacts to unique geologic resources. Therefore, impacts to soils would be less than significant.

Central

Twenty-seven GRN projects would occur in the Central Region as a result of Alternative 2:

- Three intersection improvement projects (GRN #1, 2, and 113) and 16 pavement strengthening projects (GRN #6, 7, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 30, 31, 32, and 33) would not require road widening or road realignment in previously undisturbed ground. No impacts to geological and soil resources would occur.
- Two intersection improvement projects involving modifications to MAPs (GRN #44 and 46) would be required. These projects would occur in previously developed areas, and minimal soil disturbance would be required.
- Two bridge/culvert replacement projects (GRN #3 and 35) would require clearing and excavation of soil, as well as construction activities adjacent to, and over water.

- Three road widening projects (GRN #16, 28, and 29) would require removal of vegetation and disturbance to Limestone Upland soils.
- The relocation of Route 15 (GRN #36) would require removal of vegetation and disturbance to Limestone Upland soils.

Soil disturbances from the latter three project groups described above could result in an increased rate of erosion and soil loss. Soil erosion would be a concern for discharge into any nearby surface waters. With implementation of construction SOPs and BMPs, impacts from soil erosion would be prevented or minimized. Therefore, impacts to soils would be less than significant.

Apra Harbor

Impacts would be identical to Alternative 1 because the same projects would be constructed.

South

Impacts would be identical to Alternative 1 because the same projects would be constructed.

Proposed Mitigation Measures

No mitigation measures would be required. Standard construction SOPs and BMPs would be identical to Alternative 1.

5.2.6.3 Alternative 3

North

Fourteen GRN projects would occur in the North Region as a result of Alternative 3. Roadway projects would be identical to those described for Alternative 1, with the exclusion of GRN #124 (Finegayan Connection) that would not be constructed. Different intersection improvements at MAPs would be included, as well as pavement strengthening along Routes 8A and 16. Soil disturbances from Alternative 3 projects could result in an increased rate of erosion and soil loss. Soil erosion would be a concern for discharge into any nearby surface waters. With implementation of construction SOPs and BMPs, impacts from soil erosion would be prevented or minimized. Therefore, impacts to soils would be less than significant.

Central

Thirty-one GRN projects would occur in the Central Region as a result of Alternative 3:

- Three intersection improvement projects (GRN #1, #2, and #113) and 14 pavement strengthening projects (GRN #6, #7, #11, #12, #13, #14, #15, #17, #18, #19, #21, #30, #32, and #33) would not require road widening or road realignment in previously undisturbed ground. No impacts to geologic resources and soils would occur.
- Six intersection improvement projects involving modifications to MAPs (GRN #44, #46, #47, #48, #49, and #49A) would be required. These projects would occur in previously developed areas, and minimal soil disturbance would be required.
- Two bridge/culvert replacement projects (GRN #3 and #35) would require clearing and excavation of soil, as well as construction activities adjacent to, and over water.
- Five road widening projects (GRN #16, #28, #29, #63, and #74) would require removal of vegetation and disturbance to Limestone Upland soils.
- The relocation of Route 15 (GRN #36) would require removal of vegetation and disturbance to Limestone Upland soils.

Soil disturbances from the latter three project groups described above could result in an increased rate of erosion and soil loss. Soil erosion would be a concern for discharge into any nearby surface waters. With implementation of construction SOPs and BMPs, impacts from soil erosion would be prevented or minimized. Therefore, impacts to soils would be less than significant. Therefore, impacts to soils would be less than significant.

Apra Harbor

Impacts would be the same as Alternative 1 because the same projects would be constructed.

South

Impacts would be the same as Alternative 1 because the same projects would be constructed.

Proposed Mitigation Measures

No mitigation measures would be required.

5.2.6.4 Alternative 8

North

Impacts would be identical to Alternative 1 because the same projects would be constructed.

Central

Impacts would be nearly identical to Alternative 1 with the addition of a new access along Route 15 for Barrigada (Air Force) (GRN #49A).

Apra Harbor

Impacts would be to the same as Alternative 1 because the same projects would be constructed.

South

Impacts would be to the same as Alternative 1 because the same projects would be constructed.

Proposed Mitigation Measures

No mitigation measures would be required.

5.2.6.5 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam, the visiting aircraft carrier would berth at Kilo Wharf, and an Army Air and Missile Defense Task Force would not be positioned on Guam; therefore, the no-action alternative would obviate the need to improve roads necessary for the military relocation. While none of the GRN projects identified herein would be constructed, road improvements associated with the organic growth of Guam's population would continue. The road segment and intersection improvement projects planned by GovGuam are identified in Table 5.2-10. Road improvements supporting organic growth would most likely require vegetation removal, grading, excavation and/or cut and fill, use of heavy equipment, and possible leaching of contaminants into soils; therefore, direct and indirect effects associated with localized soil disturbance would also occur as a result of the no-action alternative. Future organic growth projects would be conducted in previously disturbed areas in accordance with established procedures and site-specific constraints, including BMPs to prevent effects such as erosion or loss of topsoil. With incorporation of SOPs and BMPs identified for Alternative 1, the roadway projects to be conducted for the no-action alternative would have minimal impacts to geological and soil resources.

The geologic hazards associated with earthquakes, active volcanoes, and collapse of subterranean cavities in limestone formation have not resulted in any impact on existing roadways. Localized disruption of soils may result from GovGuam road widening projects that extend beyond the existing road footprints. With adherence to SOPs and BMPs for control of erosion, impacts to geologic resources would be less than significant.

2014

The no-action alternative for future year 2014 represent the roadway network assuming that construction associated with military relocation had not occurred. While no construction associated with the planned military relocation would occur, GovGuam would have initiated construction of road segment and intersection improvement projects along segments of Routes 1, 7, 10A, and 27 (extension), and Tiyan Parkway, as identified in Table 5.2-10. With incorporation of SOPs and BMPs for roadway construction, the no-action alternative would have less than significant impacts to geological or soil resources.

2030

The no-action alternative for future year 2030 represent the roadway network assuming that construction associated with military relocation had not occurred. While no construction associated with the planned military relocation would occur, GovGuam would have completed construction of road segment and intersection improvement projects along segments of Routes 1, 2, 4, 7A, 16, 25, and 26, as identified in Table 5.2-10. With incorporation of SOPs and BMPs for roadway construction, the no-action alternative would have less than significant impacts to geological or soil resources.

5.2.6.6 Summary of Impacts

Table 5.2-10 summarizes the potential impacts of each alternative.

Table 5.2-10. Summary of Potential Roadway Project Impacts

Potentially Impacted Resource	*Alternative 1*	*Alternative 2**	*Alternative 3*	*Alternative 8*
Increased rate of erosion and soil loss from physical disturbance	LSI	LSI	LSI	LSI
Soil contamination levels that are potentially harmful to human health or the environment	LSI	LSI	LSI	LSI
Increased vulnerability to geologic hazards	LSI	LSI	LSI	LSI

Legend: LSI = Less than significant impact. * Preferred Alternative.

Construction activities would consist of intersection improvements, bridge/culvert replacements, pavement strengthening, road relocation, road widening, and construction of a new road. While the typical activities associated with each of these types of roadway construction projects would involve work in developed and paved areas, some roadway projects could result in alteration of topography and disturbance to soils. These disturbances could lead to an increased rate of erosion and soil loss. Loss of vegetation would contribute to soil loss and erosion. Improper storage of construction materials could result in spills or leaks that could result in contaminants leaching into the soil. Construction SOPs and BMPs would be implemented to avoid or minimize potential effects on geological and soil resources. Roadways and bridges would be designed in accordance with specific geotechnical considerations to prevent impacts from geologic hazards. With implementation of SOPs and BMPs, these impacts would be less than significant.

5.2.6.7 Summary of Proposed Mitigation Measures

No mitigation measures would be required for impacts to geological and soil resources under all alternatives for roadway projects.

CHAPTER 6.
WATER RESOURCES

6.1 INTRODUCTION

Water resources as defined in this Environmental Impact Statement are sources of water available for use by humans, flora, or fauna, including surface and groundwater, nearshore waters, and wetlands. Surface water resources, including but not limited to lakes, streams, and rivers, are important for economic, ecological, recreational, and human health reasons. Groundwater may be used for potable water, agricultural irrigation, and industrial applications. Groundwater is classified as any source of water beneath the ground surface, and is the primary source of potable water used to support human consumption. Consistent with the definition contained in 22 Guam Administrative Rule 5105, nearshore waters are defined as all coastal waters lying within a defined reef area, all coastal waters of a depth of less than 10 fathoms (60 feet [ft], 18.3 meters [m]), and all coastal waters greater than 10 fathoms up to 100 ft (30.5 m) offshore where there is no defined reef area. Nearshore waters can be directly affected by human activity, and are important for human recreation and subsistence. Wetlands are habitats that are subject to permanent or periodic inundation or prolonged soil saturation, and include marshes, swamps, and similar areas. Areas described and mapped as wetland communities may also contain small streams or shallow ponds, or pond or lake edges.

This chapter contains a discussion of the potential environmental consequences associated with implementing the alternatives within the region of influence (ROI) for this resource. For a description of the affected environment for all resources, refer to the respective chapter of Volume 2. The locations described in Volume 2 include the ROI for the utilities and roadway projects, and the chapters are presented in the same order as the resource areas contained in Volume 6.

6.2 ENVIRONMENTAL CONSEQUENCES

6.2.1 Approach to Analysis

6.2.1.1 Methodology

Utilities

This section contains a discussion of potential environmental consequences associated with implementing the alternatives within the ROI for water resources. The environmental consequences of each alternative and the no-action alternative are presented in this section. The available literature was used to assess the existing conditions and to establish a baseline for the assessment, as described in the affected environment section (Volume 2, Chapter 4, Section 4.1-1). The methodology for identifying, evaluating, and mitigating impacts to water resources have been established based on federal and Government of Guam (GovGuam) laws and regulations as described in Volume 2, Chapter 4, Section 4.1.1.

The environmental consequences evaluation for water resources includes a qualitative and quantitative analysis of surface water, groundwater, nearshore waters, and wetlands to the extent possible given available project data. Environmental impact assessments were made and compared to baseline conditions, items of public concern, and significance criteria to determine the magnitude of potential impacts to water resources.

The proposed action analysis is separated into two main activities: construction and operations. Each of these activities has potential effects with associated impacts. The analysis of potential impacts considers both direct and indirect impacts. Direct impacts are those that may occur during the construction phase of the project and cease when the project is complete or those that may occur as a result of project operations following the completion of construction. Indirect impacts are those that may occur as a result of the completed project or those that may occur during operations but not as a direct result of the construction or operational action.

Sustainability Requirements and Goals

Implementation of the proposed action would be consistent with Navy policy in compliance with laws and executive orders whereby Department of Defense (DoD) entities are required to reduce demand for indoor water by as much as 20 percent (%) and outdoor water use by 50% in the coming years. Concurrent with these mandates is the Navy/Marine Corps policy to pursue and facilitate Leadership in Energy and Environmental Design (LEED) Silver certification for their facilities. LEED is a voluntary point system tool that measures the degree of sustainability features incorporated into a development.

Water resource sustainability is addressed in two categories: minimize water demand and maximize the quantity and quality of groundwater recharge. Elements identified to achieve minimum water use are:

- Water Conservation – Identify and specify appropriate minimum water demand fixtures and devices.
- Irrigation – Minimize use of irrigation systems and water.
- Grey Water Use – Evaluate options for use of grey water (from laundry, dishwashing, and bathing) for irrigation.
- Rainwater Harvesting – Investigate harvesting, storage and distribution systems.

The quantity and quality of groundwater recharge is addressed in the existing Unified Facilities Criteria Low Impact Development (LID) Manual that would be followed. This manual includes specific Integrated Management Practices to be considered and included in the drainage design of the proposed action sites. In addition, National Pollutant Discharge Elimination System (NPDES) permitting requirements, LEED goals, and DoD policy based on recent executive orders and laws (e.g., the Energy Independence and Security Act of 2007) mandate certain drainage quantity and quality performance standards. Thus, the proposed action includes incorporating post-construction drainage quality, quantity, and velocity dissipation measures to approximate (or improve upon) pre-construction conditions at the property line.

Surface Water/Stormwater

Surface water issues include:

- Water quality
- Flooding
- Flow path alterations

Surface water quality impacts are evaluated by examining the potential increase of contamination including chemicals, heavy metals, nutrients, and/or sediments in the surface water as a result of the proposed action. The analysis is performed by comparing existing water quality data with possible increases in water quality contaminants in the surface water. Potential impacts to surface water quantity and velocity are analyzed by examining changes in drainage volumes and patterns associated with the proposed action.

Construction activities that result in disturbance of more than 1 acre (0.4 hectare) of land require a construction stormwater permit, which regulates stormwater quality and quantity to reduce pollutant impacts from contaminated runoff. The permit may require mitigation to meet required standards. Stormwater discharges from construction activity may contain elevated sediment concentrations, and spills and leaks of chemicals such as lubricants, fuels, or other construction materials that may increase pollutant loading in to the surface water. In addition, direct construction or alteration of stream channels or reservoirs may cause increased contamination by sedimentation or chemical constituents. If flow paths or patterns are altered, additional studies, such as instream flow analysis, would be conducted to ensure the human uses and/or biological services are preserved. Therefore, construction activities that result in disturbance of more than 1 acre (0.4 hectare) of land are considered to have an impact to surface water.

Operational effects include stormwater discharges that may increase the volume of sediment loading to the surface water as well as increase contaminants from vehicle maintenance, household discharge, privately-owned vehicles, and animal waste. Contamination of surface water from leaks or spills of hazardous, or otherwise regulated materials, is also a potential impact. Increased water usage may reduce the water availability in the reservoirs and/or reduce instream flows. Increased impervious areas may increase the runoff and increase the potential for flooding. Development in the floodplain may result in potential damage from flooding. Diversion of water courses for municipal water consumption may impact the ecological resources.

Groundwater

Groundwater impact concerns include water quality and water quantity. Groundwater quality is assessed by examining the potential risk of a hazardous or regulated waste release, as well as approximating the amount of additional stormwater and associated non-point source pollution that enter the groundwater.

Construction activities that result in disturbance of more than 1 acre (0.4 hectare) of land require a construction stormwater permit to mitigate pollutant impacts from contaminated infiltration. Stormwater discharges from construction activity may contain elevated sediment concentrations, and spills and leaks of chemicals such as lubricants, fuels, or other construction materials that may increase pollutant loading to groundwater resources.

The possible impacts connected with operational activities include increases of impervious areas, waste-generating activities, storage of potential contaminants, and landfill leaching. The direct impacts include an increase in polluted stormwater runoff and contamination from leaks or spills of hazardous or regulated materials. In addition, the increased water usage may increase the depletion of groundwater resources (see Volume 6, Chapter 3, Section 3.1.3). The potential impacts include decreases in groundwater recharge from increased impervious areas and saltwater intrusion from increased aquifer pumping.

Nearshore Waters

The nearshore water impact analysis focuses on water quality. Recreational nearshore issues are addressed in Volume 6, Chapter 11. The potential increases of contamination including chemicals, heavy metals, nutrients, and/or sediments in nearshore waters as a result of the proposed action are assessed by comparing existing water quality data with the projected changes in water quality.

Potential impacts associated with construction activities include construction spills and leaks that may discharge to nearshore waters, an increase in stormwater discharge that may increase non-point source pollution, and physical impacts to nearshore waters from dredging.

Operation effects include potential non-point source and point-source pollution. The point-source pollution consists of chemicals, heavy metals, nutrients, and/or sediments that may runoff from the increase in impervious, urban areas. The point source pollution would be related to direct discharges to the nearshore waters such as wastewater effluent.

Wetlands

The wetland impact areas of concern include:

- Pollutants
- Loss of area
- Loss of functionality

The potential for pollutants to impact a wetland was evaluated by examining the risk of hazardous materials leaking or spilling and their proximity to the wetlands. The loss of area was assessed by the total amount of delineated wetland area that would be directly removed either in loss of area or function as a result of the proposed action. The wetland functionality refers to the ability of the wetland to trap sediment and nutrients, receive and retain water, maintain wildlife habitat (both flora and fauna), and provide recreational uses. The impacts to wildlife habitat associated with wetlands are addressed in Volume 6, Chapter 12.

For construction activities, the effects associated with activities in close proximity to any designated wetland or activities in the wetlands themselves are considered. Runoff from nearby construction sites may contain increased chemicals, heavy metals, nutrients, and/or sediment that could adversely affect those wetlands. Wetland impacts could result from changes in land uses and/or spills or leaks from construction operations and equipment. Loss of functionality can also occur if construction operations occur directly within the designated wetlands. Loss of wetland area would occur if the proposed action involves the direct removal of wetlands.

The effects associated with operations include an increase in potential spills and leaks from hazardous materials that may be stored in close proximity to designated wetlands. An indirect impact to existing wetlands may occur by altering (i.e., diverting or restricting) the surface water flowing into the wetlands. Indirect impacts to wetlands could also occur as a result of altered sedimentation of watercourses or drainage conveyances connected to wetland areas.

Off Base Roadways

This section contains a discussion of potential environmental consequences associated with implementing the alternatives within the ROI for water resources. The environmental consequences of each alternative and the no-action alternative are presented in this section. The available literature was used to assess the existing conditions and establish a baseline for the assessment, as described in the Volume 2, Chapter 4. The methodology for identifying, evaluating, and mitigating impacts to water resources have been established based on federal and local laws and regulations, Federal Highway Administration (FHWA) guidelines, and Guam Environmental Protection Agency (GEPA) guidelines. A Storm Water Implementation Plan describing detailed Stormwater Pollution Control measures for the Guam Road Network (GRN) is provided in Appendix G. DoD is committed to following guidance contained in this manual for all GRN projects, and in the Guam Transportation Stormwater Drainage Manual after it is evaluated and finalized.

The environmental consequences evaluation for water resources includes a qualitative and quantitative analysis of floodplains, runoff and drainage, and water quality of surface and groundwater resources to the extent possible given available project data. The assessment was set up to ensure compliance with FHWA requirements by identifying (1) public water sources with emphasis on sole source aquifers; (2) watershed characteristics, including overall runoff and drainage flow patterns and floodplains; (2) surface water resource characteristics, including streams, lakes, and bays; (3) coastal resources that are delineated in Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs) as identified in Volume 2; (4) National Wild and Scenic Rivers that do not exist within the vicinity of the study area; (5) areas within the Coastal Zone Management Program; (6) areas subject to the Coastal Barriers Resources Act that do not exist within the vicinity of the study area; (7) wetlands that are primarily discussed under the Marine Biology section; and (8) factors that influence percolation and infiltration into the groundwater. Environmental impact assessments were made and compared to baseline conditions in the various hydrologic regimes of the island for the various types of roadway projects to determine the magnitude of potential impacts to water resources. The proposed action analysis is separated in two main activities: construction impacts (year 2014) and long-term impacts (year 2030). Each of these activities has potential effects with associated impacts.

6.2.1.2 Determination of Significance

The following factors are considered in evaluating impacts to water resources:

- Reducing availability or accessibility of water resources.
- Creating noncompliance with applicable laws and regulations.
- Increasing risk associated with environmental hazards or human health.
- Decreasing existing and/or future beneficial use.
- Increasing risk of flooding.
- Depleting, recharging, or contaminating usable groundwater aquifer for municipal, private, or agricultural purposes.
- Locating increases in soil settlement or ground swelling that damages structures, utilities, or other facilities caused by inundation and/or changes in groundwater levels.
- Reducing impacts to wetlands available for human use or ecological services.
- Increasing long-term inundation, sedimentation, and/or damage to water resources.

If an activity is deemed as having an impact, the activity can be evaluated to determine if the impact is significant or insignificant. For significant impacts, a determination is made as to whether the impacts can be mitigated to less than significant impacts.

6.2.1.3 Issues Identified During Public Scoping Process

As part of the analysis, concerns related to water resources that were mentioned by the public, including regulatory stakeholders, during the public scoping meetings were addressed. These include:

- Describing water quality with respect to public health requirements, drinking water regulations, and applicable water quality standards.
- Estimating quality and quantity of stormwater runoff to be generated by increased impervious surface, methods of contaminant removal, methods of runoff redirection to recharge the aquifer, and groundwater under the direct influence of surface water.
- Causing accidental or intentional contamination of groundwater.
- Ensuring that the capacity of water resources meets agricultural needs.
- Implementing stormwater management controls to prevent pollution during construction and subsequent operations.

- Preventing construction that could potentially cause runoff and could pollute the beaches and destroy marine life.
- Outlining the effects of training and dredging on sedimentation stress for the coral reefs and other marine life.
- Identifying ways to monitor and mitigate indirect impacts from sediments on coral reefs.

6.2.2 Power

6.2.2.1 Basic Alternative 1 (Preferred Alternative)

Basic Alternative 1 would utilize existing Guam Power Authority (GPA) power plants for base loads. The reconditioning of up to five Combustion Turbines (CTs) would be undertaken by the GPA on existing permitted facilities to provide required peaking and reserve power. Reconditioning would be made to existing permitted facilities at the Marbo, Yigo, Dededo (2 units), and Macheche CTs. These CTs are not currently being used up to their permit limits. Transmission and Distribution (T&D) system upgrades would be on existing above ground and underground transmission lines. This alternative supports Main Cantonment Alternatives 1 and 2. Main Cantonment Alternatives 3 and 8 would require additional upgrades to the T&D system.

Reconditioning GPA Facilities

The proposed T&D systems refurbishment would not directly impact surface water, groundwater, nearshore water, or wetlands because the new T&D systems would utilize existing utility corridors and not occur in sensitive water resources areas under Basic Alternative 1. The DoD reconditioning of the GPA facilities would not involve additional storage of fuels or materials that would be exposed to rain events. GPA would continue to follow their Spill Prevention Control and Countermeasure Plan to prevent or control spills that might occur during operations to minimize potential impacts to water resources. Stormwater would continue to be managed by GPA through an existing United States (U.S.) Environmental Protection Agency (USEPA) stormwater multi-sector general permit. This multi-sector general permit requires the development of a Stormwater Pollution Prevention Plan (SWPPP) that incorporates Best Management Practices (BMPs) to control pollutants. Therefore, this portion of the alternative would have no impacts on water resources.

Upgrades to T&D Lines

Proposed upgrades to existing T&D lines associated with this alternative would include installing upgraded and new underground and overhead power lines. T&D lines proposed for the southern portions of Guam are primarily above ground, and would therefore require little soil disturbing activities. Land disturbing activities would trigger the requirement to seek coverage under the Construction General Permit (CGP). A site-specific SWPPP would be prepared and implemented in accordance with the CGP. The SWPPP would identify site-specific BMPs (Volume 2, Chapter 4, Table 4.2-1) that would be implemented as part of Basic Alternative 1 to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts.

Stormwater runoff in the northern portion of Guam infiltrates into the ground, with little to no surface water runoff. A review of GEPA’s impaired waterbodies list (also known as the Clean Water Act [CWA] Section (§) 303(d) list) does not show any impaired surface waters in the areas where construction activities are proposed for the military relocation. Therefore, these construction activities are not anticipated to contribute to water quality impairments in this area, particularly given the implementation of SWPPP BMPs. Implementation of SWPPP BMPs would ensure that pollutants in stormwater runoff from construction areas are contained and treated on site. Stormwater runoff in the southern portion of

Guam can eventually flow to surface waters, and pollutants such as sediment can enter these surface waters. A review of GEPA's impaired waterbodies list shows impairments for sediment and bacteria in areas other than where construction activities are proposed for the military relocation. Therefore, these construction activities are not anticipated to contribute to water quality impairments in these areas, and the implementation of SWPPP BMPs would ensure that pollutants in stormwater runoff from construction areas are contained and treated on site.

A review was also conducted of GEPA's existing and proposed Total Maximum Daily Loads (TMDLs). A TMDL calculates the maximum amount of a pollutant that is allowed to enter a waterbody so that the waterbody will meet and continue to meet water quality standards for that particular pollutant. The TMDL allocates (or divides) the load between all of the sources of discharges to the waterbody. The sources to a waterbody include direct discharges such as outfalls from treatments plants, and indirect discharges such as stormwater runoff and septic tanks. GEPA has prepared TMDLs for waterbodies that are identified as impaired on the 303(d) list, which includes developing plans for each impaired waterbody to control discharges to it. GEPA has several TMDLs that have been approved by USEPA Region 9 for waters that are impaired for bacteria. The TMDLs identify the source of bacteria to likely be from sewage treatment discharges, septic tanks, and stormwater runoff. The proposed construction activities for the military relocation in the northern and southern portions of Guam are not expected to interfere with the implementation of promulgated or proposed TMDLs, or the attainment of water quality in waters where TMDLs are being pursued because construction activities are not associated with bacteria-producing pollutants.

A study to identify wetlands was conducted in various proposed project areas (Volume 9, Appendix G; Naval Facilities Engineering Command [NAVFAC] Pacific 2010) and the results are summarized in Volume 2, Chapter 4. No wetlands were identified in northern Guam in proposed project areas. Wetlands were identified adjacent to the proposed powerline corridor along Marine Corps Drive. However, the upgrades and new lines would be installed in existing upland corridors adjacent to the roadway and would not result in disturbance of wetlands.

Based on the above analysis, impacts to water resources from proposed power facility construction activities would be less than significant.

Summary of Basic Alternative 1 Impacts

Basic Alternative 1 would potentially affect water resources. However, through compliance with a CGP and implementation of a SWPPP and associated site-specific BMPs, effects to water resources would be minimized; therefore, there would be less than significant impacts to water resources.

Proposed Mitigation Measures

No mitigation measures related to water resources are needed for Basic Alternative 1.

6.2.2.2 Summary of Impacts

Table 6.2-1 summarizes the potential impacts of Basic Alternative 1. A text summary is provided below.

Table 6.2-1. Summary of Potential Power Impacts

*Basic Alternative 1**
Construction Impacts (direct and indirect impacts are the same)
SW – LSI GW – LSI NW – LSI WL – NI
Operation Impacts (direct and indirect impacts are the same)
SW – NI GW – NI NW – NI WL – NI

Legend: GW=Groundwater; LSI = Less than significant impact; NI = No impact; NW = Nearshore Waters; SW= Surface Water/Stormwater; WL = Wetland.

Implementation of Basic Alternative 1 would have no impacts to water resources as there would be limited construction or change in operations under this alternative. The induced civilian population growth would have no impacts to water resources since there would be limited construction or change in operations. Stormwater would continue to be managed in accordance with laws, regulations, and plans which would reduce potential impacts to groundwater and nearshore waters. Because Basic Alternative 1 would involve land disturbing activities that trigger the requirements for CGP coverage, a Notice of Intent would be filed and a site-specific SWPPP would be prepared and implemented in accordance with the CGP. The SWPPP would identify site-specific BMPs (Volume 2, Chapter 4, Table 4.2.1) that would be implemented as part of the alternative to reduce the potential for erosion, runoff, sedimentation, and subsequent surface water quality impacts, which would also reduce potential for impacts to groundwater and nearshore water resources. Stormwater runoff from construction would not prevent the attainment of water quality standards in receiving waters or interfere with the implementation of TMDLs. No impacts to wetlands would occur.

6.2.3 Potable Water

This section focuses on the potential impacts to water resources, including groundwater that could result from the construction and operation of potable water systems in support of the proposed action. Volume 6, Chapter 3 describes the potential impacts from the potable water alternatives that could impact groundwater resources.

6.2.3.1 Basic Alternative 1 (Preferred Alternative)

Basic Alternative 1 would provide additional water capacity of 11.3 MGd (42.8 MLd), which is anticipated to be met by an estimated 22 new wells at Andersen Air Force Base (AFB), rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 2.5 MG (9.5 ML) water storage tanks would be constructed at ground level at NCTS Finegayan. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

<u>New Water Supply Facilities and Distribution Lines</u>

Construction

Under Basic Alternative 1, proposed well construction activities would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. Because construction would involve land disturbing activities that trigger the requirement for CGP coverage, a Notice of Intent would be filed and a site-specific SWPPP would be prepared and implemented in accordance with the CGP. The SWPPP would identify site-specific BMPs (Volume 2, Chapter 4, Table 4.2-1) that would be reduce the potential for erosion, runoff, sedimentation, and subsequent surface water quality impacts, which would also reduce the potential for impacts to groundwater and nearshore water resources. No buildings/structures would be constructed in the 100-year flood zone; however, some stormwater detention basins could be constructed in the 100-year flood zone. In some of these areas, these open, grassed stormwater detention basins could also be utilized for additional uses, for example, as recreational fields.

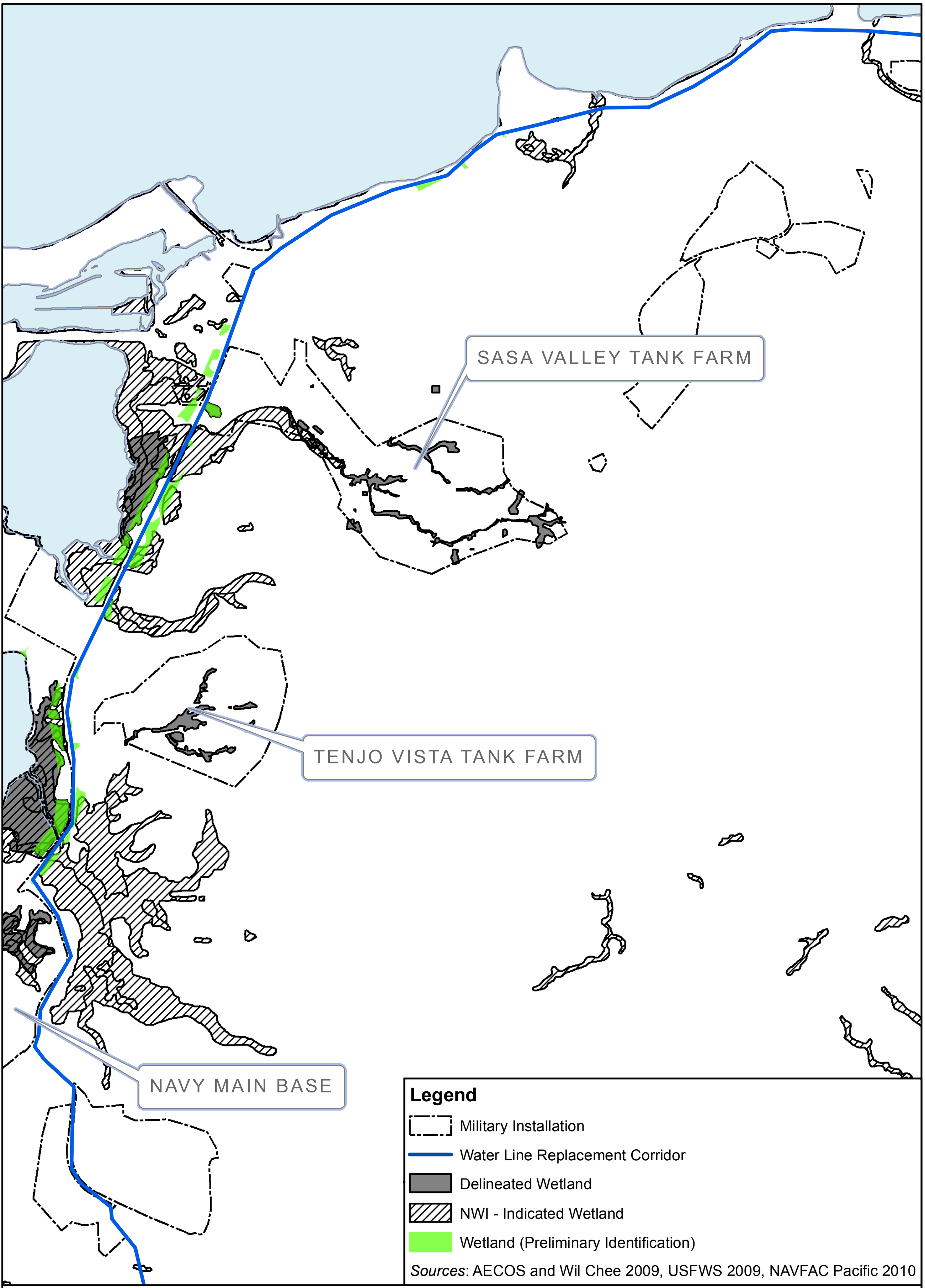
Based on a preliminary review of Geographic Information System (GIS) data, the proposed water main construction footprint associated with Basic Alternative 1 would traverse areas adjacent to delineated and National Wetland Inventory (NWI)-indicated wetlands (Figure 6.2-1). A study to further evaluate these wetlands and other proposed project areas was conducted (Volume 9, Appendix G; NAVFAC Pacific 2010) and the results are summarized in Volume 2, Chapter 4. No wetlands were identified in northern Guam in proposed potable water project areas; wetlands were identified adjacent to the proposed potable water line corridor along Marine Corps Drive (Figure 6.2-1). The upgrades and new lines would be installed in existing upland corridors adjacent to the roadway and would not result in work in wetlands. Where waterlines cross rivers along Marine Corps Drive the lines would not be located underground and attached to bridges where necessary. Therefore, there would be no direct impacts to identified wetlands.

A SWPPP would be prepared and implemented and site-specific BMPs (Volume 2, Chapter 4, Table 4.2-1) would be implemented as part of the CGP during construction of the water main. These BMPs would reduce the potential for erosion, runoff, sedimentation, and subsequent indirect impacts to nearby wetland areas.

Stormwater runoff in the northern portion of Guam infiltrates into the ground, with little to no surface water runoff. A review of GEPA's impaired waterbodies list (also known as the CWA § 303(d) list) does not show any impaired surface waters in the areas where construction activities are proposed for the military relocation, including where wells and potable water distribution lines are proposed. Therefore, these construction activities are not anticipated to contribute to water quality impairments in this area, particularly given the implementation of SWPPP BMPs. Implementation of SWPPP BMPs would ensure that pollutants in stormwater runoff from construction areas are contained and treated on site. Stormwater runoff in the southern portion of Guam can eventually flow to surface waters, and pollutants such as sediment can enter these surface waters. A review of GEPA's impaired waterbodies list shows impairments for sediment and bacteria in areas other than where construction activities are proposed for the military relocation. Therefore, these construction activities are not anticipated to contribute to water quality impairments in these areas, and the implementation of SWPPP BMPs would ensure that pollutants in stormwater runoff from construction areas are contained and treated on site.

A review was also conducted of GEPA's existing and proposed TMDLs. GEPA has several TMDLs that have been approved by USEPA Region 9 for waters that are impaired for bacteria. The TMDLs identify the source of bacteria to likely be from sewage treatment discharges, septic tanks, and stormwater runoff. The proposed construction activities for the military relocation in the northern and southern portions of Guam are not expected to interfere with the implementation of promulgated or proposed TMDLs, or the attainment of water quality in waters where TMDLs are being pursued because construction activities are not associated with bacteria-producing pollutants.

Based on the above analysis, impacts to water resources from proposed potable water system construction activities associated with Basic Alternative 1 would be less than significant.



Sources: AECOS and Wil Chee 2009, USFWS 2009, NAVFAC Pacific 2010

Printing Date: Jun 25, 2009, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_6\6.2-1.mxd

Figure 6.2-1
Location of Wetlands Adjacent to Proposed Waterline Replacement Corridor

Operation

The proposed new water wells that would draw from the Andersen and the Agafa-Gumas subbasins which are underdeveloped (as compared to the southern subbasins). The proposed resulting withdrawals associated with the new and existing wells under Basic Alternative 1 (including GWA and Andersen AFB planned expansions) would not exceed sustainable levels. The remaining three wells would be installed in the Finegayan subbasin. As with the other subbasins, the additional demand on this resource would not exceed the estimated sustainable yield. However, the planned withdrawal rate for the Agafa-Gumas and the Finegayan subbasins is only slightly below or equal to the estimated sustainable yield so close monitoring of these water sources would occur to ensure these rates are sustainable.

Since waterbody impairments and TMDLs relate to surface waters and not groundwater, an analysis of groundwater withdrawal as it relates to these potential effects is not applicable.

There are numerous caves near the shoreline on Guam that provide flow paths for groundwater to the ocean. These caves commonly form along the water table surface and are thus sensitive to changes in groundwater table elevation (Taborosi et al. 2003). The cave and pool systems that have the greatest probability of being impacted by increased groundwater withdrawals are those along the northern shoreline. Each cave and pool system is unique and the actual impact is dependent on the hydrology for each system. In the absence of site-specific cave hydrogeology studies, this impact analysis relies on general aquifer-wide data. Increased groundwater withdrawals could potentially impact water levels in these caves by potentially decreasing the amount of fresh groundwater entering the cave system.

The impact of increased groundwater withdrawals on the pools and caves would likely be dampened by the dynamics of the overall freshwater lens system. Increasing pumping would decrease the thickness of the freshwater lens, but the majority of the thinning occurs as a shallowing of the bottom freshwater lens rather than a drop in the elevation of the water table. The Ghyben-Herzberg principle (described in Volume 2, Chapter 4, Section 4.1.1.3) states that for every foot, the top of the groundwater table drops and the mid-point of the freshwater/saltwater transition zone becomes 40 ft shallower. Also, the average sea level itself imposes a constant boundary condition (as average for tidal fluctuations); the water table would remain slightly above the ocean level. Thus, due to the boundary imposed by the ocean and the dynamics of the freshwater lens, the change in water table elevation of pools and caves would likely experience very little change due to increase groundwater withdrawals. The majority of the recharge would still flow to the ocean.

Implementation of Basic Alternative 1 would be in compliance with all federal, GovGuam, and military orders, laws, and regulations, and would include implementing BMPs and facility-specific LID measures to be identified and developed as part of project design. These actions would minimize potential water quality impacts from facility operations, to include the transportation, storage, and use of fuel on surface and groundwater resources. While alterations to the watershed can result in indirect impacts that could alter nearshore water quality, these potential effects would be minimized by complying with all applicable orders, laws, and regulations. No wetland areas would be affected by operations, as the segments of the water line would be buried in the areas where the line would cross wetland areas and there would be no change to existing hydrology; water flow to wetland areas would not change. Therefore, operations associated with Basic Alternative 1 would result in less than significant impacts to water resources.

Potential impacts to groundwater resources related to the withdrawal of water from the Northern Guam Lens Aquifer (NGLA) and protection of the NGLA from contamination related to stormwater runoff are discussed in Volume 6, Chapter 2, Section 2.2. Volume 6, Chapters 2 and 3 also discuss the shortfall of water supply from off base indirect population demands for water, and DoD's proposed mitigation to provide excess water available from the DoD operated water system to meet the shortfall in the GWA operated water system, thereby eliminating the need for GWA to withdraw additional groundwater from the NGLA to meet near term peak demands. However, the DoD operated water system would withdraw additional water to provide it to the GWA operated system. Therefore, there would be less than significant impacts to groundwater resources from indirect population growth related to drinking water supplies.

New Water Storage Facilities

Construction

Under Basic Alternative 1, the construction of the new facilities would involve land disturbing activities that would trigger the requirement to seek coverage under the CGP. As part of the CGP requirement, a SWPPP would be prepared and implemented. The SWPPP would identify site-specific BMPs (Volume 2, Chapter 4, Table 4.2-1) that would be implemented as part of the alternative to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts, which would also reduce potential for impacts to groundwater and nearshore water resources. No buildings/structures would be constructed in the 100-year flood zone; however, some stormwater detention basins could be constructed in the 100-year flood zone. In some of these areas, these open, grassed stormwater detention basins could also be utilized for additional uses (e.g., recreational fields). No wetlands are located in the construction area.

The analysis of water body impairments and implementation of TMDLs related to the construction of new storage facilities is the same as those described above for construction activities of water supply facilities. Therefore, stormwater runoff from construction activities would not prevent the attainment of water quality standards or interfere with the implementation of TMDLs.

Based on the above analysis, impacts to water resources from proposed water storage tank construction would be less than significant.

Operation

The operational phase of Basic Alternative 1 would result in a minor increase in the area of impervious surface that would result in an associated relatively minor increase in stormwater discharge intensities and volume. This increase would be accommodated by stormwater infrastructure, and stormwater flow paths would continue to follow area topography. The increase in impervious surface would not significantly decrease aquifer recharge rates, as no diversion or restriction of surface water flow would occur.

Implementation of Basic Alternative 1 would be in compliance with all federal, GovGuam, and military orders, laws, and regulations, and would include the implementation of BMPs and facility-specific LID measures to be identified and developed as part of project design. These actions would minimize potential water quality impacts from facility operation, to include the transportation, storage, and use of fuel on surface and groundwater resources. The analysis of water body impairments and implementation of TMDLs related to the operation of these facilities is the same as those described for construction activities above. Therefore, stormwater runoff from operating facilities would not prevent the attainment of water quality standards or interfere with the implementation of TMDLs. While alterations to the watershed can result in indirect impacts that could alter nearshore water quality, these potential effects would be minimized by complying with all applicable orders, laws, and regulations. No wetland areas would be affected by operations, as no delineated wetland areas are located near the proposed water storage sites. Therefore, operations associated with Basic Alternative 1 would result in less than significant impacts to water resources.

Summary of Basic Alternative 1 Impacts

Under Basic Alternative 1, there would be no construction in wetlands on Guam, and there would be no reduction in the availability or accessibility of water resources. However, increased groundwater withdrawals could potentially impact water levels in caves located along the northern shoreline of Guam by potentially decreasing the amount of fresh groundwater entering the cave system. The cave and pool systems may be considered jurisdictional waters of the U.S.; thus, any anticipated impacts to the system would require approval from the U.S. Army Corps of Engineers (USACE). Implementation of sustainability practices would reduce the amount of groundwater needed, that would help minimize impacts to groundwater availability. Increases in stormwater would be managed by existing stormwater infrastructure or stormwater infrastructure improvements and stormwater flow paths would continue to mimic area topography; therefore, there would be no increase in flooding risk. No buildings/structures would be constructed in the 100-year flood zone; however, some stormwater detention basins could be constructed in the 100-year flood zone. In some of these areas, these open, grassed stormwater detention basins could also be utilized for additional uses, for example, as recreational fields.

Through the development and implementation of BMPs (Volume 2, Chapter 4, Table 4.2-1) and LID measures, and facility-specific plans and procedures, there would no increased risk from environmental hazards or to human health. All actions would be implemented in accordance with all applicable federal, GovGuam, and military orders, laws, and regulations (Volume 8, Chapter 3, Table 3.1-1). A detailed description of resource protection measures potentially required by regulatory mandates is in Volume 7, Section 3.1. A more detailed explanation of potential regulatory permitting requirements is also available in Volume 8 (Table 3.1-1). Therefore, with the implementation of these measures, Basic Alternative 1 would result in less than significant impacts to water resources.

Proposed Mitigation Measures

Impacts to cave and pool systems would be avoided if possible. If impacts are unavoidable, then potential impacts would be minimized to less than significant in accordance with measures developed through agency coordination.

6.2.3.2 Basic Alternative 2

Basic Alternative 2 would provide additional water capacity of 11.7 MGd (44.3 MLd), which is anticipated to be met by an estimated 20 new wells at Andersen Air Force Base (AFB) and 11 new wells at Air Force Base Barrigada, rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 1.8 MG (6.8 ML) water storage tanks would be constructed at ground level at NCTS Finegayan and one 1 MG (3.8 ML) water storage tank would be construction at Air Force Base Barrigada. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

Under Basic Alternative 2, impacts to water resources would be similar to those described under Basic Alternative 1, as dispersing the groundwater wells would not change the overall pumping rates nor exceed sustainable yields for the subbasins, and no wetlands are located in the identified groundwater well areas. The proposed water tank and water lines at Air Force Barrigada would avoid wetland areas identified at the facility (wetland locations are shown in Volume 2, Chapter 4). Refer to Section 6.2.3.1 for a discussion of potential impacts. Volume 6, Chapters 2 and 3 also discuss the shortfall of water supply from off base indirect population demands for water, and DoD's proposed mitigation to provide excess water from the DoD operated water system to the GWA operated water system to meet the shortfall, thereby eliminating the need for GWA to withdraw additional groundwater from the NGLA to meet near term peak demands. However, the DoD operated water system would withdraw additional water to provide it to the GWA operated system. Therefore, there would be less than significant impacts to groundwater resources from indirect population growth related to drinking water supplies.

Summary of Basic Alternative 2 Impacts

Under Basic Alternative 2, there would be no reduction in the amount of wetlands on Guam, and there would be no reduction in the availability or accessibility of water resources. Implementation of sustainability practices would reduce the amount of groundwater needed, that would help minimize impacts to groundwater availability, as would the development of brackish water. Monitoring groundwater extracted from the aquifer for groundwater chemistry and brine content would ensure protective measures could be taken in time to prevent harm to existing or beneficial use of groundwater as a drinking water source. Increases in stormwater would be managed by existing stormwater infrastructure or stormwater infrastructure improvements and stormwater flow paths would continue to follow area topography; therefore, there would be no increase in flooding risk. No buildings/structures would be constructed in the 100-year flood zone; however, some stormwater detention basins could be constructed in the 100-year flood zone. In some of these areas, these open, grassed stormwater detention basins could also be utilized for additional uses, for example, as recreational fields. Through the development and implementation of BMPs (Volume 2, Chapter 4, Table 4.2-1) and LID measures, and facility-specific plans and procedures, there would no increased risk from environmental hazards or to human health. All actions would be implemented in accordance with all applicable federal, GovGuam, and military orders, laws, and regulations (Volume 8, Chapter 3, Table 3.1-1). Therefore, with the implementation of these measures, Basic Alternative 2 would result in less than significant impacts to water resources.

Proposed Mitigation Measures

Basic Alternative 2 would include the same mitigation measures described under Basic Alternative 1. Please refer to Section 6.2.3.1.

6.2.3.3 Summary of Impacts

Table 6.2-2 summarizes the potential impacts of each basic alternative. A text summary is provided below.

Construction and operational activities would have the potential to cause erosion and sedimentation that could degrade surface water quality. In addition, the action alternatives would increase the potential for leaks and spills from contaminants. However, a combination of BMPs (Volume 2, Chapter 4, Table 4.2-1), LID measures, and water monitoring programs would be implemented as a part of the proposed action to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts. Increases in stormwater would be managed by existing stormwater infrastructure or stormwater infrastructure improvements and stormwater flow paths would continue to follow area topography. Stormwater runoff from construction would not prevent the attainment of water quality standards in receiving waters or interfere with the implementation of TMDLs. While groundwater withdrawal rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed, which would help minimize impacts to groundwater availability. The resulting total annual groundwater withdrawals would be less than the sustainable yield. Monitoring of groundwater chemistry and brine content of extracted groundwater would ensure protective measures could be taken in time to prevent harm to existing or beneficial use of groundwater as a drinking water source. With the implementation of potential mitigation measures (i.e., mitigation measures to be determined during the

USACE permitting process for potential impacts to the cave/pool system), potential impacts to jurisdictional waters of the U.S. would be less than significant. The alternatives would be implemented in compliance with all federal, local, and military orders, laws, and regulations (Volume 8, Chapter 3, Table 3.1-1), including Commander Navy Region (COMNAV) Marianas Instruction 3500.4, as well as the implementation of BMPs, LID, and monitoring.

Table 6.2-2. Summary of Potential Potable Water Impacts

*Basic Alternative 1**	*Basic Alternative 2*
Construction Impacts (direct and indirect are the same)	
SW – LSI • temporary increase in stormwater runoff, erosion, and sedimentation GW – LSI • increased potential for local groundwater contamination; localized increase in sea water intrusion NW – LSI • minor increase in runoff volume and pollutant loading potential WL – NI	SW – LSI • temporary increase in stormwater runoff, erosion, and sedimentation GW – LSI • increased potential for local groundwater contamination; localized increase in sea water intrusion NW – LSI • minor increase in runoff volume and pollutant loading potential WL – NI
Operation Impacts (direct and indirect are the same)	
SW – LSI • minor increase in stormwater discharge intensities and volume; potential decrease in cave and pool water levels GW – LSI • increased potential for local groundwater contamination NW – LSI • minor increase in runoff volume and pollutant loading potential WL – NI	SW – LSI • minor increase in stormwater discharge intensities and volume; potential decrease in cave and pool water levels GW – LSI • increased potential for local groundwater contamination NW – LSI • minor increase in runoff volume and pollutant loading potential WL – NI

Legend: GW=Groundwater; LSI = Less than significant impact; NI = No impact; NW = Nearshore Waters; SW= Surface Water/Stormwater; WL = Wetland; * Preferred Alternative.

6.2.4 Wastewater

As discussed in Volume 6, Chapter 3, existing off-base GWA wastewater system infrastructure is considered by USEPA Region 9 to be substandard. Problems with the wastewater system include inadequate treatment of sewage at treatment plants, frequent sewage spills, and overflows from collection piping and lift stations, poor quality of water discharged from treatment plants, inadequate wastewater connection service on Guam, and poor condition and reliability of the system. In its comments on the Draft Environmental Impact Statement, USEPA Region 9 stated that Guam's environmental and public health problems exceed those of most U.S. communities, with its population experiencing frequent sewage spills, exposures to waterborne disease, and illegal dumping that can result in public health problems associated with its wastewater collection and disposal systems. Over the last 7 years, the USEPA Region 9 has issued fines and enforcement orders to the GWA in an effort to address these problems and bring the wastewater system infrastructure into compliance with federal environmental laws and public health standards.

There have been some improvements to the wastewater system as a result of these enforcement actions, and at least one treatment plant, the Hagatna Wastewater Treatment Plant (WWTP), has undergone repairs and upgrades. Still, the wastewater system continues to suffer from decades of deferred maintenance and upgrades due to a lack of funding and limits on user fees paid by the customers they service. All of the 6-GWA treatment plants are routinely in non-compliance with their discharge permits, many due to the inoperability of a significant portion of the treatment processes at individual plants. The condition of the sewage collection system is largely unsurveyed and unknown. Piping is suspected to be undersized and damaged in much of the system, and pump stations undersized or failing. These issues lead to frequent sewage overflows into streets and neighborhoods, resulting in exposure to microbiological and other contaminants, leaching of sewage and contaminants into the groundwater aquifer used as a drinking water source, potentially resulting in illness. Lack of maintenance, corrosion, leakage, bypassed treatment processes, age, and vandalism all contribute to the substandard condition of the system.

Basic Alternative 1 (Alternative 1a supports Main Cantonment Alternatives 1 and 2; and Alternative 1b supports Main Cantonment Alternatives 3 and 8) combines upgrades to the existing primary treatment facilities and expansion to secondary treatment at the Northern District WWTP (NDWWTP). The difference between Alternatives 1a and 1b is a requirement for a new sewer line from Barrigada housing to NDWWTP for Alternative 1b.

6.2.4.1 Basic Alternative 1a (Preferred Alternative)

Construction

The proposed refurbishment of the NDWWTP to its original primary treatment design capacity, expansion of secondary treatment capacity, installation of secondary treatment, and installation of a sewer line would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. Construction would involve land disturbing activities that would trigger coverage under the NPDES stormwater CGP and preparation of a SWPPP. A site-specific SWPPP would be prepared and implemented in accordance with the CGP. The SWPPP would identify site-specific BMPs (Volume 2, Chapter 4, Table 4.2-1) that would be implemented as part of the alternative to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts, which would also reduce potential for impacts to groundwater, nearshore water resources, and the marine environment.

Stormwater runoff in the northern portion of Guam infiltrates into the ground with little to no surface water runoff. A review of GEPA's impaired waterbodies list (also known as the CWA § 303(d) list) does not show any impaired surface waters in the areas where sewer collection systems are proposed nor in the area of the NDWWTP. There are water quality impairments in nearshore waters where the NDWWTP discharges, which are discussed in the Operation section that follows and in Volume 6, Chapter 16. Therefore, the construction activities are not anticipated to contribute to water quality impairments in this area, particularly given the implementation of SWPPP BMPs. Implementation of SWPPP BMPs would ensure that pollutants in stormwater runoff from construction areas are contained and treated on site. Stormwater runoff in the southern portion of Guam can eventually flow to surface waters and pollutants, such as sediment, can enter these surface waters. A review of GEPA's impaired waterbodies list shows impairments for sediment and bacteria in areas other than where construction activities are proposed for the military relocation. Therefore, the construction activities are not anticipated to contribute to water quality impairments in these areas, and the implementation of SWPPP BMPs would ensure that pollutants in stormwater runoff from construction areas are contained and treated on site.

A review was also conducted of GEPA's existing and proposed TMDLs. GEPA has several TMDLs that have been approved by USEPA Region 9 for waters that are impaired for bacteria. The TMDLs identify the source of bacteria to likely be from sewage treatment discharges, septic tanks, and stormwater runoff. The proposed construction activities for the military relocation in the northern and southern portions of Guam are not expected to interfere with the implementation of promulgated or proposed TMDLs, or the attainment of water quality in waters where TMDLs are being pursued because construction activities are not associated with bacteria-producing pollutants.

As summarized in Volume 2, Chapter 4, no wetlands were identified in northern Guam in proposed wastewater project areas.

Based on the above analysis, impacts to water resources from proposed wastewater facility construction activities would be less than significant.

Operation

As described in Volume 6, Chapters 2 and 3, the DoD proposes to use the existing GWA NDWWTP to treat and dispose of wastewater directly generated from new DoD facilities in northern Guam, and to use the Navy's Apra Harbor WWTP to treat sewage from additional visiting ships at Naval Base Guam. The GWA NDWWTP would handle most of the increased wastewater treatment demand from the DoD relocation. The Navy Apra Harbor WWTP would handle the increased wastewater treatment demand for all increases at Apra Harbor, such as the shipboard transient population. The GWA Hagatna WWTP and four southern Guam WWTPs would handle some of the increased wastewater treatment demand from the construction workforce and increased civilian population under proposed DoD relocation.

Direct Impacts

GWA NDWWTP. The Navy is conducting a study to evaluate potential impacts on water quality and the marine environment from the GWA NDWWTP wastewater discharge at its new ocean outfall (NAVFAC Pacific 2009). The study assessed the potential impacts to the receiving marine environment resulting from the primary and secondary treatment and disposal of wastewater, including additional wastewater loadings associated with the military relocation on Guam. The study considered flows to the NDWWTP from the military relocation of 18 MG (68 ML) per day. Initial results indicate that upgrading the NDWWTP to secondary treatment would result in the plant effluent meeting all water quality standards, resulting in an improvement over current discharge water quality. Therefore, operation of GWA NDWWTP under Alternative 1a would result in a beneficial impact to nearshore water upon completion of improvements.

A review of GEPA's impaired waterbodies 303(d) list shows water body impairments for bacteria in numerous beaches in Guam, including Tanguisson Beach, which is located near the NDWWTP. Additionally, USEPA Region 9 approved a TMDL for Tanguisson Beach in December 2009. The TMDL for Tanguisson Beach includes a load allocation for bacteria (*Enterococci*) for the NDWWTP that would be imposed under a revised permit. The TMDL states, "The Guam Waterworks Authority (GWA) owns and operates two wastewater treatment facilities that affect these TMDL waters. GWA is currently under a Stipulated Order to address several problems that contribute to beach advisories. Included in the Order are renovations and upgrades to the WWTPs, as well as actions to correct problems associated with portions of the conveyance system. Permitted facilities identified in the table below (*sic* includes the NDWWTP) receive waste load allocations (WLAs)" (USEPA 2010:4). The TMDL states that point sources, including the NDWWTP, would be given a wasteload allocation of 104 colonies per 26 MG (100 ML) for *Enterococcus* species, which is equal to the Guam Water Quality ambient water quality standard. The repairs and upgrades to the NDWWTP as outlined in the Stipulated Order are for primary treatment systems. The proposed action is for the repair and upgrade of the NDWWTP to 12 MG (45 ML) per day capacity, which is consistent with this TMDL. Additionally, the DoD proposes to provide further upgrades to the NDWWTP to secondary treatment in the event that these upgrades are imposed by USEPA Region 9 in the future.

The DoD conducted a study that predicted ambient concentrations of various pollutants from the NDWWTP outfall in the marine environment (NAVFAC Pacific 2009). The study concluded that even with upgrades and repairs to the NDWWTP primary systems, the discharge from the treatment plant would be just over the ambient water quality standard, with the water quality standards for *Enterococcus* species at 104 colonies per 26 MG (100 ML) and in ocean concentrations at the outfall diffuser at 110 colonies per 26 MG (100 ML). The study also concluded that with the installation of secondary treatment at the NDWWTP, the ocean concentrations at the outfall diffuser would meet ambient water quality standards, predicting these concentrations to be 78 colonies per 26 MG (100 ML). The proposed DoD primary upgrades to the NDWWTP would likely not support the attainment of the TMDL and ultimate attainment of bacteria standards for Tanguisson Beach, but secondary upgrades would support the achievement of the TMDL and attainment of water quality. Therefore, with DoD upgrades to secondary treatment, the proposed use of the NDWWTP would result in less than significant impacts to nearshore waters.

Apra Harbor Wastewater Treatment Plant. Volume 6, Chapter 3 describes DoD's proposal to use the existing Navy-owned Apra Harbor WWTP to treat sewage generated from new visiting ships to Naval Base Guam. The Apra Harbor WWTP is currently in non-compliance for aluminum, copper, and nickel in its discharge. However, the expected flows from the visiting ships are not expected to significantly increase or change the metals concentrations at the treatment plant. Volume 6, Chapter 3 describes the efforts underway to modify the permit to allow for a zone of initial dilution for this discharge. The Apra Harbor WWTP has been shown to have adequate current capacity, both physically and in its permit, to handle the estimated future wastewater demand. The plants current permit capacity allows for these additional flows and the resulting zone of initial dilution is expected to be issued to account for this full permitted flow. A review of the GEPA's impaired waterbodies 303(d) list does not show any impairment in nearshore waters in the area of the Apra Harbor WWTP. Therefore, operation of Apra Harbor WWTP under Basic Alternative 1a would result in less than significant impacts to nearshore waters.

Indirect Impacts

NDWWTP. As discussed in Volume 6, Chapters 2 and 3, the NDWWTP would receive some portion of the wastewater that would result from the indirect construction workforce and induced population growth from the military relocation. This indirect wastewater flow was estimated for the NDWWTP and incorporated into the plant capacity analysis that was conducted in Chapter 2 along with the direct wastewater flows expected from the DoD population. Indirect impacts related to this flow are considered along with the direct impacts in Chapter 3 as it relates to plant capacity and performance and in Chapter 16 as it relates to ocean water quality and marine life. For groundwater, surface water, and wetlands, these indirect impacts are not considered separately in this chapter, but are part of the analysis for the NDWWTP direct impacts in Section 6.2.4.1 above.

Hagatna Wastewater Treatment Plant and Collection System. As described in Volume 6, Chapters 2 and 3, Hagatna WWTP has been shown to have adequate capacity to handle the estimated increased demand from indirect wastewater generated by the military relocation associated temporary construction workforce and induced civilian growth in central Guam area. The Hagatna WWTP was recently refurbished and plant performance has improved, with permit violations occurring less frequently. It is unclear whether the repairs and upgrades to the Hagatna WWTP would adequately treat the additional wastewater flows from the indirect populations. Therefore, the impacts to the Hagatna WWTP in terms of treatment and effluent quality are assumed to be significant. Impacts related to the discharge at the plant into the ocean outfall are addressed in Volume 6, Chapter 16.

The sewage collection system to the Hagatna WWTP experiences problems with inadequate capacity, leaks, line breaks and pump station outages, all resulting in sewage overflows onto the ground and into storm drains. The increased wastewater flow from the indirect populations would likely exacerbate the sewer overflow problems that currently exist in this collection system. There is an ongoing GWA development moratorium project that is planned that limits development in this portion of Guam due to the sewer system shortfalls, and includes the repair and replacement of the major portions of the collection system (Volume 6, see Chapter 3, Section 3.2.4).

If improvements are not made to the central sewer collection system under the moratorium project, then overflows would continue to occur and may become more frequent as increased flows from the indirect populations overwhelm the already inadequate system. Indirect impacts would likely cause further degradation to water resources with increased potential for sewage spills. Depending on the location of overflows, a sewage spill has the potential to impact surface water, groundwater (including the NGLA), nearshore water, and wetlands. Therefore, indirect impacts from construction workforce and induced population wastewater would result in significant impacts to water resources due to increased potential for sewage overflows in the collection system.

A review of GEPA’s impaired waterbodies 303(d) list shows water body impairments for bacteria in numerous beaches in Guam, including beaches on Agana Bay, which is located near the Hagatna WWTP outfall. Additionally, USEPA Region 9 approved a TMDL for these beaches in December 2009. The TMDL includes a load allocation for bacteria (*Enterococci*) for the NDWWTP that would be imposed under a revised permit. Sewer line overflows are also identified in the TMDL as attributing to impairments, and are given a load allocation. The TMDL states, “The Guam Waterworks Authority (GWA) owns and operates two wastewater treatment facilities that affect these TMDL waters. GWA is currently under a Stipulated Order to address several problems that contribute to beach advisories. Included in the Order are renovations and upgrades to the WWTPs, as well as actions to correct problems associated with portions of the conveyance system. Permitted facilities identified in the table below (*sic* includes the Hagatna WWTP) receive waste load allocations (WLAs)” (USEPA 2010:4). GWA recently repaired and upgraded the Hagatna WWTP and compliance with permit limits for the plant has been improved. However, it is unclear whether these upgrades are sufficient to meet the TMDL wasteload allocations, or whether additional repairs are needed. Since it is uncertain whether existing treatment at the Hagatna WWTP is sufficient to meet the goals for GWA sewage treatment plants in the TMDL, this analysis assumes there is an existing negative impact on nearshore water quality from the existing Hagatna WWTP discharge, and additional flows to the plant resulting from the indirect construction workforce and induced population would further degrade water quality. Therefore, there would be a significant impact to nearshore water quality from the Hagatna WWTP and collection system from the indirect population increase on Guam resulting from the military relocation.

DoD acknowledges the existing sub-standard conditions of utility infrastructure systems on Guam and the desire by many for DoD to fund improvements to these systems and services. DoD also recognizes the constraints on GovGuam to be able to address these indirect impacts of the proposed military relocation. GovGuam has identified the need for $1.3 billion in funding to implement necessary water and wastewater infrastructure improvements that must be accomplished in the first five years to accommodate the military relocation. The Council on Environmental Quality has facilitated interagency meetings with DoD and appropriate federal agencies to identify funding sources to meet this need. DoD is seeking from GoJ approximately $580 million for water and wastewater improvement projects pursuant to the terms of the Realignment Roadmap Agreement, described in Volume 1. The Economic Adjustment Committee (EAC) is evaluating overall Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD military relocation. As part of this evaluation the EAC is specifically examining federal funding options for water and wastewater infrastructure improvements that may not be funded through GoJ financing.

Agat-Santa WWTP. The Agat-Santa WWTP is located in central Guam and is described in Volume 6, Chapter 3. This secondary treatment plant discharges to an ocean outfall and is currently out of compliance with its permit limits. Repairs to this plant are required under the 2003 Stipulated Order but have not been accomplished. Under the proposed DoD relocation, construction workers and civilian population growth would also result in indirect impacts to this plant due to increased wastewater flows. This increased demand on the Agat-Santa WWTP would only exacerbate current treatment and collection system problems and non-compliance. A review of GEPA's impaired waterbodies 303(d) list shows no water body impairments for bacteria in waters or beaches near the outfall of the Agat-Santa WWTP. Therefore, there would be a significant impact to nearshore water quality from the Agat-Santa WWTP from the indirect population increase on Guam resulting from the military relocation.

Other Wastewater Treatment Plants in Southern Guam. Under the proposed DoD relocation, construction workers and civilian population growth would also result in indirect impacts to four southern Guam WWTPs due to increased wastewater flows and increased demand. Volume 6, Chapters 2 and 3 describe the decrepit condition of these plants, and their significant noncompliance with their permit limits. These four plants are the Baza Gardens WWTP, the Umatac-Merizo WWTP, the Inarajan WWTP, and the Pago Socio WWTP, and are described in Volume 6, Chapter 3. Repairs to these plants are required under the 2003 Stipulated Order, but have not been accomplished. All of these plants are in significant non-compliance with their discharge permits. Under the proposed DoD relocation, construction workers and civilian population growth would also result in indirect impacts to these plants due to increased wastewater flows. The increased demand on the plants would only exacerbate problems at the already non-compliant plants. These plants discharge either to the ocean, small surface streams, or to the ground (and eventually the groundwater). Increasing flows to these plants could result in significant impacts to surface water quality, stormwater, groundwater, and marine water. Marine water impacts are discussed in Volume 6, Chapter 16. Volume 6, Chapter 3 discusses the GWA collection system and problems with line capacities and sewage overflows. These problems would likely result in significant impacts to water quality, stormwater, groundwater, and the marine environment from more frequent sewage overflows. A review of GEPA's impaired waterbodies 303(d) list shows water body impairments for bacteria in waters and areas near these plants, but there are no TMDLs currently proposed for them. Therefore, there would be a significant impact to water quality and potential impacts to groundwater from the indirect population increase on Guam resulting from the military relocation.

DoD acknowledges the existing sub-standard conditions of utility infrastructure systems on Guam and the desire by many for DoD to fund improvements to these systems and services. DoD also recognizes the constraints on GovGuam to be able to address these indirect impacts of the proposed military relocation. GovGuam has identified the need for $1.3 billion in funding to implement necessary water and wastewater infrastructure improvements that must be accomplished in the first five years to accommodate the military relocation. The Council on Environmental Quality has facilitated interagency meetings with

DoD and appropriate federal agencies to identify funding sources to meet this need. DoD is seeking from GoJ approximately $580 million for water and wastewater improvement projects pursuant to the terms of the Realignment Roadmap Agreement, described in Volume 1. The Economic Adjustment Committee (EAC) is evaluating overall Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD military relocation. As part of this evaluation the EAC is specifically examining federal funding options for water and wastewater infrastructure improvements that may not be funded through GoJ financing.

Summary of Basic Alternative 1a Impacts

Under Basic Alternative 1a, there would be no work in or reduction in the amount of wetlands on Guam, and there would be no reduction in the availability or accessibility of water resources. There would be no permanent increase in stormwater and stormwater flow paths would continue to follow area topography. There would be no increase in flooding risk. No buildings/structures would be constructed in the 100-year flood zone; however, some stormwater detention basins could be constructed in the 100-year flood zone. In some of these areas, these open, grassed stormwater detention basins could also be utilized for additional uses (e.g., recreational fields). Through the development and implementation of the site-specific SWPPP and the implementation the LID measures, and facility-specific plans and procedures, there would no increased risk from environmental hazards or to human health. All actions would be implemented in accordance with all applicable federal, GovGuam, and military orders, laws, and regulations (Volume 8, Chapter 3, Table 3.1-1).

Upon completion of the proposed upgrade to the NDWWTP's primary system and expansion to secondary treatment, the effluent discharge would meet discharge requirements in receiving waters and improve the water quality. However, increased potential for sewage spills would likely occur due to indirect impacts from construction workers and civilian population growth under DoD relocation that would result in increased wastewater flow to the NDWWTP, Hagatna WWTP, and other southern area WWTPs in already inadequate sewer collection systems and inadequate treatment plants in the south. Therefore, Basic Alternative 1a would result in less than significant direct impacts and significant indirect impacts to water resources until the sewer collection systems and southern area WWTPs can be upgraded to meet increased demands.

Proposed Mitigation Measures

Mitigation measures would be as described for Wastewater Basic Alternative 1a in Volume 6, Chapter 3, Section 3.2.4.1.

6.2.4.2 Basic Alternative 1b

Under Basic Alternative 1b, the proposed upgrade of the NDWWTP, expansion to secondary treatment, and installation of a sewer line would be the same as described under Basic Alternative 1a and would therefore have the same impacts for construction of these facilities. In addition to the sewer line proposed in Basic Alternative 1a, Basic Alternative 1b would include a new sewer line and pump stations to convey wastewater generated from Barrigada housing to the NDWWTP.

Construction

Under Basic Alternative 1b, new sewer line and pump stations would be installed from Navy Barrigada to the existing GWA NDWWTP collection system. The pipelines would follow along previously disturbed areas within the existing right of way, so there would be no direct impacts on wetlands or surface water features along the route. No wetlands were identified in proposed wastewater project areas in northern Guam (see Volume 2, Chapter 4).

Construction would involve land disturbing activities that would trigger coverage under the NPDES stormwater CGP and preparation of a site-specific SWPPP. The SWPPP would identify site-specific BMPs (Volume 2, Chapter 4, Table 4.2-1) that would be implemented as part of the alternative to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts, which would also reduce potential for impacts to groundwater, nearshore water resources, and the marine environment. Therefore, construction activities associated with Basic Alternative 1b would result in less than significant impacts to water resources.

Operation

Operation of the new collection system from Barrigada would not impact water resources as the line would be buried. Under Basic Alternative 1b, the direct and indirect impacts the military relocation would have on the Hagatna WWTP and the central Guam sewage collection system and on the southern Guam WWTPs would be identical to those described under Basic Alternative 1a. Therefore, Basic Alternative 1b would result in less than significant direct impacts and significant indirect impacts to water resources until the sewer collection systems and southern treatment plants can be upgraded to meet increased demands.

Summary of Basic Alternative 1b Impacts

Under Basic Alternative 1b, there would be no work in or reduction in the amount of wetlands on Guam, and there would be no reduction in the availability or accessibility of water resources. There would be no permanent increase in stormwater and stormwater flow paths would continue to follow area topography. There would be no increase in flooding risk. No buildings/structures would be constructed in the 100-year flood zone; however, some stormwater detention basins would be constructed in the 100-year flood zone. In some of these areas, these open, grassed stormwater detention basins would also be utilized for additional uses, for example, as recreational fields. Through the development and implementation of a site-specific SWPPP and BMPs, and the implementation of LID measures and facility-specific plans and procedures, there would be no increased risk from environmental hazards or to human health. All actions would be implemented in accordance with all applicable federal, GovGuam, and military orders, laws, and regulations (Volume 8, Chapter 3, Table 3.1-1).

Upon completion of proposed upgrade to the NDWWTP's primary system and expansion to secondary treatment, the effluent discharge would meet discharge requirements in receiving waters and improve the water quality. However, increased potential for sewage spills would likely occur due to indirect impacts from construction workers and civilian population growth under DoD relocation that would result in increased wastewater flow to the NDWWTP, the Hagatna WWTP, and southern WWTPs in already inadequate sewer collection systems and overloaded and non-compliant WWTPs. All actions would be implemented in accordance with all applicable federal, GovGuam, and military orders, laws, and regulations (Volume 8, Chapter 3, Table 3.1-1). Therefore, Basic Alternative 1b would result in less than significant direct impacts and significant indirect impacts to water resources until the sewer collection systems and southern WWTPs can be upgraded to meet increased demand.

DoD acknowledges the existing sub-standard conditions of utility infrastructure systems on Guam and the desire by many for DoD to fund improvements to these systems and services. DoD also recognizes the constraints on GovGuam to be able to address these indirect impacts of the proposed military relocation. GovGuam has identified the need for $1.3 billion in funding to implement necessary water and wastewater infrastructure improvements that must be accomplished in the first five years to accommodate the military relocation. The Council on Environmental Quality has facilitated interagency meetings with DoD and appropriate federal agencies to identify funding sources to meet this need. DoD is seeking from GoJ approximately $580 million for water and wastewater improvement projects pursuant to the terms of the Realignment Roadmap Agreement, described in Volume 1. The Economic Adjustment Committee (EAC) is evaluating overall Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD military relocation. As part of this evaluation the EAC is specifically examining federal funding options for water and wastewater infrastructure improvements that may not be funded through GoJ financing.

Proposed Mitigation Measures

Proposed mitigation measures would be as described for Basic Alternative 1a.

6.2.4.3 Summary of Impacts

Table 6.2-3 summarizes the potential impacts of each interim alternative. A text summary is provided below.

Table 6.2-3. Summary of Potential Wastewater Impacts

*Basic Alternative 1a**	*Basic Alternative 1b*
Construction Impacts (direct and indirect are the same)	
SW – LSI • temporary increase in stormwater runoff, erosion, and sedimentation. GW – LSI • increased potential for local groundwater contamination. NW – LSI • localized increase in turbidity. WL – NI	SW – LSI • temporary increase in stormwater runoff, erosion, and sedimentation. GW – LSI • increased potential for local groundwater contamination. NW – LSI • localized increase in turbidity. WL – NI
Operation Impacts (direct with indirect in parenthesis)	
SW – NI (SI) • increased potential for sewage spill with increased demand on central sewer collection system under indirect impacts of DoD relocation. GW – LSI (SI) • increased potential for sewage spill with increased demand on central sewer collection system under indirect impacts of DoD relocation. NW – LSI (SI) • increased potential for sewage spill with increased demand on central sewer collection system under indirect impacts of DoD relocation. • increase in effluent discharge at NDWWTP but improved water quality WL – NI (SI) • increased potential for sewage spill with increased demand on central sewer collection system under indirect impacts of DoD relocation.	SW – NI (SI) • increased potential for sewage spill with increased demand on central sewer collection system under indirect impacts of DoD relocation. GW – LSI (SI) • increased potential for sewage spill with increased demand on central sewer collection system under indirect impacts of DoD relocation. NW – LSI (SI) • increased potential for sewage spill with increased demand on central sewer collection system under indirect impacts of DoD relocation. • increase in effluent discharge at NDWWTP but improved water quality. WL – NI (SI) • increased potential for sewage spill with increased demand on central sewer collection system under indirect impacts of DoD relocation.

Legend: DoD = Department of Defense; GW = Groundwater; LSI = Less than significant impact; NDWWTP = Northern District Wastewater Treatment Plant; NI = No impact; NW = Nearshore Waters; SI = Significant impact; SW = Surface Water/Stormwater; WL = Wetland. * Preferred Alternative.

Under implementation of Basic Alternative 1a or 1b, stormwater would continue to be managed in accordance with laws, regulations, and plans that would reduce potential impacts to groundwater and nearshore waters. No impacts to wetlands would occur. Upon completion of the improvements to the NDWWTP's primary treatment system and expansion to secondary treatment, discharge effluent would meet water quality standards (NPDES permit limits) and therefore would result in beneficial impacts on nearshore water quality.

However, increased potential for sewage spills would likely occur due to indirect impacts from construction workers and civilian population growth under DoD relocation. This would result in increased wastewater flow to the NDWWTP, the Hagatna WWTP, and southern WWTPs in already inadequate sewer collection systems and overloaded and noncompliant southern WWTPs. The DoD cannot financially fix other current deficiencies in the GWA sewer collection system due to legal restraints, but would lead studies to identify where the impacts are and work with GWA to prioritize the improvement projects. Plus, the DoD is leading a federal inter-agency effort to identify other federal programs and funding sources that could benefit the people of Guam. Therefore, Basic Alternative 1a and 1b would result in less than significant direct impacts and significant indirect impacts to water resources until the sewer collection systems and southern WWTPs can be upgraded to meet increased demands.

6.2.5 Solid Waste

6.2.5.1 Basic Alternative 1 (Preferred Alternative)

The Preferred Alternative would be to continue to use the Navy landfill at Apra Harbor for municipal solid waste (MSW) until the new GovGuam Layon Landfill at Dandan is available for use. Disposal of other waste streams excluded from Layon Landfill would continue at the Navy landfill. Construction and demolition (C&D) debris would continue to be disposed at the Navy hardfill.

The proposed Layon Landfill and its impacts to water resources were evaluated in the Final Supplemental Environmental Impact Statement for the Siting of a Municipal Solid Waste Facility, Guam (GDPW 2005). The Layon Landfill has been designed to accommodate solid waste from all current and future DoD sources, as well as civilian and commercial sources. GEPA approved the Final Integrated Hydrogeologic Assessment for the Layon Municipal Sanitary Landfill Site (AMEC Geomatrix Consultants, Inc. 2008) that established that the proposed landfill would not be located over an important source of groundwater because of potential low yield and marginal groundwater quality. The following analysis focuses on the potential impacts to water resources as a result of the continued use of the Navy Sanitary Landfill at Apra Harbor.

There would be no construction associated with the Preferred Alternative. Therefore, no impacts to surface water, groundwater, nearshore waters, or wetlands would occur due to construction.

Because the existing Navy Sanitary Landfill is unlined, there is a potential for leachate to adversely affect the underlying groundwater. Studies are currently under way to assess whether or not the underlying groundwater has been affected by leachate. Based on the conclusions of these studies, further action may be required. Continued use of the Navy Sanitary Landfill under the Preferred Alternative would further contribute to the potential contamination of the underlying groundwater. However, the landfill is located over aquifers not used for supplying drinking water, thus any leachate that might percolate into the aquifer would not affect regional groundwater drinking quality or quantities. Surface waters, nearshore waters, and wetlands would not be affected by continued use of the Navy Sanitary Landfill. Therefore, less than significant impacts to water resources would occur under the Preferred Alternative.

Proposed Mitigation Measures

No mitigation measures related to water resources are needed for the Preferred Basic Alternative.

6.2.5.2 Summary of Impacts

Table 6.2-4 summarizes the potential impact of the Preferred Basic Alternative. A text summary is provided below.

Table 6.2-4. Summary of Potential Solid Waste Impacts

Preferred Alternative
Construction Impacts (direct and indirect are the same)
• No construction would occur.
Operation Impacts (direct and indirect are the same)
SW – NI GW – LSI • Contamination from leachate at existing Navy Sanitary Landfill is being determined. NW – NI WL – NI

Legend: GW = Groundwater; LSI = Less than significant impact; NI = No impact; NW = Nearshore Waters; SW = Surface Water/Stormwater; WL = Wetland.

Implementation of the Preferred Alternative has the potential to contribute to continued contamination of the underlying groundwater. However, the landfill is located over aquifers not used for supplying drinking water, thus any leachate that might percolate into the aquifer would not affect regional groundwater drinking quality or quantities. Surface waters, nearshore waters, and wetlands would not be affected by continued use of the Navy Sanitary Landfill. Therefore, less than significant impacts to water resources would occur under the Preferred Alternative.

6.2.6 Off Base Roadways

The major components of the proposed GRN projects include intersection improvement, bridge replacement, pavement strengthening, road widening, roadway relocation, and construction of a new road, all of which impact water resources to various degrees. Intersection improvement projects include relocation of existing Military Access Points (MAPs) and various levels of roadway intersection improvements throughout the island. These types of projects generally involve some pavement widening and subsequent increase in impervious surfaces. Pavement strengthening projects and roadway rehabilitation projects would involve rehabilitating existing pavement materials and placing an asphalt overlay or reconstructing the pavement with new materials. Although such projects generally do not increase impervious surfaces, they may require retrofit of the existing drainage systems to convey stormwater to roadway BMPs. Roadway widening projects include clearing and grubbing, site grading, and widening of pavement and subsequent increase in impervious surfaces along the roadway. With respect to water resources, all of these proposed improvements would generally have (1) little to no impact on floodplains; (2) minor impact on runoff and drainage, possibly requiring relocation or adjustments of drainage catch basins and increasing roadway runoff due to the addition of impervious surfaces; (3) little to no impact to coastal resources because the projects do not involve work in the coastal bays or estuaries and most are located away from the coastline; (4) no impact to National Wild and Scenic Rivers because no rivers in the vicinity of the projects have been designated as such; and (5) potential impact to water quality due to the addition of impervious surfaces that would likely contain sediment, nutrients, hydrocarbons, metals, bacteria, and other particulates that accumulate on roadway surfaces (such pollutants originate from highway use and maintenance and from ambient atmospheric deposition), and due to erosion and siltation impacts in the drainage area during construction when heavy storms or high wind events occur. These potential impacts are analyzed for each alternative. Also discussed are the impacts attributable to bridge and roadway relocation projects. A Stormwater Implementation Plan describing detailed stormwater pollution control measures for the GRN is provided in Volume 9, Appendix G.

Waters of the U.S., which are wetlands and stream channels under the CWA jurisdiction, are discussed in a regulatory context in this chapter. Potential impacts to wetlands, stream channels, and other aquatic habitats are discussed in an ecological context (i.e., potential impacts to special status species, vegetation, and marine communities) within the biological resource chapters (Chapter 12 for terrestrial and freshwater aquatic communities and species and Chapter 13 for marine environments).

6.2.6.1 Alternative 1

Year 2014 (Peak Construction and Peak Population)

North

Surface Water/Stormwater. Construction for the North Region projects for this alternative include pavement strengthening along Routes 1, 3, and 9; pavement widening along Routes 3, 9, and 28; construction of a new road; and intersection improvements including MAPs along Routes 3, 9 and 15. With construction of this type, the potential for accidental spills of sediment, fuel, and other toxic materials may occur at any time during the construction period. Water quality impacts from spills could be short or long-term depending on the type of material, size of the spill, and seasonal timing.

To address these potential impacts, roadway-specific BMPs would be included in the planning, design, and construction for all proposed projects. To start construction, regulations set forth by GEPA require a Clearing and Grading Permit to be obtained from the Guam Department of Public Works (GDPW). This permit requires development of an Environmental Protection Plan, which must incorporate compliance measures to protect marine and surface water resources, including the preparation of a Water Quality Monitoring Plan. An Erosion Control Plan is also required for clearing, grading, grubbing, embankment or filling, excavation, or other earth-moving operations. This plan would also describe construction site BMPs to be used during construction to minimize the impacts of construction and construction-related activities on the watershed. These include, but are not limited to, temporary soil stabilization, temporary sediment control, scheduling, waste management, materials handling, and other non-stormwater BMPs.

During construction, work within or adjacent to floodplains would be equipped with appropriate stormwater control BMPs to prevent spills from occurring within the waterways, debris from entering the waterway, and erosion from occurring within the streambed. Water would be diverted away from any construction activities using appropriate water diversion BMPs.

Through the development and implementation of site-specific BMPs (Volume 2, Chapter 4, Table 4.2-1) there would be no increased risk from environmental hazards or to human health. Furthermore, all actions associated with Alternative 1 would be implemented in accordance with all applicable federal, local, and military orders, laws, and regulations (Volume 8, Chapter 3, Table 3.1-1), including Commander Navy Region (COMNAV) Marianas Instruction 3500.4. Therefore, construction activities associated with Alternative 1, Year 2014 in the North Region would result in less than significant impacts to surface water.

Groundwater. As described in Volume 2, Chapter 4, the infiltration characteristics are high in the North Region; therefore, any surface water quality impact could also impact groundwater quality if poor quality surface water percolates directly to the groundwater. Thus, the same surface water quality protection measures discussed above would also serve to protect groundwater resources. To ensure consistency with the Sole Source Aquifer Program and in accordance with Section 1424(e) of the Safe Drinking Water Act, project activities over the Northern Guam Sole Source Aquifer or the NGLA would be subject to review during design by GEPA in coordination with FHWA and USEPA Region 9. USEPA Region 9 also has a role coordinating with other federal agencies to review federal financial assistance projects that may impact the NGLA. In addition, in the event groundwater dewatering is proposed or anticipated during construction, and an alternative method of disposal (e.g., discharge to sanitary sewer, retention on site) is not feasible, then the Contractor would coordinate with the GDPW prior to discharging waste. Therefore, construction activities associated with Alternative 1, Year 2014 in the North Region would result in less than significant impacts to groundwater.

Nearshore Waters. Potential impacts from roadway construction activities would be lessened through the implementation of the surface water BMPs and adherence to all applicable orders, laws, and regulations relating to water quality. No direct impacts to coastal resources would occur. Therefore, construction activities associated with Alternative 1, Year 2014 in the North Region would result in less than significant impacts to nearshore waters.

Central

Proposed construction projects located in the Central Region have been evaluated for two areas that have two very different hydrologic regimes. One is the northern section of the Central Region (characterized as a broad sloping limestone plateau) and the other is the southern section of the Central Region (characterized as a mountainous region composed of eroded volcanic formations and steep narrow streambeds that outlet directly into the bays). Proposed construction in the northern section includes pavement strengthening along Routes 1, 8, 8A, 10, 15, 16, 25, 26, and 27, and Chalan Lujuna; pavement widening along Routes 8, 8A, 16, 26, and 28, and Alageta-Lily; intersection improvements (including MAPs) along Routes 1, 8A, 15, and 16; and roadway relocation along Route 15. Proposed construction in the southern section of the Central Region includes pavement strengthening along Route 1, replacement of five bridges along Route 1, and replacement of box culverts of three bridges along Route 1. Construction of the type proposed in the north section of the Central Region is the same as those described for the North Region.

Surface Water/Stormwater. In addition to the potential impacts and associated water quality protection measures discussed for Alternative 1, North (Section 6.2.6.1), construction of the type proposed in the south section of the Central Region has the potential to (1) damage existing riverbeds and embankments for work occurring within waterways if appropriate construction BMPs, such as soil stabilization, sediment control, and surface water diversion away from the construction site, are not in place prior to commencement of construction activities; and (2) cause an increase in suspended sediment, hydrocarbons, oil and grease, and heavy metal discharge to surface water bodies if appropriate stormwater and non-stormwater BMPs are not in place prior to work occurring within or adjacent to the rivers where the bridge replacements are to occur.

Proposed dewatering activities associated with structure placement could also introduce contaminants into the surface waters if inappropriate sampling and disposal methods for potentially contaminated groundwater are not conducted during construction. The bridge replacement projects could cause erosion and sedimentation within the streams if the improvements result in increased flow velocities or incorporate inadequate erosion control practices for short-term (construction) operations and for long-term operations within and/or adjacent to the stream channels. Hydraulic modeling would therefore be required to assess the potential impacts and provide adequate data for the design of flood and erosion control facilities. The bridge replacements are proposed to span crossings along Route 1 over the Agana River, Atantano River, Laguas River, Sasa River, and Fonte Rivers. These rivers are considered perennial (flowing water for all or most of the year) and have a direct nexus with waters considered navigable under the CWA. Therefore, the channels of these rivers bounded by observed ordinary high water marks along each channel's stream bank are jurisdictional under the CWA (Waters of the U.S.). As shown in Table 6.2-5, construction activities associated with the five bridge replacements and three bridge box culvert replacements would temporarily affect a total area of 1.52 acres (0.62 hectares) of potential Waters of the U.S. Temporary direct impacts associated with construction activities include the potential for increased erosion associated with grading into the subsoil within and outside the stream channel, vegetation removal, and degradation of aquatic communities in the immediate area of the bridge/box culvert replacement. Indirect impacts may occur farther downstream outside of the immediate construction area and be prolonged in time. These indirect effects may include degradation of stream channel aquatic habitats and marine habitats supporting coral communities and fisheries. FHWA and GEPA have mandated standard operating procedures and BMPs specific to sediment control that accounts for storm water runoff and other Guam-specific criteria for pollution prevention during construction and operation of the proposed roads. Improved hydraulic conveyance under the new bridges would benefit downstream channel segments, wetland areas, and open water habitats by decreasing scour along the stream bank near the bridge replacements and decreasing sediment inputs into downstream freshwater and marine habitats. In summary, the bridge/box culvert replacement projects would cause an unavoidable loss of 1.52 acres (0.62 hectares) of Waters of the U.S. However, the impacts would be minimized through (1) use of construction and source control BMPs cooperatively developed by the FHWA and GEPA, and (2) improved hydraulic conveyance under the proposed bridge/box culvert replacements. Improvement of hydraulic conveyance in bridge areas would reduce scour and stream redirection by channeling the water flow more efficiently through the bridge or culvert structure. Reducing stream bank scour would maintain the integrity of stream banks in the immediate area of the bridge and reduce sedimentation in downstream freshwater aquatic and marine habitats.

Table 6.2-5. Bridge Replacements and Estimated Direct Impacts to Potential Waters of the U.S.

		Dimensions (ft)		*Impact to Potential Waters of the U.S. (acres)*	
GRN Project #	*Bridge Name*	*Structure Width*	*Stream Channel Width*	*Streams*	*Wetlands*
3	Agana Bridge #1	102.0	39.3	0.15	0
35	Atantano Bridge	80.6	42.7	0.14	0
	Aguada Bridge	95.3	41.3	0.15	0
	Asan Bridge # 1	100.0	77.3	0.28	0
	Asan Bridge # 2	96.5	72.1	0.26	0
	Fonte Bridge	100.0	76.5	0.28	0
	Laguas Bridge	80.8	41.2	0.13	0
	Sasa Bridge	82.3	40.3	0.13	0
Total Area				**1.52**	**0**

Notes: Stream channel widths were calculated by averaging the width of four cross-stream lines between observed ordinary high water marks (OHWM) for each bridge. Two upstream lines and two downstream lines were measured for each bridge.

The estimated area of direct impacts to potential waters of the U.S. was calculated by the following equation: (Stream channel width) x [(Structure width) + (Assumed area of upstream channel modifications [30']) + (Assumed area of downstream channel modifications [30'])].

Legend: ft = feet; GRN = Guam Road Network; U.S. = United States.

The FHWA has determined that U.S. Coast Guard bridge construction permits are not required for the bridge and culvert replacement projects pursuant to 23 U.S.C. 144(h) [Notwithstanding any other provision of law, the General Bridge Act of 1946 (33 U.S.C. 523-533) shall apply to bridges authorized to be replaced, in whole or in part, by this section, except that subsection (b) of section 502 of such Act of 1946 and section 9 of the Act of March 3, 1899 (30 Stat. 1151) shall not apply to any bridge constructed, reconstructed, rehabilitated, or replaced with assistance under this title, if such bridge is over waters (1) which are not used or susceptible to use in their natural condition or by reasonable improvement as a means to transport interstate or foreign commerce, and (2) which are (a) non tidal, or (b) if tidal, used only by recreational boating, fishing, and other small vessels less than 21 feet in length.]. Coordination letters between the FHWA (for the determination) and the U.S. Coast Guard (for its concurrence on the determination) are included in this EIS in Volume 9, Appendix C.

Through the development and implementation of site-specific BMPs (Volume 2, Chapter 4, Table 4.2-1) there would no increased risk from environmental hazards or to human health. Furthermore, all actions associated with Alternative 1 would be implemented in accordance with all applicable federal, local, and military orders, laws, and regulations (Volume 8, Chapter 3, Table 3.1-1), including COMNAV Marianas Instruction 3500.4. Therefore, construction activities associated with Alternative 1, Year 2014 in the Central Region would result in less than significant impacts to surface water.

If mitigation is required during the CWA Section 404 regulatory permitting process, FHWA would identify potential areas available for compensatory mitigation. These areas may include aquatic habitat enhancements at Camp Covington or other areas identified during the permitting process.

Groundwater. Potential construction impacts to groundwater resources resulting from implementation of Alternative 1, Year 2014 in the Central Region would be similar to the potential impacts discussed under Alternative 1, Year 2014 for the North Region (refer to Section 6.2.6.1). Therefore, construction activities associated with Alternative 1, Year 2014 in the Central Region would result in less than significant impacts to groundwater.

Nearshore Waters. Potential construction impacts to nearshore waters resulting from implementation of Alternative 1, Year 2014 in the Central Region would be similar to the potential impacts discussed under Alternative 1, Year 2014 for the North Region (refer to Section 6.2.6.1). Therefore, construction activities associated with Alternative 1, Year 2014 in the Central Region would not result in adverse impacts to nearshore waters.

Apra Harbor

Proposed construction projects within the Apra Harbor Region include pavement strengthening along Routes 1 and 2A, roadway rehabilitation along Route 11, and intersection improvements along Route 1. Route 11 is the main entry to Apra Harbor which is shown to be within the coastal flood zone in the FEMA FIRMs. The Route 1/11 interchange is located within the floodplain of the Masso River. Construction of this type has the potential to cause an increase in suspended sediment, hydrocarbons, oil and grease, and heavy metals in the surface water bodies for work occurring within or adjacent to the Masso River and the adjacent Piti Canal.

Potential construction impacts to water resources in Apra Harbor are similar to those described for Alternative 1, Year 2014, North Region (refer to Section 6.2.6.1). Therefore, construction activities associated with Alternative 1, Year 2014 in Apra Harbor would result in less than significant impacts to water resources.

South

Proposed construction projects within the South Region include improvements along Route 5 (pavement strengthening only), Route 2 (intersection improvement) and Route 12 (relocation of MAPs).

Potential construction impacts to water resources in the South Region are similar to those described for Alternative 1, North Region (refer to Section 6.2.6.1). Therefore, construction activities associated with Alternative 1, Year 2014 in the South Region would not result in adverse impacts to water resources.

Proposed Mitigation Measures

Mitigation measures have not been identified for Alternative 1.

<u>Year 2030 (Operation)</u>

North

The North Region projects for this alternative include pavement strengthening and intersection improvements for MAPs. Resulting long-term impacts on water resources within this area are itemized below.

Surface Water/Stormwater. Under Alternative 1, potential impacts to runoff and drainage flows could occur due to increased impervious surfaces and could require modifications to existing drainage systems. These impacts would be minimized through management of stormwater runoff in accordance with the source control and treatment BMPs outlined in the Stormwater Implementation Plan (Volume 9, Appendix G); therefore, these impacts are less than significant. In this area, the roadway drainage generally flows off the pavement via sheet flow minimizing the need for underground storm drain and catch basin networks. This may require adjustments of adjacent swales or construction of new surface flow systems to enable proper drainage flow offsite. No impacts to floodplains are anticipated because no flood hazard zones have been designated where the proposed improvements are located.

Diversion of drainage from one watershed to another would be avoided. Roadway-specific BMPs would be included in the planning, design, and construction for all proposed projects. As mentioned above, an Erosion Control Plan is required for a Clearing and Grading Permit by the GDPW when the area to be graded is more than 5,000 square feet (ft^2) (464 square meters [m^2]) or a proposed cut or fill is greater than 5.0 ft (1.5 m) in height. This stormwater plan would describe the impacts and proposed mitigation related to runoff and drainage.

Through the development and implementation of site-specific BMPs outlined in the Stormwater Implementation Plan (Volume 9, Appendix G) there would be no increased risk from environmental hazards or to human health. Furthermore, all actions associated with Alternative 1 would be implemented in accordance with all applicable federal, local, and military orders, laws, and regulations (Volume 8, Chapter 3, Table 3.1-1), including COMNAV Marianas Instruction 3500.4. Therefore, Alternative 1, Year 2030 in the North Region would result in less than significant impacts to surface waters.

Groundwater. Under Alternative 1, potential impacts to groundwater quality could occur due to the addition of impervious surfaces that would likely contain sediment, nutrients, hydrocarbons, metals, bacteria, and other particulates that accumulate on roadway surfaces (such pollutants originate from routine roadway use and maintenance and from ambient atmospheric deposition). Because the infiltration characteristics are high, any surface water quality impact could also impact groundwater quality. Groundwater is the primary drinking water supply for the island; therefore, water quality protection would be important. Thus, the same surface water quality protection measures discussed above would also serve to protect groundwater resources. Therefore, Alternative 1, Year 2030 in the North Region would result in less than significant impacts to groundwater.

Nearshore Waters. While alterations to the watershed have the potential result in indirect impacts that could alter the nearshore water quality, these potential effects would be minimized by complying with all applicable orders, laws and regulations presented in Volume 8, Chapter 3, Table 3.1-1. In addition, the aforementioned surface water resource protection measures would minimize potential indirect impacts to nearshore waters. No direct impacts to coastal resources would occur. Therefore, Alternative 1, Year 2030 in the North Region would result in less than significant impacts to nearshore waters.

Central

Descriptions of affected water resources for the Central Region have been split into the northern and southern part and are described in detail in Volume 2. Roadway projects located in the northern part of the Central Region include pavement strengthening; pavement widening; intersection improvements, including MAPs; and roadway relocation.

Surface Water/Stormwater. Proposed GRN projects in the southern part of the Central Region include pavement strengthening, and bridge (five) and box culvert (three) replacements at eight stream crossings. The bridge/box culvert replacement projects would be undertaken to correct structural deficiencies, increase load capacity, and provide compliance with seismic requirements of the bridges. Studies have shown that the Agana Bridge #1 would not be able to support the proposed loadings for the military relocation. Due to the age and condition of this structure, replacement is required. The new structure would be lengthened to adequately accommodate the flood flow of the river. The width of the new structure would accommodate wider lanes and a median, with sidewalks and barriers on each side.

Hydraulic modeling and flood control improvements associated with the Agana River Bridge Replacement Project would be coordinated through the USACE Flood Control Study and subsequent Section 404 permit process for the Hagatna (Agana) River. Flood control was originally studied by USACE in 1977 and was found to be feasible. Since then, conditions have changed, requiring reinvestigation of federal interest by USACE. A new feasibility study is currently underway. The bridge projects also include replacement of the Agueda Bridge, Atantano Bridge, Asan Bridge # 1, Asan Bridge # 2, Laguas Bridge, Sasa Bridge, and Fonte Bridge. These bridges would be replaced due to structural deficiencies, but they would have hydraulic conveyance capacity similar to those under existing conditions. Bridge/box culvert replacement efforts would also include improvements to the underlying channel as necessary to enable adequate hydraulic conveyance capacity while maintaining or improving potential erosive characteristics of the channel embankments. Improvements to the channels would involve such items as debris removal; placement of erosion control, such as riprap, gabions, vegetated surfaces (with or without erosion control blankets depending on shear forces in the channel), or concrete channel lining on the upstream and/or downstream sides of the bridges and above piers where necessary; and wing wall replacement, where necessary.

Under Alternative 1, potential impacts to floodplains located in the northern part of the Central Region would be minimal because very few designated flood hazard areas are shown to exist on the FEMA FIRMs (FIRMs 2010). Only two floodplain areas are shown to be within any of the improvements in the North Central Area and these are both located on Route 1. These include the Harmon Sink and the Tamuning Drainageway. Route 1 road improvements in these areas are limited to pavement strengthening that should have no impact to the floodplains. Impacts to floodplains in the southern part of the Central Region are also limited to Route 1. Numerous culverts and bridges along Route 1 cross narrow streams that outlet into the bays and to Apra Harbor. Encroachments into the floodplains and floodways of some of these streams would occur for the bridge/box culvert replacement projects. These include replacement of five bridges and three bridge box culverts located along Route 1. All of these bridge improvement projects would involve work within or adjacent to 100-year floodplains. Work occurring within the Agana and Fonte Rivers would be within a FEMA-designated floodway. Bridge lengthening, pier replacement, pier widening, channel lining, and/or bridge replacement activities could impact the upstream floodplain by increasing depths of flow for the 100-year storm event. Location hydraulic studies for each bridge site would require hydraulic modeling to demonstrate the pre- and post-project hydraulic conditions of the floodplain to assess and mitigate the impacts. In general, these bridges or their box culverts would be replaced due to structural deficiencies, but they would have hydraulic conveyance capacity similar to those under existing conditions with the possible exception of the Agana Bridge # 1, that may be designed with additional capacity in accordance with recommendations set forth by the USACE as specified in their ongoing Hagatna River Flood Control Study.

Potential impacts to runoff and drainage in the northern part of the Central Region could occur due to roadway widening, intersection improvements, and relocation of Route 15, all of which would increase impervious surfaces and could require modifications to existing drainage systems, including swales, storm drains, catch basins, and connecting stormwater treatment BMPs such as detention basins or biofiltration systems. In this area, the roadway drainage on the east side of the island generally flows off the pavement via sheet flow, minimizing the need for underground storm drain and catch basin networks. This may require adjustments of adjacent swales or construction of new surface flow systems to enable proper drainage flow offsite. Roadway drainage on the west side of the island generally flows to a curb and gutter system and to a catch basin/ storm drain conveyance system. Route 1 is curbed and flows southerly in a storm drain system to the Tamuning Drainageway or to the Harmon Sink. Work along Route 1 may require adjustments to catch basins and incorporation of BMPs at the Tamuning Drainageway outlet. In other areas, runoff flows directly to sinks that allow the untreated runoff to percolate to the groundwater system below, that could impact groundwater quality if the percolation rates are too high. In the south central area, impacts to runoff and drainage would occur along Route 1. The roadway is generally curbed, and runoff flows to storm drain networks that outlet directly to the adjacent waterways. All bridge improvement projects could impact runoff and drainage if the bridge improvements/replacements increase flow depths or velocities within the stream channels. This could result in flow conveyance capacity reductions of the connecting drainage systems or increased erosion potential within the channel. Hydraulic modeling would therefore be required to assess the potential impacts and provide adequate data for the design of flood and erosion control facilities. Improved hydraulic conveyance under the new bridges would benefit downstream channel segments, wetland areas, and open water habitats by decreasing scour along the stream bank near the bridge replacements and decreasing sediment inputs into downstream freshwater and marine habitats.

Through the development and implementation of site-specific BMPs outlined in the Stormwater Implementation Plan (Volume 9, Appendix G) there would be no increased risk from environmental hazards or to human health. Furthermore, all actions associated with Alternative 1 would be implemented in accordance with all applicable federal, local, and military orders, laws, and regulations (Volume 8, Chapter 3, Table 3.1-1), including COMNAV Marianas Instruction 3500.4. Therefore Alternative 1, Year 2030 in the Central Region would result in less than significant impacts to surface water.

Groundwater. In the northern part of the Central Region, potential impacts to groundwater quality could occur due to the addition of impervious surfaces that would likely contain sediment, nutrients, hydrocarbons, metals, bacteria, and other particulates that accumulate on roadway surfaces (such pollutants originate from routine roadway use and maintenance and from ambient atmospheric deposition). Increases in suspended sediment, hydrocarbons, oil and grease, and heavy metals during construction could also impact groundwater quality. Because the infiltration characteristics are so high, any surface water quality impact could also impact groundwater quality. Groundwater is the primary drinking water supply for the island; therefore, water quality protection would be important. Surface water quality protection measures discussed above would also serve to protect groundwater resources.

In the southern part of the Central Region, groundwater resources are very limited; hence, water quality impacts would generally apply to surface water resources and would mainly involve the bridge projects along Route 1. Therefore, Alternative 1, Year 2030 groundwater impacts in the Central Region would be less than significant.

Nearshore Waters. Potential construction impacts to nearshore waters resulting from implementation of Alternative 1, Year 2030 in the Central Region would be similar to the potential impacts discussed under Alternative 1, Year 2030 for the North Region (refer to Section 6.2.6.1, Year 2030). Therefore, Alternative 1, Year 2030 in the Central Region would result in less than significant impacts to nearshore waters.

Apra Harbor

The proposed GRN projects within the Apra Harbor Region include pavement strengthening, roadway rehabilitation along Route 11, and intersection improvements. Route 11 is the main entry to Apra Harbor and is shown to be within the coastal flood zone in the FEMA FIRMs. The Routes 1/11 interchange is located within the floodplain of the Masso River. Proposed improvements could have the following impacts to water resources:

- *Surface Water/Stormwater.* Potential impacts to surface water resources resulting from implementation of Alternative 1, Year 2030 in Apra Harbor would be similar to the potential impacts discussed under Alternative 1, Year 2030 for the North Region (refer to Section 6.2.6.1, Year 2030). Therefore, Alternative 1, Year 2030 in Apra Harbor would result in less than significant impacts to surface water.
- *Groundwater.* Potential impacts to groundwater resources resulting from implementation of Alternative 1, Year 2030 in Apra Harbor would be similar to the potential impacts discussed under Alternative 1, Year 2030 for the North Region (refer to Section 6.2.6.1, Year 2030). Therefore, Alternative 1, Year 2030 in Apra Harbor would result in less than significant impacts to groundwater.
- *Nearshore Waters.* Potential impacts to nearshore waters resulting from implementation of Alternative 1, Year 2030 in Apra Harbor would be similar to the potential impacts discussed under Alternative 1, Year 2030 for the North Region (refer to Section 6.2.6.1, Year 2030). Therefore, Alternative 1, Year 2030 in Apra Harbor would result in less than significant impacts to nearshore waters.

South

The proposed GRN projects within the South Region include improvements along Route 5 (pavement strengthening only) and Route 12 (relocation of MAPs). These routes are located within the upper reaches of the Atantano River and Namo River watersheds along the southwest portion of the island. The Atantano River flows westerly into the Inner Apra Harbor, while the Namo River flows westerly to Agat Bay. Proposed improvements could have the following impacts to water resources:

- *Surface Water/Stormwater*. Potential impacts to surface water resources resulting from implementation of Alternative 1, Year 2030 in the South Region would be similar to the potential impacts discussed under Alternative 1, Year 2030 for the South Region (refer to Section 6.2.6.1, Year 2030). Therefore, Alternative 1, Year 2030 in the South Region would result in less than significant impacts to surface water.
- *Groundwater*. Potential impacts to groundwater resources resulting from implementation of Alternative 1, Year 2030 in the South Region would be similar to the potential impacts discussed under Alternative 1, Year 2030 for the North Region (refer to Section 6.2.6.1, Year 2030). Therefore, Alternative 1, Year 2030 in the South Region would result in less than significant impacts to groundwater.
- *Nearshore Waters*. Potential impacts to nearshore waters resulting from implementation of Alternative 1, Year 2030 in the South Region would be similar to the potential impacts discussed under Alternative 1, Year 2030 for the North Region (refer to Section 6.2.6.1, Year 2030). Therefore, Alternative 1, Year 2030 in the South Region would result in less than significant impacts to nearshore waters.

Proposed Mitigation Measures

Most floodplain impacts are associated with the bridge rehabilitation/ improvement projects located along Route 1. A Floodplain Evaluation is required under the National Flood Insurance Program (23 Code of Federal Regulations 650, Subpart A § 650). Measures to mitigate floodplain impacts could include:

- Channel widening, channel lining, channel recontouring
- Pier placement/reconfiguration
- Utility line relocation where utilities cause obstructions to flow
- Debris removal, incorporation of debris noses upstream of piers and wingwalls
- Steepening of embankments using lining such as gabions

6.2.6.2 Alternative 2 (Preferred Alternative)

Peak construction and permanent impacts on water resources under Alternative 2 would be similar to those described under Alternative 1 because the same projects are proposed under this alternative with the exception of varying locations of the MAPs along Route 3.

Proposed Mitigation Measures

Proposed mitigation measures for Alternative 2 would be the same as those proposed for Alternative 1.

6.2.6.3 Alternative 3

Peak construction and permanent impacts on water resources under Alternative 3 would be similar to those described under Alternative 1 because the same projects are proposed under this alternative, with the exception of a few projects that would not be built as part of the GRN improvements program and varying locations of a few MAPs.

Proposed Mitigation Measures

Proposed mitigation measures for Alternative 3 would be the same as those proposed for Alternative 1.

6.2.6.4 Alternative 8

Peak construction and permanent impacts on water resources under Alternative 8 would be similar to those described under Alternative 1 because the same projects are proposed under this alternative, with the exception of a few projects that would not be built as part of the GRN improvements program and varying locations of a few MAPs.

Proposed Mitigation Measures

Proposed mitigation measures for Alternative 8 would be the same as those proposed for Alternative 1.

6.2.6.5 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam, the visiting aircraft carrier would berth at Kilo Wharf, and an Army Ballistic Missile Defense Task Force would not be positioned on Guam; therefore, the no-action alternative would obviate the need to improve roads necessary for the military relocation. Road improvements associated with the natural growth of Guam's population would continue and include several projects previously identified. These include projects to be constructed by the years 2014 and 2030. Projects to be in place by 2014 include pavement widening along Routes 10A and 27, and Tiyan Parkway, and intersection improvement projects along Routes 1 and 7. All of these projects are located within the Central Region. Projects to be in place by 2030 include pavement widening along Routes 2, 7A, 25, and 26 and intersection improvements located along Routes 1, 4, and 16. All of these projects are located within the Central Region, with the exception of the Route 2 widening, that is located in the South Region.

2010

Construction activities for the improvement projects to be completed by 2014 would commence in 2010 and would be typical of public works maintenance projects. Because the no-action alternative would involve significantly fewer projects to be constructed during the year 2014, construction impacts on water resources under this alternative would be less than with the action alternatives. Typical impacts to water resources from the proposed roadway improvements to be constructed in Year 2014 are described below.

Surface Water/Stormwater

Under the no-action alternative, Year 2010, there would be an increase in impervious surfaces and potential changes to drainage systems that include swales, storm drains, catch basins, and connecting stormwater treatment BMPs, such as detention basins. Increases in onsite drainage velocities and/or flow due to increased impervious area would be mitigated through the use of detention facilities, energy-dissipating devices at outlets, channel lining, use of grass swales or hydroseeded embankments where potential erosion could occur, incorporation of headwalls or flared end outlets, and use of appropriate stormwater treatment BMPs that would remove pollutants from the drainage system. Roadway-specific BMPs would be included in the planning, design, and construction for all proposed projects. An Erosion Control Plan is required by the GDPW for a Clearing and Grading Permit when the area to be graded is more than 5,000 ft^2 (464 m^2) or a proposed cut or fill is greater than 5.0 ft (1.5 m) in height. This stormwater plan would describe the impacts and proposed mitigation related to runoff and drainage. No impacts to floodplains are anticipated because no flood hazard zones have been designated where the proposed improvements are to take place.

Prior to starting construction, regulations set forth by GEPA require a Clearing and Grading Permit to be obtained from the GDPW. This permit requires development of an Environmental Protection Plan, which must incorporate compliance measures to protect marine and surface water resources, including the preparation of a Water Quality Monitoring Plan. An Erosion Control Plan is also required for clearing, grading, grubbing, embankment or filling, excavation, or other earth-moving operations. The Erosion Control Plan would describe construction site BMPs to be used during construction to minimize the impacts of construction and construction-related activities on the watershed. These include, but are not limited to, temporary soil stabilization, temporary sediment control, scheduling, waste management, materials handling, and other non-stormwater BMPs. In the event groundwater dewatering is proposed or anticipated during construction, and an alternative method of disposal (e.g., discharge to sanitary sewer, retention on site) is not feasible, then the Contractor would coordinate with the GDPW prior to discharging waste. Therefore, the no-action alternative, Year 2010, would result in less than significant impacts to surface water.

Groundwater

Under the no-action alternative, Year 2010, potential impacts to groundwater quality could occur due to the addition of impervious surfaces that would likely contain sediment, nutrients, hydrocarbons, metals, bacteria, and other particulates that accumulate on roadway surfaces (such pollutants originate from routine roadway use and maintenance and from ambient atmospheric deposition). Because the infiltration characteristics are high, any surface water quality impact could also impact groundwater quality. Groundwater is the primary drinking water supply for the island; therefore, water quality protection would be important. The same surface water quality protection measures discussed above would also serve to protect groundwater resources. Therefore, the no-action alternative, Year 2010, would result in less than significant impacts to groundwater.

Nearshore Waters

Under the no-action alternative, alterations to the watershed have the potential to result in indirect impacts that could alter the nearshore water quality; however, these potential effects would be minimized by complying with all applicable orders, laws and regulations presented in Volume 7, Chapter 3, Section 3.1. In addition, the aforementioned surface water resource protection measures would minimize potential indirect impacts to nearshore waters. No direct impacts to coastal resources would occur. Therefore, the no-action alternative, Year 2010, would result in less than significant impacts to nearshore waters.

2014

Potential impacts and proposed mitigation associated with the no-action alternative to water resources would be the same as those described for 2010 (refer to Section 6.2.6.4, Year 2010). Therefore, the no-action alternative, Year 2014, would result in less than significant impacts to water resources.

2030

Potential impacts and required mitigation associated with the no-action alternative to water resources would be the same as those described for 2009 (refer to Section 6.2.6.4, Year 2010). Therefore, the no-action alternative, Year 2030, would result in less than significant impacts to water resources.

6.2.6.6 Summary of Impacts

Table 6.2-6 summarizes the potential impacts of each alternative. A text summary is provided below.

Table 6.2-6. Summary of Potential Roadway Project Impacts

Potentially Impacted Resource	*Alternative 1*	*Alternative 2**	*Alternative 3*	*Alternative 8*
Floodplains	LSI	LSI	LSI	LSI
Runoff and Drainage	LSI	LSI	LSI	LSI
Coastal Resources	NI	NI	NI	NI
Surface Water Quality**	LSI	LSI	LSI	LSI
Groundwater Quality	LSI	LSI	LSI	LSI

Legend: LSI = Less than significant impact; NI = No impact. * Preferred Alternative. ** Includes floodplains, wetlands, streams, temporary and permanent impoundments and other aquatic habitats.

Construction activities would consist of intersection improvements, bridge/box culvert replacements, pavement strengthening, road relocation, road widening, and construction of a new road. With respect to water resources, all these types of improvements would generally have: (1) potential impact on floodplains where the bridge/box culvert replacement projects are proposed; (2) minor impact on runoff and drainage for all projects, possibly requiring relocation or adjustments of drainage catch basins and increasing roadway runoff due to the addition of impervious surfaces; (3) little to no direct impact to coastal resources because the projects do not involve work in the coastal bays or estuaries and most are located away from the coastline; (4) potential impact to surface water quality due to the addition of impervious surfaces that would likely contain sediment, nutrients, hydrocarbons, metals, bacteria, and particulates that accumulate on roadway surfaces (such pollutants originate from highway use and maintenance and from ambient atmospheric deposition) and due to erosion and siltation impacts in the drainage area during construction when heavy storms or high wind events occur; and (5) potential impact to groundwater quality in the north area of the island because soil infiltration characteristics are high in this area causing the potential for groundwater to be under the influence of surface water impacts.

Each of the action alternatives would include physical changes that would be considered potentially significant impacts on water resources. Roadways, bridges, drainage systems, stormwater pollution control systems, erosion control systems, and flood control systems would be designed in accordance with specific water resource considerations to prevent impacts to surface and groundwater resources, floodplains, coastal resources, and the overall runoff and drainage systems. Storm Water Pollution Prevention Plans, Environmental Protection Plans, Erosion Control Plans, and Location Hydraulic Studies for flood plains would be required prior to construction. All of these documents would be used to develop and implement proper measures to prevent water resource impacts.

Through the development and implementation of site-specific construction BMPs (Volume 2, Chapter 4, Table 4.2-1) and permanent BMPs (Volume 9, Appendix G), there would be no increased risk from environmental hazards or to human health. Furthermore, all actions associated with each alternative would be implemented in accordance with all applicable federal, local, and military orders, laws, and regulations (Volume 8, Chapter 3, Table 3.1-1), including COMNAV Marianas Instruction 3500.4.

6.2.6.7 Summary of Proposed Mitigation Measures

Table 6.2-7 summarizes the proposed mitigation measures for roadway project impacts to water resources.

Table 6.2-7. Summary of Proposed Mitigation Measures for Roadway Projects Impacts to Water Resources

Phase	*Mitigation Measure*
Construction	• Aquatic habitat enhancements at Camp Covington or other identified areas as required during the permit process.
Operation	• Channel widening, channel lining, channel recontouring • Pier placement/reconfiguration • Utility line relocation where utilities cause obstructions to flow • Debris removal, incorporation of debris noses upstream of piers and wingwalls

6.3 LEAST ENVIRONMENTALLY DAMAGING PRACTICABLE ALTERNATIVE

Stream channels that are potentially jurisdictional under the CWA would be impacted by bridge/box culvert replacements; therefore, the five bridge and three box culvert replacement projects included in this Environmental Impact Statement would be subject to Section 404 permitting requirements. All of the action alternatives include the eight bridge/box culvert replacement projects; therefore, an analysis of the *least environmentally damaging practicable alternative* as defined in the CWA is not necessary.

CHAPTER 7.
AIR QUALITY

7.1 INTRODUCTION

This chapter describes the potential environmental consequences associated with implementation of the alternatives within the four regions of influence (ROI) – North, Central, Apra Harbor, and South – for air quality resources. A description of the air quality resources in these four ROIs is provided in Section 5.1 of Volume 2 (Marine Corps Relocation – Guam), inclusive of a regulatory overview, stationary sources, mobile sources, ambient air quality modeling, climate, and greenhouse gas (GHG) emissions that are quantified in Volume 7, Chapter 3 for the preferred alternatives. The locations described in that Volume include the ROIs for the utilities and off base roadway project components of the proposed action.

7.2 ENVIRONMENTAL CONSEQUENCES

The comprehensive air quality consequences analysis performed in this Volume includes the following analysis components that examine potential impacts of utilities and roadway projects on Guam on air quality:

<u>Utilities</u>

- A discussion of microscale (localized) criteria pollutant analysis for each affected major Combustion Turbine (CT) under Basic Alternative including a dispersion modeling analysis for an affected CT under its permitted condition.
- A Clean Air Act (CAA) general conformity applicability analysis of direct and indirect sulfur dioxide (SO_2) emission increases that would result from the proposed action within the two SO_2 nonattainment areas on Guam that were identified in Volume 2, Section 5.1.
- A net incremental emissions analysis of criteria pollutants and GHGs in terms of carbon dioxide (CO_2) emissions with the potential to emit from the following stationary sources:
- Affected CT facilities
- Solid waste landfill facility
- Note that a full analysis of CO_2 equivalent compounds GHG contributions at the regional level is provided in Volume 7.
- A net incremental emissions analysis of criteria pollutants and CO_2 with the potential to emit from the following mobile sources during the construction period:
- Construction equipment and hauling trucks
- Workers’ commuting vehicles

<u>Roadway Projects</u>

- A microscale carbon monoxide (CO) analysis of potential impacts from local traffic at congested intersections
- A qualitative particulate matter (PM) and primary Mobile Source Air Toxic (MSAT) analysis
- A quantitative microscale MSAT analysis of potential impacts from local traffic at congested intersections and highest volume freeflow location using United States (U.S.) Environmental Protection Agency (USEPA)-recommended methodologies

- A net incremental emissions analysis of criteria pollutants and CO_2 emissions with the potential to emit from the following mobile sources during the construction period:
- Traffic-related on-road motor vehicle operations
- Roadway construction equipment and hauling trucks

Regional Analysis

The regional or mesoscale analysis of a project determines the overall impact of a project on regional air quality levels. A transportation project is analyzed as part of a regional transportation network developed by the county or state. Projects included in this network are found in Government of Guam's (GovGuam) Territorial Transportation Improvement Plan (GovGuam 2009) developed by the Department of Public Works. The Territorial Transportation Improvement Plan is the basis for the regional analysis; utilizing vehicle miles traveled (VMT) and vehicle hours traveled within the region to determine daily "pollutant burden" levels. The results of this analysis determine if an area is in conformity with regulations set forth in the USEPA's Final Transportation Conformity Rule.

Particulate Matter

On March 10, 2006, the USEPA issued a Final Rule regarding localized or "hot-spot" analyses of PM less than 2.5 microns in diameter ($PM_{2.5}$) and PM less than 10 microns in diameter (PM_{10}) (40 Code of Federal Regulations [CFR] Part 93). This rule requires that a $PM_{2.5}$ and/or PM_{10} hot-spot analysis be performed only for transportation projects with significant diesel traffic in areas not meeting $PM_{2.5}$ and/or PM_{10} air quality standards. The project area is classified as an attainment area for $PM_{2.5}$ and PM_{10}. The project is also not anticipated to generate significant additional diesel traffic. As such, a hot-spot analysis is not required. However, a qualitative hot-spot analysis was conducted following Federal Highway Administration (FHWA)/USEPA's March 29, 2006 joint guidance Transportation Conformity Guidance for Qualitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas (USEPA 2006).

Attainment of National Ambient Air Quality Standards (NAAQS)

The USEPA, under the requirements of the 1970 CAA, as amended in 1977 and 1990 (CAA Amendments), has established NAAQS for six contaminants, referred to as criteria pollutants (40 CFR 50). The regulations establish the NAAQS criteria in order to protect public health and the environment by limiting the amount of pollutants allowed in the ambient air. These six criteria pollutants are:

- CO
- Nitrogen dioxide (NO_2)
- Ozone, with nitrogen oxides (NO_x) and volatile organic compounds (VOCs) as precursors
- $PM_{2.5}$ and PM_{10}
- Lead
- SO_2

Areas where concentration levels are below the NAAQS for a criteria pollutant are designated as being in "attainment." Areas where a criteria pollutant level equals or exceeds the NAAQS are designated as being in "nonattainment." Based on the severity of the pollution problem, nonattainment areas are categorized as marginal, moderate, serious, severe, or extreme. Where insufficient data exist to determine an area's attainment status, it is designated as either unclassifiable or in attainment.

Components of the proposed action would occur in various locations on Guam. Many of the areas where the actions are proposed are currently designated as attainment areas for all criteria pollutants. There are two areas on Guam that are designated as attainment areas for CO, NO_x, ozone, PM, and lead, but are designated as nonattainment areas for SO_2, as follows:

- Piti: Portion of Guam within a 2.2-mile (mi) (3.5- kilometers [km]) radius of the Piti Power Plant
- Tanguisson: Portion of Guam within a 2.2 mi (3.5-km) radius of the Tanguisson Power Plant

On June 3, 2010 the USEPA issued a final new standard for SO_2, setting the 1-hour SO_2 standard at 75 parts per billion (ppb), a level designed to protect against short-term exposures ranging from 5 minutes to 24 hours. USEPA also revoked the previous 24-hour and annual SO_2 standards and anticipates that the attainment/nonattainment designation for the new standard will occur in 2012.

The primary contributors of SO_2 in the environment are from burning fossil fuels such as fuel oil like that used by power plants: gasoline used by vehicles and diesel fuel used by vehicles and non-road engines. One way that USEPA limits SO_2 emissions in the ambient air is to require the use of low sulfur fuels in power plants. It also requires the production and use of gasoline with a low sulfur content (termed “Tier 2 Standards”) and diesel fuel with low sulfur content. These requirements were promulgated as part of the CAA, and implemented in the CFR. These low sulfur fuels are readily available in the continental U.S. but not on U.S. Pacific Island Territories.

Although Guam is in nonattainment for SO_2 in the two areas around the Piti and Tanguisson power plants, on December 28, 2006 USEPA issued a partial waiver to Guam that conditionally exempts Guam from the requirements to use low sulfur fuels in its power plants and in gasoline that is used islandwide in vehicles. The exemption also applies to American Samoa and the Commonwealth of the Northern Mariana Islands. In its decision to grant the partial waiver, USEPA cited both economic and environmental reasons for granting the waiver as follows:

> “We are exempting American Samoa, Guam, and CNMI from the Tier 2 gasoline sulfur standard due to the high economic burden of compliance, isolated nature of the territories, both in terms of gasoline importation and pollution transport, and minimal air quality effects.”
>
> “Generally, the Far East market, primarily Singapore, supplies gasoline to the U.S. Pacific Island Territories. The Tier 2 sulfur standard effectively requires special gasoline shipments, which would increase the cost and could jeopardize the security of the gasoline supply to the Pacific Island Territories. The air quality in American Samoa, Guam, and C.N.M.I. is generally pristine, due to the wet climate, strong prevailing winds, and considerable distance from any pollution sources. We recognize that exempting the U.S. Pacific Island Territories from the gasoline sulfur standard will result in smaller emission reductions. However, Tier 2 vehicles using higher sulfur gasoline still emit 30% less hydrocarbons and 60% less nitrogen oxide (NO_X) than Tier 1 vehicles and negative effects on the catalytic converter due to the higher sulfur levels are, in many cases, reversible. Additionally, these reduced benefits are acceptable due to the pristine air quality, the fact that gasoline quality will not change, and the cost and difficulty of consistently acquiring Tier 2 compliant gasoline.”
>
> “Guam is in attainment with the primary NAAQS, with the exception of sulfur dioxide in two areas. This action is not expected to have any significant impact on the ambient air quality status of Guam, including the status of the two areas designated as nonattainment for sulfur dioxide. Both areas are designated nonattainment for SO_2 as a result of monitored

> and modeled exceedances in the 1970's prior to implementing changes to power generation facilities. In the 1990's both plants were rebuilt, upgrading their emission controls. Guam has submitted a redesignation request to the USEPA. That pending redesignation request shows that they are now in attainment. An emissions inventory shows that the power plants are the major source of SO_2 on Guam. Both plants are on the western side of the island. The Trade Winds blow persistently from east-to-west, further lessening the impact of the SO_2 emissions on the people of Guam from the power plants."
>
> "Mobile sources, like cars, are a minor contributor to the SO_2 emission budget. Exempting Guam from the Tier 2 gasoline sulfur and vehicle emission standards would not cause an increase in emissions. Guam has received enforcement discretion for the Tier 2 gasoline sulfur standards from the onset of the program and therefore the gasoline sent to Guam has not been required to meet the Tier 2 sulfur levels. Emissions from older vehicles will remain unchanged. Tier 2 vehicles using high sulfur gasoline will be cleaner than Tier 1 vehicles. Tier 2 vehicles using gasoline with 330 ppm sulfur emit 30% less hydrocarbons and 60% less NO_X than Tier 1 vehicles. While this rule will lead to a smaller reduction in emissions than would occur if the Tier 2 sulfur regulations are required, Guam's current air quality does not require further reductions. Because of Guam's remoteness, there are no cross border issues."

As cited in the USEPA waiver decision, both Piti and Tanguisson areas are designated nonattainment for SO_2 as a result of monitored and modeled exceedances in the 1970's prior to implementing changes to power generation facilities. Since that time, changes have been made to these power generation facilities. In accordance with 40 CFR Parts 80 and 86, both plants were rebuilt, upgrading their emission controls in the 1990s. Based on these improvements, Guam has submitted a redesignation request to USEPA. The pending redesignation request shows that the Piti power plant is now in attainment. However, it should be noted that the USEPA revised the short-term standard for SO_2 on June 3, 2010 from 140 ppb, averaged over 24 hours to 75 ppb, measured hourly. The future attainment/nonattainment designation of the new SO_2 hourly standard is anticipated to occur in 2012.

In addition, as both plants are located on the western side of the island and the trade winds blow persistently from east-to-west, the impact of the SO_2 emissions on the people of Guam from the power plants is reduced. Mobile sources, such as cars, are a minor contributor to SO_2 emissions. Despite the USEPA partial waiver, the Department of Defense (DoD) is currently working with relevant stakeholders, including USEPA, Guam Environmental Protection Agency (GEPA), Guam Power Authority (GPA), and suppliers to determine an appropriate strategy for implementing an islandwide switch to lower sulfur for diesel fuel. There are several ongoing logistics, economics, contracts, and regulatory issues, which must be resolved before an islandwide switch to ultra low sulfur fuel is committed.

MSAT Analysis

MSATs are hazardous air pollutants. USEPA has classified over 150 air toxics as MSATs. Of the 150 MSATs, 7 are identified as having significant contributions from mobile sources and are listed among the national and regional-scale cancer risk drivers (USEPA 1999): napthalene, acrolein, benzene, 1-3 butadiene, formaldehyde, polycyclic organic matter, and diesel PM plus diesel exhaust organic gases (diesel PM). This list is subject to change and may be adjusted in consideration of future USEPA rules.

As part of the National Environmental Policy Act (NEPA) process, Environmental Impact Statements (EISs) require review and evaluation of air toxics as they could affect the quality of the human environment. For these analyses, a tiered approach developed by the FHWA in the Interim Guidance

Update on Mobile Source Air Toxic Analysis in NEPA Documents (FHWA 2009) was used, which includes the following three levels of analysis:

- No analysis for projects with no potential for meaningful MSAT effects;
- Qualitative analysis for projects with low potential MSAT effects; or
- Quantitative analysis to differentiate alternatives for projects with higher potential MSAT effects.

Using this methodology, an initial MSAT analysis for this project indicated that it would have a low potential for MSAT effects. However, a quantitative MSAT analysis was developed for this project based on the methodology described in the research report *Analyzing, Documenting and Communicating the Impacts of Mobile Source Air Toxic Emissions in the NEPA Process* (American Association of State Highway and Transportation Officials [AASHTO] 2007).

The analysis approach was developed based on available project information, potential community impact, and the public's level of concern. Not only were the impacts of the project on localized MSAT levels raised as a concern with this project, but several intersections in the project area under the Build alternatives are projected to have Annual Average Daily Traffic (AADT) over the 40,000 threshold specified in the AASHTO report.

As a result, a screening-level MSAT dispersion modeling analysis was conducted based on the procedures provided in Appendix C of the AASHTO report to estimate whether the incremental health-related risk associated with the proposed project would exceed the following thresholds:

- A maximum total incremental carcinogenic risk from the exposure to all identified pollutants of 10 in a million (i.e., 10×10^{-6}); and
- A maximum total incremental non-carcinogenic Hazard Index risk from the exposure to all identified pollutants of 1.

The analysis focused on the potential impacts of operational emissions rather than construction phase emissions because the health-related risks, if any, associated with this project would primarily be the result of long-term exposure. This is because the roadway construction phase of this project is temporary (i.e., less than 5 years) and would occur at any given location for a relatively short period of time. Therefore, this analysis has focused on the long-term operational impacts of the project.

- A 30-year exposure duration was used in this analysis. This duration is based on recommendations included in USEPA's Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (USEPA 2005b). According to Table C-2-1 of this protocol, a reasonable maximum exposure duration for an adult resident is 30 years, and the reference given for this value is USEPA's Proposed Guidelines for Carcinogen Risk Assessment (USEPA 1996). In addition, this 30-year value is incorporated into Trinity's BREEZE Risk Analyst – Human Health Risk Software, which is an industry standard tool for conducting multi-pathway human health risk assessments. Comments from USEPA have suggested that a 70-year exposure duration should be applied to this analysis, rather than the 30-year exposure duration. Applying the 70-year exposure value would increase the predicted cancer risk value by approximately 2.4 times. The values reported in the tables presented in this document, represent the 30-year exposure duration. The effects of applying the more conservative 70-year exposure duration are discussed in the results of the analysis.

The following tasks were conducted for the dispersion modeling analysis:

- Local microscale sites (congested intersections) were selected for analysis.
- MSAT emission factors were estimated using USEPA's MOBILE6.2 model (Note: input parameters to accurately model MSAT were determined through consultation with USEPA and FHWA).
- CAL3QHCR dispersion modeling was conducted using worst case meteorology to estimate 1-hour concentrations of each MSAT, which were used to estimate acute (short-term) impacts. These 1-hour values were then converted, using conservative traffic and meteorological persistence factors, to annual values in order to estimate annual impacts.

Diesel PM was not quantitatively considered in the screening-level dispersion modeling analysis because of the significant limitations of the MOBILE6.2 model noted by the USEPA in the 2006 Conformity Rule (71 Federal Register 12498):

> ”We continue to believe that appropriate tools and guidance are necessary to ensure credible and meaningful PM2.5 and PM10 hot-spot analyses. Before such analyses can be performed, technical limitations in applying existing motor vehicle emission factor models must be addressed, and proper federal guidance for using dispersion models for PM hot-spot analysis must be issued. With the release of MOBILE6.2, state and local transportation agencies now have an approved model for estimating regional PM2.5 and PM10 emission factors in SIP [State Implementation Plan] inventories and regional emissions analyses for transportation conformity. However, MOBILE6.2 has significant limitations that make it unsatisfactory for use in microscale analysis of PM2.5 and PM10 emissions as necessary for quantitative hot-spot analysis.”

Federal guidance for using dispersion models for PM hot-spot analyses has not been issued. As a result, a qualitative analysis for diesel PM was completed based on FHWA/USEPA's March 29, 2006 joint direction Transportation Conformity Guidance for Qualitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas (USEPA 2006).

The seven priority MSAT compounds considered were as follows:

- Acrolein, benzene, 1,3-butadiene, formaldehyde, and naphthalene were analyzed quantitatively.
- Polycyclic organic matter was considered as being comprised of the following compounds, which were quantitatively analyzed on a pollutant-by-pollutant basis:
    - acenaphthene
    - acenaphylene
    - anthracene
    - benzo(g,h,i) perylene
    - benzo[b]fluoranthene
    - benzo[k]fluoranthene
    - benz[a]anthracene
    - benzo[a]pyrene
    - chrysene
    - dibenz[a,h]anthracene
    - fluoranthene
    - fluorene
    - ideno[1,2,3-cd]pyrene
    - phenanthrene, and
    - pyrene
- Diesel PM was analyzed qualitatively.

Absent the appropriate tools and guidance necessary to ensure credible and meaningful quantitative PM hot-spot analyses, a qualitative analysis of diesel PM was conducted. The objective of the analysis is to determine if the proposed project could produce levels in excess of the annual $PM_{2.5}$ NAAQS, which is designed to provide protection from the noncancer and premature mortality effects of $PM_{2.5}$ as a whole, of which diesel PM is a constituent. The two-step approach was adopted based on the March 10, 2006 Final Rule issued by the USEPA regarding the localized or "hot-spot" analysis of $PM_{2.5}$ (40 CFR Part 93): 1) apply criteria to determine if the project would involve a significant number of significant increase in the number of diesel vehicles; and 2) comparing air monitoring values from an area representative of project conditions. As previously discussed, the study area is classified as attainment for $PM_{2.5}$ NAAQS.

The criteria to determine if the project would involve a significant number or significant increase in the number of diesel vehicles are follows:

- New or expanded highway projects that have a significant number of or significant increase in diesel vehicles.
- Projects affecting intersections that are at Level of Service (LOS) D, E, or F with a significant number of diesel vehicles, or those that would change to LOS D, E, or F because of increased traffic volumes from a significant number of diesel vehicles related to the project.
- New bus and rail terminals and transfer points that have a significant number of diesel vehicles congregating at a single location.
- Expanded bus and rail terminals and transfer points that significantly increase the number of diesel vehicles congregating at a single location.
- Projects in or affecting locations, areas, or categories of sites which are identified in the PM2.5 applicable implementation plan or implementation plan submission, as appropriate, as sites of violation or possible violation.

Based on the above criteria, it is determined if the project is one of air quality concern with respect to $PM_{2.5}$.

Microscale CO Air Quality Analysis

Microscale air quality modeling was performed using the most recent version of the USEPA mobile source emission factor model (MOBILE6.2) (USEPA 2003) and the CAL3QHC (Version 2.0) air quality dispersion model (USEPA 1995b) to estimate future no-build (without the proposed project) and future build (with the proposed project) CO levels at selected locations in the project area.

Dispersion Model

Mobile source models are the basic analytical tools used to estimate CO concentrations expected under given traffic, roadway geometry, and meteorological conditions. The mathematical expressions and formulations that comprise the various models attempt to describe an extremely complex physical phenomenon as closely as possible. The dispersion modeling program used in this project for estimating pollutant concentrations near roadway intersections is the CAL3QHC (Version 2.0) dispersion model developed by USEPA and first released in 1992.

CAL3QHC is a Gaussian model recommended in the USEPA's Guidelines for Modeling Carbon Monoxide from Roadway Intersections (USEPA 1992). Gaussian models assume that the dispersion of pollutants downwind of a pollution source follow a normal distribution from the center of the pollution source.

Different emission rates occur when vehicles are stopped (i.e., idling), accelerating, decelerating, and moving at different average speeds. CAL3QHC simplifies these different emission rates into two components:

- Emissions when vehicles are stopped (i.e., idling) during the red phase of a signalized intersection
- Emissions when vehicles are in motion during the green phase of a signalized intersection

The CAL3QHC (Version 2.0) air quality dispersion model has undergone extensive testing by USEPA and has been found to provide reliable estimates of inert (i.e., nonreactive) pollutant concentrations resulting from motor vehicle emissions. A complete description of the model is provided in the User's Guide to CAL3QHC (Version 2.0): A Modeling Methodology for Predicting Pollutant Concentrations near Roadway Intersections (Revised) (USEPA 1995b).

Vehicular Emissions

Vehicular emissions were estimated using the USEPA MOBILE6.2 vehicular emission factor model (USEPA 2003). MOBILE6.2 is a mobile source emission estimate program that provides current and future estimates of emissions from highway motor vehicles. The latest in the MOBILE series, which dates back to 1978, MOBILE6.2 was designed by USEPA to address a wide variety of air pollution modeling needs and incorporates updated information on basic emission rates, more realistic driving patterns, separation of start and running emissions, improved correction factors, and changing fleet composition. It also includes impacts of new regulations promulgated since the previous version, MOBILE5b released in 1996.

Site Selection and Receptor Locations

A screening evaluation was performed to identify which intersections in the project area are most congested and most affected by the build alternatives. Sites fail the screening evaluation if (1) the LOS decreases below D in one of the build alternatives compared to the no-action alternative, or (2) if the delay and/or volume increase from the no-action alternative to build alternatives along with an LOS below D. The LOS describes the quality of traffic operating conditions, ranging from A to F, and it is measured as the duration of delay that a driver experiences at a given intersection. LOS A represents free-flow movement of traffic and minimal delays to motorists. LOS F generally indicates severely congested conditions with excessive delays to motorists. Intermediate grades of B, C, D, and E reflect incremental increases in congestion.

Determination of Significance

Potential project impacts were evaluated against the appropriate thresholds and regulations set forth by the federal and local government, including USEPA and GEPA.

7.2.1 Approach to Analysis

7.2.1.1 Methodology

Utility Stationary Sources

The following new or existing stationary sources are associated with the utility development:

- Major existing power generation facilities under the Basic Alternative described in Chapter 2.
- Wastewater treatment plant under Basic Alternative 1a and 1b and one long-term alternative.
- One Basic Alternative for solid waste landfill alternative.

The major facility-associated potential annual emissions under the basic alternatives are predicted based on the design capacities discussed in this EIS and on manufacturer-provided emission factors or using USEPA-approved emission factor models. USEPA emission factor models that were used include:

- USEPA AP-42 Compilation of Air Pollutant Emission Factors for Stationary Point and Area Sources (USEPA 1995a and after) – AP-42 provides emission factors for combustion source emissions
- Landfill Gas Emissions Model (LandGEM) (USEPA 2005c) – LandGEM is a screening tool to assist in estimating emission rates for total landfill gas, methane, CO_2, and non-methane VOCs from municipal solid waste landfills

A detailed discussion on emissions estimates is provided in Volume 9, Appendix I, Sections 3.1 and 3.2. Note that the existing CTs use a maximum sulfur content of 0.6 percent (%).

Annual emissions thresholds for air pollutants for a major source and a major source modification are summarized in Table 7.2-1. If sources with annual emission levels exceed the threshold of a major stationary source or major modification of the existing major stationary source, microscale ambient concentration levels from these sources are predicted and compared with the applicable significance thresholds. The analysis is conducted in accordance with the NEPA requirements, and the air permitting requirements established in various USEPA programs and GEPA's Air Pollution Control Standards and Regulations § 1104.6 (c) (12) (ix) (GEPA 2004).

Table 7.2-1. Applicable Major Source and Major Modification Thresholds

Pollutant	*Major Source Threshold (TPY)*	*Major PSD Source Threshold (TPY)*	*Major Modification Threshold (TPY)*
SO_2	100	250/100[a]	40
CO	100	250/100[a]	100
PM_{10}	100	250/100[a]	15
NO_x	100	250/100[a]	40
VOCs	100	250/100[a]	40

Note: [a] 100 TPY applies to certain sources such as fossil fuel fired steam electric plants with more than 250 British thermal unit per hour heat input.

Legend: CO = carbon monoxide; NO_x = nitrogen oxides; PM_{10} = particulate matter less than 10 microns in diameter; PSD = Prevention of Significant Deterioration; SO_2 = sulfur dioxide; TPY = tons per year; VOC = volatile organic compound.

Source: 40 CFR 52.

As discussed in Section 5.1 of Volume 2, Prevention of Significant Deterioration (PSD) regulations were established by the USEPA to ensure that air quality in clean (attainment) areas does not significantly deteriorate and that a margin for future industrial growth is maintained. This is to be accomplished by requiring major emission sources and major modifications to employ the Best Available Control Technology to curb air pollutant emissions.

According to CAA regulations, a facility is considered to be a major source when annual emissions exceed 100 tons per year (TPY) of any criteria pollutants in an attainment area or a SO_2 nonattainment area. Under the PSD regulations, last modified under the 1990 CAA Amendments (42 U.S. Code §§7470-7479), a facility is considered to be a major stationary source when annual emissions exceed 250 or 100 TPY of attainment pollutants, depending on the specific source category. Examples of source categories with a 100 TPY major stationary source threshold include fossil-fuel-fired steam electric plants with more than 250 British Thermal Units per hour heat input and many specific types of plants, mills, and smelters. For an existing major stationary source, the net emission increase of each attainment pollutant that exceeds a specified significant emission increase level is considered to be a major modification that is subject to the provisions of the PSD regulations and a PSD New Source Review (NSR).

Because Guam has two nonattainment areas for SO_2, a nonattainment NSR would be required by the project for SO_2 if the proposed stationary facility and the existing major stationary source modification within the SO_2 nonattainment area exceed the nonattainment NSR threshold. If applicable, the new sources would likely be required to use Lowest Achievable Emission Rate technology, obtain emission offsets to satisfy the nonattainment NSR regulatory requirements, and reduce overall emissions facility-wide. Nonattainment area-specific regulations on emission offsets are provided in Guam Air Pollution Control Standards and Regulations § 1105.4 and § 1105.5 (GEPA 2004).

Air dispersion modeling was conducted only for the Marbo CT facility, an affected existing major source (under the Basic Alternative), for which the compliance demonstration of the NAAQS cannot be found, the estimated emission rates were further used in ambient concentration dispersion modeling, as discussed below.

The dispersion modeling approach is designed to estimate near-field impacts, defined as within a 31-mi (50-km) transport radius (USEPA 2005c). The modeling approach was developed in accordance with the following USEPA guidance:

- Guideline on Air Quality Models (Revised), incorporated as Appendix W of 40 CFR Part 51, Federal Register Revision to the Guideline on Air Quality Models (USEPA 2005a)
- Draft NSR Workshop Manual (USEPA 1990)

The USEPA-recommended regulatory dispersion model for near-field applications, American Meteorological Society/USEPA Regulatory Model (AERMOD) (USEPA 2007), was used for the Basic Alternative impact analysis. AERMOD is a steady-state plume dispersion model that simulates transport and dispersion from multiple point, area, or volume sources based on an up-to-date characterization of the atmospheric boundary layer. The model employs hourly sequential pre-processed meteorological data to estimate concentrations for selected averaging times ranging from 1 hour to 1 year.

Because the existing sources to be impacted under the basic alternative are located inland in areas remote from coastal effects, and under the influence of the relatively constant nature of the trade winds, the near-source steady-state regulatory model, AERMOD, is an appropriate tool for estimating air impacts from the affected existing major stationary sources.

The hourly emission rates and the daily and annual emission rates, as appropriate, from the existing sources to be utilized under the Basic Alternative were used as the inputs to AERMOD in order to determine both long-term (annual) and short-term (24-hour average or shorter) impact concentration levels with respect to the applicable impact thresholds.

A detailed discussion of dispersion modeling methodology, meteorological data, receptor grid used, and dispersion modeling results is provided in Volume 9, Appendix I, Section 3.1 Major Sources.

Utility Construction Mobile Sources

Potential air quality impacts from mobile sources were evaluated in terms of net incremental annual emissions levels for each criteria pollutant and CO_2 associated with each source type and the annual activity level. The mobile sources considered in this evaluation include construction equipment and hauling truck emissions during the utility resources construction period. Construction activities involving the operation of construction equipment, trucks, and workers' commuting vehicles may have short-term air quality impacts.

In order to predict construction emissions, estimates of construction crew and equipment requirements and productivity including the hours of equipment use were made, based on the data presented in 2003 RSMeans Facilities Construction Cost Data (RSMeans 2003) and 2006 RSMeans Heavy Construction Cost Data (RSMeans 2006). Given the lack of a specific construction schedule for each applicable project during the early planning stage, the overall length of utility construction for each project is assumed to be 4 years from 2011 through 2014. The subsequent emissions for construction were evenly distributed over the 4-year construction period to determine the average annual emissions levels.

The weekly duration for each activity was assumed to be 8 hours per day, 5 days per week. The emissions estimate assumes for only one piece of equipment because the same amount of construction activities can be accomplished by using one piece of equipment for 1 week, or can be shortened to half a week by using two pieces simultaneously. The key input in the emissions calculations is the total number of equipment hours required to complete the work. Therefore, the input of one piece of equipment used in the calculations is only for the purposes of completing them and does not reflect the actual number of pieces equipment that would be used on site during construction.

Estimates of construction equipment operational emissions were based on (1) the estimated hours of equipment use as described above, and (2) the emission factors for each piece of equipment, as provided by the USEPA in the nonroad emission factor model based on the national default model inputs (USEPA 2008). The average equipment horsepower values and equipment power load factors are also provided in association with the nonroad emission factors.

A maximum sulfur content of 0.5% was used based on USEPA's Heavy-Duty Standards/Diesel Fuel Regulatory Impact Analysis (USEPA 2000). Based on the Regulatory Impact Analysis, data observed in 1992 shows that No. 2 diesel fuel imports actually had sulfur content ranging from 0.39% to 0.5%. Therefore, using the actual highest sulfur content observed in 1992 (0.5%) for vehicles in this analysis is considered appropriate and conservative and is also coincident with the highest sulfur content fuel input available in the nonroad model. It should also be noted that with the introduction of the Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements (40 CFR Parts 69, 80, and 86) in 2006, refiners were required to start producing diesel fuel for use in highway vehicles with a sulfur content of no more than 15 parts per million (ppm) (i.e., 0.0015% content). Therefore, the sulfur content of fuels since 1992 has decreased in general although Guam has been granted an exemption from using low sulfur fuel (see Section 7.2 of this Volume). The DoD is currently examining the potential use of ultra low sulfur fuel for construction activities and highway diesel vehicles on Guam, so that the actual sulfur content may be far lower than the level used in the analysis.

Because the operational activity data presented in RSMeans' books are generated based on the overall duration of equipment presence on site, an equipment actual running time factor (i.e., actual usage factor) was further employed to determine actual equipment usage hours for the purposes of estimating equipment emissions. The usage factor for each equipment type was obtained from FHWA's Roadway Construction Noise Model User's Guide (FHWA 2006). Emission factors related to construction-associated delivery trucks and workers' commuting vehicles were estimated using the USEPA Mobile6 emission factor model (USEPA 2003). The detailed methodology used to calculate these emissions is presented in Volume 9, Appendix I, Section 3.4 Construction Activity Emissions.

Under the General Conformity Rule (GCR), emissions associated with all operational and construction activities from a proposed federal action, both direct and indirect, must be quantified and compared to annual *de minimis* (threshold) levels for pollutants that occur within the applicable nonattainment area. Direct emissions are emissions of a criteria pollutant or its precursors that are caused or initiated by a federal action and occur at the same time and place as the action. Indirect emissions are emissions occurring later in time and/or further removed in distance from the action itself. Indirect emissions must be included in the determination if both of the following apply:

- The federal agency proposing the action can practicably control the emissions and has continuing program responsibility to maintain control
- The emissions caused by the federal action are reasonably foreseeable

As previously mentioned, Guam has two SO_2 nonattainment areas around the Piti and Tanguisson power plants. The emissions from both stationary and mobile sources with potential to occur within the two SO_2 nonattainment areas were quantified using the same methodologies discussed previously for both stationary and mobile sources. If a proposed stationary and/or mobile source emission level is below the *de minimis* threshold, it is exempt from the GCR. Also, according to the GCR, if a proposed stationary source is a major stationary source or major PSD source, and/or a proposed existing major source modification is a major modification that is required to be in compliance with the PSD and/or nonattainment NSR programs, it is exempt from the GCR. Therefore, the operational emissions from this source or source modification are not considered in the general conformity applicability analysis.

Estimates of direct and indirect annual emissions within SO_2 nonattainment areas for utility resources are described in detail in Volume 9, Appendix I, Section 3.6 CAA General Conformity Applicability Analysis.

Roadway Mobile Sources

The primary on-road vehicle-related air pollutants are CO, PM, NO_x, and VOCs (NO_x and VOCs are precursors to the formation of ozone). MSAT are also a concern. The project-level air quality impacts of traffic-related projects are generally evaluated on the following two scales for specific pollutants:

- Microscale (hot-spot) level for CO, PM (PM_{10} and $PM_{2.5}$) and MSAT. A microscale analysis of traffic-related impacts at intersections or free flow sites provides estimates of localized pollutant concentrations for direct comparison to the NAAQS and/or applicable impact thresholds.
- Mesoscale (regional) level for NO_x, VOC, CO, and PM (PM_{10} and $PM_{2.5}$). Emissions of these typical pollutants are calculated on a mesoscale basis to provide a comparison of regional emissions among alternatives.

On-road vehicular emissions impacts are predicted to estimate the CO concentration levels at the worst-case congested intersections under future conditions with and without the proposed action. If the model-predicted CO levels are below the NAAQS at the worst-case congested intersections, the traffic-related microscale air quality impacts are expected to be in compliance at other less-congested intersections where lower emissions would be generated.

Though the potential traffic-related PM ($PM_{2.5}$ and PM_{10}) impact hot-spot analyses were not warranted based on the attainment status of the study area, a qualitative analysis was conducted. This rule requires that a PM_{10} and/or a $PM_{2.5}$ hot-spot analysis be performed only for transportation projects with substantial diesel traffic in areas not meeting PM_{10} and/or $PM_{2.5}$ air quality standards. Refer to MSAT Analysis for Diesel PM in Section 7.2 of this Volume.

The mesoscale vehicular and roadway construction emissions of criteria pollutants as well as GHG emissions in terms of CO_2 emissions were also considered through an estimate of vehicular emissions on the affected roadway system on Guam and construction equipment emissions during roadway construction. GHG emissions in terms of CO_2 equivalent compounds are presented in Volume 7 for all proposed alternatives, as these emissions are evaluated on a regional, rather than local level.

7.2.1.2 Determination of Significance

The selected impact thresholds (significance criteria) for making a determination of the significance of impact using the analysis approach outlined in the previous section are summarized in Table 7.2-2 along with measuring metrics for individual utilities and roadway project mobile sources.

Table 7.2-2. Impact Analysis Thresholds

Emission Sources	*Measuring Metric*	*Significance Criteria*
Utility Operation and Construction Emissions		
CT Facility	Criteria pollutant concentration from each affected existing CT facility	NAAQS
Solid waste landfill	VOC emission	250 TPY [a] (PSD major stationary source threshold)
Construction of power, water, wastewater and landfill facilities	Criteria pollutant emissions	
Construction mobile source and non-major stationary source operation within nonattainment areas	SO_2 annual emissions in Piti and Tanguisson nonattainment areas	100 TPY[a] (*de minimis* level)
Roadway Project Mobile Sources		
On-road vehicles	CO concentration	NAAQS
On-road vehicles	PM and air toxics emissions and/or concentrations	Health Risk Assessment [b]: Project of Air Quality Concern for PM. Incremental carcinogenic risk greater than 10 in a million. Incremental non-carcinogenic hazard index less than 1.
Mesoscale on-road vehicle emissions and roadway construction emissions	Criteria pollutant emissions	250 TPY[a] (PSD major stationary source threshold)
All sources with emission factor data	CO_2 Eq emissions	NA

Notes: [a] Emissions from corresponding source activities are combined with the emissions from other components of the proposed action and presented in Volume 7. These impact significance threshold are considered as de minimis levels and are used to make an impact determination from a disclosure comparison with the combined annual emission levels. However, if such levels are exceeded for a specific pollutant, a further formal analysis is considered, when appropriate, in order to make a formal determination of impact significance.

[b] A health risk assessment is not required, but is being performed on the request of USEPA.

Legend: CO = carbon monoxide; CO_2 Eq = carbon dioxide equivalent compound; CT = Combustion Turbine; NA= not applicable; NAAQS = National Ambient Air Quality Standards; PM = particulate matter; PSD = Prevention of Significant Deterioration; SO_2 = sulfur dioxide; TPY = tons per year; VOC = volatile organic compound.

Microscale Concentration Impact

For major emission source impacts where no compliance demonstration of NAAQS was performed historically or found, the NAAQS shown in Table 7.2-3 were used to evaluate the impact significance potentially resulting from the proposed operations of each affected existing CT within its individual permitted capacity under the basic alternative. If a predicted concentration under the CT permitted condition showed no exceedances of the corresponding NAAQS, the operation of the affected existing CT is not considered to have a significant impact for that specific criteria pollutant. Conversely, if the

NAAQS are predicted to be exceeded, a further mitigation modeling analysis of the affected existing major sources would be required to eliminate the potential NAAQS exceedance.

Table 7.2-3. National Ambient Air Quality Standards

Pollutant	*Averaging Period*	*NAAQS (µg/m^3)*
NO_2	Annual	100
SO_2	Annual 24-hour 3-hour	80 365 1,300
PM_{10}	24-hour	150
$PM_{2.5}$	Annual 24-hour	15 35
CO	8-hour 1-hour	10,000 40,000

Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standard; NO_2 = nitrogen dioxide; $PM_{2.5}$ =particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; µg/m^3 = microgram per cubic meter.

For traffic-related microscale impacts, the predicted CO concentrations at the worst-case congested intersections were compared with the CO NAAQS to determine the potential significance of traffic-related microscale air quality impacts. Additionally, the MSAT analysis uses the MSAT thresholds established in the AASHTO 2007 research report to evaluate potential health risk, as per the USEPA recommendation.

GCR *de minimis* Threshold

Under the GCR, total emissions resulting from the proposed federal actions must be compared to applicable *de minimis* levels on an annual basis. As defined by the GCR, if the emissions of a criteria pollutant (or its precursors) do not exceed the *de minimis* level, the federal action has minimal air quality impact and the action is determined to be in conformity for the pollutant under study. Therefore, no further analysis is necessary. Conversely, if the total direct and indirect emissions of a pollutant are above the *de minimis* level, a formal general conformity determination is required for that pollutant. According to the GCR, the *de minimis* level applicable to the two nonattainment areas on Guam is 100 TPY for SO_2. Therefore, if the total direct and indirect emissions of SO_2 are below 100 TPY, no formal conformity determination is required and no significant air quality impact would result from the implementation of the proposed action.

It should be noted that according to the GCR, if a proposed stationary source is a major stationary source or major PSD source and/or a proposed existing major source modification is a major modification that is required to be in compliance with the regulations established in the PSD and/or nonattainment NSR programs, the emissions from this source are exempt from the general conformity requirement. Therefore, the proposed operational emissions from those PSD/NSR sources within the nonattainment area should not be included in the comparison with the SO_2 *de minimis* criterion.

Mobile Source and Non-Major Stationary Source Incremental Emissions

Under the CAA, motor vehicles, other self-propelled vehicles with internal combustion engines, and non-self-propelled non-road engines are exempt from air-permitting requirements. The GCR is not applicable to these mobile source emissions associated with the construction and operation of the proposed improvements in areas that are in attainment of the NAAQS for all criteria pollutants. Nonetheless, NEPA and its implementing regulations require analysis of the significance of air quality impacts from these sources, as well as non-major stationary sources. However, neither NEPA nor its implementing regulations have established emissions criteria for determining the significance of air quality impacts from such sources in CAA attainment areas.

In the GCR applicable to nonattainment areas, USEPA uses the “major stationary source” definition under the NSR program as the *de minimis* level to separate presumably exempt actions from those requiring a positive conformity determination. Because the proposed action and alternatives would occur mostly in areas that have always been in attainment, the EIS selected the “major stationary source” definition (≥ 250 TPY of any air pollutant is subject to regulations under the CAA) from the PSD program. The “major stationary source” definition applies to locations that are in the attainment area as the criteria for determining the potential significance of air quality impacts from these sources.

As noted above, neither the PSD permitting program nor the GCR are applicable to mobile sources and non-major stationary sources in attainment areas. Therefore, the analysis of construction and operational incremental emissions from these sources in attainment areas and the significance criteria selected (250 TPY) are solely for the purpose of informing the public and decision makers about the relative air quality impacts from the proposed action and the alternatives under NEPA. However, since the 250 TPY threshold is selected in the context of the *de minimis* threshold established in the GCR providing only an indication of potential significant impact, a further formal impact analysis should be conducted if such threshold is exceeded, where appropriate. For example, CO is a localized pollutant, if the 250 TPY threshold is exceeded for CO, a subsequent dispersion modeling for major emission contributing sources is conducted to further evaluate potential impact significance with respect to the NAAQS.

7.2.1.3 Issues Identified During Public Scoping Process

The impact analyses focus on addressing potential air quality impacts from the proposed utility and roadway improvement actions. As part of the analyses, public concerns, including those of regulatory stakeholders, raised during public scoping meetings that relate to air quality effects were addressed (if sufficient project data and available impact criteria were available). Concerns relating to potential air quality impacts are listed below:

- Increase in vehicle and vessel emissions, and need for disclosure of available information of health risks associated with vehicle emissions and MSAT
- Increase in emissions from existing power sources due to power demand or construction of new power sources
- Increase in construction-related emissions and impacts including emissions estimates of criteria pollutants and diesel PM from construction of alternatives
- Compliance with the GCR in siting project facilities
- Emissions mitigation plans during construction
- Discussion of a potential installation of an air quality monitoring network on Guam
- Discussion of project elements that would be major contributors to GHGs and identification of practices or project elements to reduce GHGs
- Need to control and monitor the relocation activities to ensure good air quality on Guam

7.2.2 Power

7.2.2.1 Historical Monitoring Observations and Existing Background Conditions

The existing major source contributions under current operational conditions around the ROIs where the CT reconditioning actions would occur were evaluated. The ROIs with the potential to be affected by the proposed power improvement actions include North, Central, and Apra Harbor.

The GovGuam has not collected ambient air quality data since 1991. Therefore, no existing ambient air quality data are available to represent current air quality conditions with respect to the criteria pollutants for which the NAAQS were established. Historical data are available from 1972 through 1991, when ambient air quality data were collected at a number of sites through a USEPA-sponsored monitoring program. The monitored pollutants were total suspended particles (TSP), SO_2, NO_2, and nitrogen monoxide. In 1991, PM_{10} was monitored in addition to TSP.

Prior to 1991, TSP were monitored at 20 sites, SO_2 at 14 sites, NO_2 at five sites, and nitrogen monoxide at one site. In 1991, PM_{10} was monitored at four sites.

In addition to the historical monitoring identified above, the GPA established a network of five stations to measure SO_2 at locations that are not downwind or close to any major electrical generating units during normal trade wind conditions from the fall of 1999 through the summer of 2000. All of the observed SO_2 concentrations were below the 24-hour NAAQS. According to 40 CFR Parts 80 and 86, Guam has submitted a redesignation request to USEPA for the Piti power plant. That pending redesignation request shows that the Piti power plant is now in attainment; however, USEPA has not taken action on this request, so the area remains in a nonattainment status. USEPA did, however, recognize the need for this redesignation in their decision to allow a waiver for the use of low sulfur fuels in power plants and vehicles in Guam (see Section 7.2, “National Ambient Air Quality Standards”). An emissions inventory shows that the power plants are the major source of SO_2 on Guam. Both plants are on the western side of the island. The trade winds blow persistently from east-to-west, further lessening the impact of the SO_2 emissions on the people of Guam from the power plants. Mobile sources, like cars, are a minor contributor to the SO_2 emission budget.

The areas around affected existing sources (Figure 7.2-1) under the Basic Alternative are in attainment areas. Ambient air quality conditions are expected to be affected by existing stationary source operations and other minor source operations such as vehicular traffic. Given the lack of existing ambient background levels, the applicable modeling results for each affected CT under its permitted capacity were compared directly with the NAAQS to determine potential impact significance.

7.2.2.2 Basic Alternative

Basic Alternative would recondition up to 5 existing CTs and upgrade Transmission and Distribution (T&D) systems and would not require new construction or enlargement of the existing footprint of the facilities. These reconditioned units would have the necessary reliability to serve as reserve capacity to ensure reliable operation of the Island-Wide Power System. They would serve as peaking and reserve units.

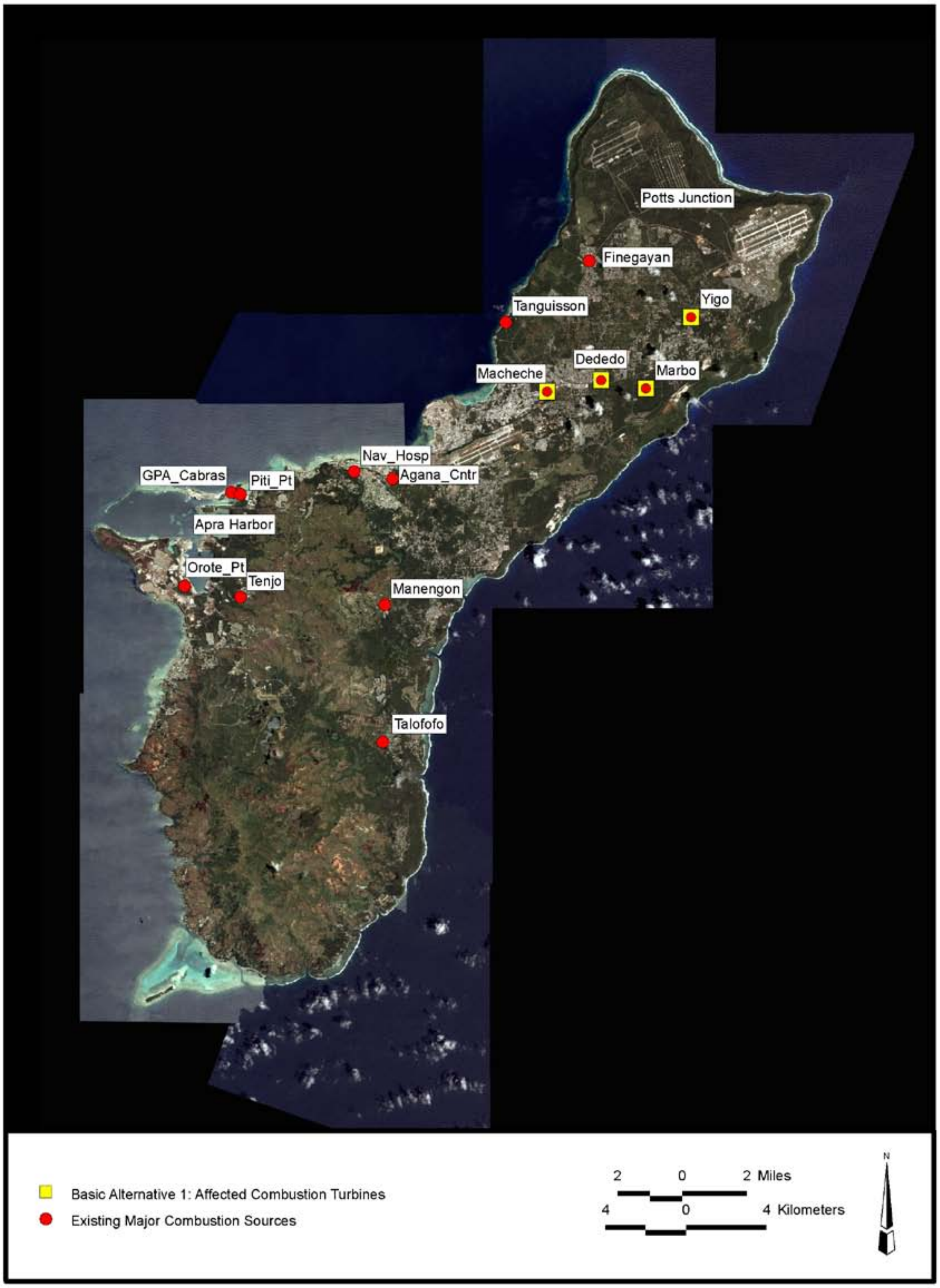


Figure 7.2-1. Locations of Major Existing Electrical Generating Unit Sources on Guam

This work would be undertaken by the GPA on its existing permitted facilities, and potentially utilize a special purpose entity to obtain funds, recondition the CTs, install the T&D upgrades, and operate the CTs for a fee to enable repayment of the financing. Reconditioning would be made to existing permitted facilities at the Marbo, Yigo, Dededo, and Macheche CTs. These CTs are not currently being used up to permit limits. T&D system upgrades would be on existing above ground and underground transmission lines. This alternative supports Main Cantonment Alternatives 1 and 2 and Main Cantonment Alternatives 3 and 8 would require additional upgrades to the T&D system.

Construction

Table 7.2-4 presents the total annual construction emissions for Basic Alternative that were calculated for the utilization and repair of the CTs, and associated facility transmission line upgrade, using the methodology described in Section 7.2.1.1 and described in Volume 9, Appendix I, Section 3.4.

Table 7.2-4. Total Annual Construction Emissions – Basic Alternative

	Pollutant						
Construction Activity	*SO_2*	*CO*	*PM_{10}*	*$PM_{2.5}$*	*NO_x*	*VOC*	*CO_2*
Total Annual Emissions (TPY)	0.1	3.8	0.0	0.0	0.4	0.1	52.0

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns per diameter; SO_2 = sulfur dioxide; TPY = tons per year; VOC = volatile organic compound.

Operation

Potential increases of air emissions, as compared to the actual affected operational conditions of the existing CTs, are anticipated from the proposed action. For NEPA disclosure purposes, the annual emissions above the current actual condition were estimated based on the anticipated total number of hours in power output required at each affected CT under the peaking condition and summarized in Table 7.2-5. The operation of reconditioned CTs (at Marbo, Dededo, Yigo, and Macheche) is anticipated to require up to a total of 2,500 hours increase (maximum) from the baseline. The air emission impact analysis calculations assume an average of 500 hours per CT. A detailed calculation is discussed in Volume 9, Appendix I, Section 3.1.4.4.

Table 7.2-5. Net Increase in Annual Emissions – Basic Alternative

	Pollutant						
Affected Source	*SO_2*	*CO*	*PM_{10}*	*NO_x*	*VOC*	*CO_2*	*HAP*
Dededo CT#1	54.5	5.3	5.0	20.8	1.0	7,695.9	0.12
Dededo CT#2	54.5	5.35	5.0	20.8	1.0	7,695.9	0.12
Yigo	31.3	5.5	5.0	14.05	1.0	7,361.3	0.07
Marbo	16.2	5.5	1.6	9.1	2.6	5,353.7	0.08
Macheche	31.3	5.5	5.0	14.0	1.0	7,361.3	0.07
Combined Sources	187.7	26.9	21.5	78.5	6.6	35,468.3	0.46

Legend: CO = carbon monoxide; CO2 = carbon dioxide; CT = Combustion Turbine; HAP = Hazardous Air Pollutant; NOx = nitrogen oxides; PM_{10} = particulate matter less than 10 microns per diameter; SO2 = sulfur dioxide; VOC = volatile organic compound.

It is anticipated that the limited increase in power required under the proposed action would be well below the permitted capacity at each affected CT for which the compliance of any applicable CAA air quality standards should have been already demonstrated during the air permitting process when GPA obtained the air permit for each affected source. Based on record searches, it was found that GPA conducted a health-based NAAQS compliance analysis for the Dededo, Macheche, and Yigo power facilities as listed below:

- PSD Air Quality Impact Analysis for Dededo Facility (GPA 1992b).
- Environmental Impact Assessment for Proposed Macheche Generating Facility (GPA 1992a).
- Environmental Impact Assessment for Proposed Yigo Generating Facility (GPA 1993).

According to these documents, the CTs that would be potentially affected by the proposed action in Dededo, Macheche, and Yigo facilities (operating under the permitted conditions) were modeled and demonstrated to be in compliance with the NAAQS.

However, a health-based NAAQS compliance analysis was not found at this time for the Marbo CT facility. The DoD in coordination with GPA conducted an ambient concentration dispersion modeling analysis, using the methodology described previously in Section 7.2.1, for the Marbo CT facility under its permitted capacity. The modeling results (Table 7.2-6) show that the affected Marbo CT facility would be in compliance with the NAAQS under its permitted condition. Detailed modeling discussions are presented in Volume 9, Appendix I, Section 3.1.4.

Table 7.2-6. Predicted Criteria Pollutant Concentrations at Marbo

Pollutant	*Station Name*	*Averaging Period*	*Concentration (µg/m3)*	*Distance (m)*	*NAAQS (µg/m3)*
SO_2	Marbo	3-hour	447.9	99	1,300
	Marbo	24-hour	145.3	99	365
	Marbo	Annual	2.3	301	80
NO_2	Marbo	Annual	0.9	301	100
CO	Marbo	1-hour	92.6	99	40,000
	Marbo	8-hour	57.4	99	10,000
PM_{10}	Marbo	24-hour	3.1	201	150
$PM_{2.5}$	Marbo	24-hour	1.2	401	35
	Marbo	Annual	0.1	301	15

Legend: CO = carbon monoxide; m = meter; NAAQS = National Ambient Air Quality Standard; NO_2 = nitrogen dioxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; $\mu g/m^3$ = microgram per cubic meter.

Because the overall permitted capacity and the operational scheme for these CTs would not change, the resulting potential air quality impact would remain the same as the current permitted conditions and in compliance with the NAAQS.

Although it is concluded that the operation of affected CTs would not result in a significant health-based air quality impact, whether a major permit modification is required at any of these CTs remain to be determined. There is an ongoing DoD CT study to determine the specific repairs needed to recondition the CTs. Based on the study, if it is determined that Title V modifications (including PSD modifications for PSD sources) are required for one or more of the CT facilities, then modifications to the respective Title V permits would be obtained prior to the commencement of any reconditioning activities and would result in a less than significant impact.

Proposed Mitigation Measures

There would be no significant impacts from construction emissions under this alternative. Proposed mitigation measures, if applicable to combined construction activity-associated emissions, are discussed in Volume 7 where the combined air quality effects are addressed.

Since no significant operational air quality impact would occur under this alternative, mitigation measures would not be required.

7.2.2.3 Summary of Impacts

Table 7.2-7 summarizes the potential air quality impacts associated with Basic Alternative. Construction activities for this alternative would result in less than a significant impact to air quality resources because the existing power facility reconditioning associated emissions were well below the significance criterion of 250 TPY. Operational activities for Basic Alternative would also result in less than significant impacts to air quality resources because required power output would be within the CAA Title V permitted capacity for each affected existing facility. Since the affected existing facilities had demonstrated their compliance under the permitted condition with all CAA regulations and standards in obtaining Title V permits, Basic Alternative would result in less than a significant impact.

Table 7.2-7. Summary of Potential Air Quality Impacts – Power

	Basic Alternative
Power	LSI

Legend: LSI = Less than significant impact.

7.2.3 Potable Water

Water resource facilities to provide potable water for the proposed action would consist of various water pumps operated periodically for a number of processes. Water pumps are expected to be powered by electricity; therefore, no air emissions would be generated during water pumping operations. The potential air quality impacts addressed in this chapter only include estimates of air emissions associated with the construction of water resources.

7.2.3.1 Basic Alternative 1 (Preferred Alternative)

Basic Alternative 1 would provide additional water capacity of 11.3 MGd (42.8 MLd), which is anticipated to be met by an estimated 22 new wells at Andersen Air Force Base (AFB), rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 2.5 MG (9.5 ML) water storage tanks would be constructed at ground level at NCTS Finegayan. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

Construction

Estimates on construction activities were calculated to identify equipment, material, and manpower requirements for the construction associated with the proposed water resources components. Assumptions were made to develop a list of major construction items, necessary equipment, and productivity levels necessary for the completed construction of these facilities. The calculated emissions produced from potential construction and vehicle activities that would occur from 2011 to 2014 form the basis from which the total air pollutant emissions in TPY were calculated (Table 7.2-8).

Table 7.2-8. Total Annual Construction Emissions – Basic Alternative 1

	Pollutant						
Construction Activity	*SO_2*	*CO*	*PM_{10}*	*$PM_{2.5}$*	*NO_x*	*VOC*	*CO_2*
Total Annual Emissions (TPY)	0.3	2.2	0.2	0.2	2.7	0.3	422.9

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns per diameter; SO_2 = sulfur dioxide; TPY = tons per year; VOC = volatile organic compound.

These predicted emissions are combined with the emissions from other components of the proposed action in Volume 7 to determine the overall potential air emissions impact significance using the impact thresholds described in Section 7.2.1.2. The construction emissions shown in Table 7.2-8, and described in Volume 9, Appendix I, Section 3.4, Construction Activity Emissions, are all well below impact thresholds.

Operation

As described at the beginning of this section, water pumps are expected to be powered by electricity, therefore no air emissions would be generated during water pumping operations.

Proposed Mitigation Measures

Proposed mitigation measures, if applicable, are discussed in Volume 7 where the combined air quality impacts are addressed.

7.2.3.2 Basic Alternative 2

Basic Alternative 2 would provide additional water capacity of 11.7 MGd (44.3 MLd), which is anticipated to be met by an estimated 20 new wells at Andersen Air Force Base (AFB) and 11 new wells at Air Force Base Barrigada, rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 1.8 MG (6.8 ML) water storage tanks would be constructed at ground level at NCTS Finegayan and one 1 MG (3.8 ML) water storage tank would be construction at Air Force Base Barrigada. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

Construction

The improvements planned for in Basic Alternative 2 would produce slightly lower total annual construction emissions than Basic Alternative 1, as summarized below in Table 7.2-9 and presented in Volume 9, Appendix I, Section 3.4, Construction Activity Emissions.

Table 7.2-9. Total Annual Construction Emissions – Basic Alternative 2

Construction Activity	*Pollutant*						
	SO_2	*CO*	*PM_{10}*	*$PM_{2.5}$*	*NO_x*	*VOC*	*CO_2*
Total Annual Emissions (TPY)	1.2	2.0	0.2	0.2	2.6	0.3	398.4

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns per diameter; SO_2 = sulfur dioxide; TPY = tons per year; VOC = volatile organic compound.

Operation

As described previously, water pumps are expected to be powered by electricity; therefore, no air emissions would be generated during water pumping operations.

Proposed Mitigation Measures

The predicted construction emissions (2011 to 2014) and operational emissions (2015 and after) for criteria pollutants within each ROI are all below the 250 TPY threshold or 100 TPY SO_2 threshold applicable for SO_2 nonattainment areas. Therefore potential air quality impacts under Basic Alternative 2 are considered less than significant and emissions mitigation measures are not warranted.

7.2.3.3 Summary of Impacts

Table 7.2-10 summarizes the potential air quality impacts associated with the two potable water alternatives. The construction activities associated with the water supply were well below the significance criterion of 250 TPY. Water pumps are expected to be powered by electricity so that no air emissions would be generated during water pumping operations. Therefore, both alternatives would result in less than significant impacts to air quality resources.

Table 7.2-10. Summary of Potential Air Quality Impacts – Potable Water

	Basic Alternative 1	*Basic Alternative 2*
Potable Water	LSI	LSI

Legend: LSI = Less than significant impact.

7.2.4 Wastewater

Construction and operation of wastewater treatment facilities would generate additional air emissions, including odor-related emissions. This section addresses potential air quality impacts, including odor impacts from the proposed basic and the long-term alternative using the methodologies described in Section 7.2.1. Given the relatively short duration of the construction period (i.e., mostly between 2011 and 2014), odor impacts under the basic alternatives were addressed qualitatively. A detailed analysis is provided in Volume 9, Appendix I, Section 3.2.1.

7.2.4.1 Basic Alternative 1a (Preferred Alternative) and 1b

Basic Alternative 1 (Alternative 1a supports Main Cantonment Alternatives 1 and 2; and Alternative 1b supports Main Cantonment Alternatives 3 and 8) combines upgrade to the existing primary treatment facilities and expansion to secondary treatment at the Northern District Wastewater Treatment Plant (NDWWTP). The difference between Alternatives 1a and 1b is a requirement for a new sewer line from Barrigada housing to NDWWTP for Alternative 1b.

Construction

The plant construction activities would result in a short-term increase in criteria pollutant and CO_2 emissions. However, given the small scale of the activity, the emissions predicted are minimal and would have negligible air quality impacts associated with them, as shown in Table 7.2-11 and described in Volume 9, Appendix I, Section 3.4. In Volume 7, these emissions are combined with the emissions from other components of the proposed action to determine the overall significance of potential air emissions impacts using the impact thresholds described in Section 7.2.1.2.

Table 7.2-11. Total Annual Construction Emissions - Alternative 1a and 1b

	Pollutant						
Construction Activity	SO_2	*CO*	PM_{10}	$PM_{2.5}$	NO_x	*VOC*	CO_2
Total Annual Emissions (TPY)	0.0	0.0	0.0	0.0	0.0	0.0	1.4

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns per diameter; SO_2 = sulfur dioxide; TPY = tons per year; VOC = volatile organic compound.

Operation

As additional wastewater flow would be treated at the NDWWTP, no changes to baseline operation impacts are predicted for Alternative 1a or 1b.

Proposed Mitigation Measures

Proposed mitigation measures, if applicable, are discussed in Volume 7, where the combined air quality impacts are addressed.

7.2.4.2 Long-Term Alternative 1

Given the incomplete design data provided for the programmatic long-term alternative, potential air quality impacts resulting from this alternative are not analyzed in this study and, if required, would be addressed in a future NEPA document. However, given the size of a typical treatment plant and the limited combustion sources, potential criteria pollutants and Hazardous Air Pollutant air quality impacts are expected to be minimal under both construction and operational conditions.

However, potential odor emissions from the long-term wastewater treatment facilities are expected to be significant particularly within the neighborhoods located around each facility, and given the relatively high temperature in Guam. Odor control measures are anticipated to be required for the long-term alternative.

7.2.4.3 Summary of Impacts

Table 7.2-12 summarizes the potential impacts associated with Basic Alternatives 1a and 1b for wastewater treatment. The construction and operation activities associated with wastewater facilities under this basic alternative would be well below the significance criterion of 250 TPY and therefore the alternative would result in less than significant impacts to air quality resources.

Table 7.2-12. Summary of Potential Air Quality Impacts – Wastewater

	Basic Alternative 1a and 1b
Wastewater	LSI

Legend: LSI = Less than significant impact.

7.2.5 Solid Waste

Operation of the existing Navy Landfill at Apra Harbor to handle additional solid waste generated as a result of the proposed action would increase air emissions. This section addresses potential air quality impacts from Basic Alternative 1 using the methodologies described in Section 7.2.1. A detailed analysis is provided in Volume 9, Appendix I, Section 3.2.2.

7.2.5.1 Basic Alternative 1 (Preferred Alternative)

The Preferred Alternative would be to continue to use the Navy Landfill at Apra Harbor for municipal solid waste (MSW) until the new GovGuam Layon Landfill at Dandan is available for use. Disposal of other waste streams excluded from Layon Landfill would continue at the Navy Landfill. Construction and demolition (C&D) debris would continue to be disposed of at the Navy hardfill.

Construction

For Solid Waste Basic Alternative 1, there would be no new construction. Therefore, there are no construction impacts to air quality.

Operation

The USEPA LandGEM model (USEPA 2005c) was used to predict the increase in VOC, CO_2, and methane emissions associated with the added solid waste disposal at the Navy Sanitary Landfill from the proposed action. The landfill throughput (input) was based on a 7.4 pounds (3.4 kilograms) per capita per day waste generation rate. The future additional waste throughput associated with Basic Alternative 1 utilizing the Navy Sanitary Landfill was considered to begin in 2010 and the resulting net annual increases in air emissions, shown in Table 7.2-13, were predicted up to 2011.

Table 7.2-13. Total Annual Operation Emissions – Basic Alternative 1 / Apra Harbor

	Pollutant (TPY)				
Year	*Uncontrolled VOC*	*Controlled VOC*	*Uncontrolled Methane*	*Controlled Methane*	*CO_2*
2011	2.6	NA	59.9	NA	164

Legend: CO_2 = carbon dioxide; NA = not applicable; TPY = tons per year; VOC = volatile organic compound.

Once the new Layon Landfill is opened, solid waste from the Navy Sanitary Landfill would be diverted to Layon per the Memorandum of Understanding between the DoD and GovGuam. The new landfill is assumed to open in 2011 and close in 2051.

The same methodology used for Basic Alternative 1 in Apra Harbor was used to predict the increase in VOC and CO_2 emissions associated with the added solid waste disposal at the proposed GovGuam landfill beyond 2011. Table 7.2-14 summarizes the predicted emissions for each year after the interim period. According to the *Revised Final Report, Guam Solid Waste Utility Study for Proposed USMC Relocation* (Naval Facilities Engineering Command, Pacific 2008), a flare system to control VOC emissions would be installed in 2013. Therefore, the controlled VOC and methane emission increase shown in Table 7.2-14 for 2014 reflects the presence of a flare controlling VOC and methane emissions with a destruction rate of 98% or greater (USEPA 2003).

The predicted construction and operational emissions are combined with the emissions from other components of the proposed action in Volume 7 to determine the overall significance of potential air emissions impacts using the thresholds described in Section 7.2.1.2.

Proposed Mitigation Measures

Mitigation measures, if applicable, for combined air quality effects are discussed in Volume 7.

7.2.5.2 Summary of Impacts

Table 7.2-15 summarizes the potential air quality impacts associated with the solid waste alternatives. The construction activities associated with solid waste facilities were well below the significance criterion of 250 TPY for all alternatives, as were operational emissions of criteria pollutants. Therefore, Basic Alternative 1 would result in less than significant impacts to air quality resources with standard control measures.

It should be noted that CO_2 and methane are not criteria pollutants and therefore are not compared to criteria pollutant thresholds. The potential effects of CO_2, methane, and other GHG emissions are by nature global and are based on cumulative impacts. Hence, the impact of proposed CO_2, methane and other GHG emissions is discussed in the context of cumulative impacts in Volume 7.

Table 7.2-14. Total Annual Operation Emissions – Basic Alternative 1 / Layon

	Pollutant (TPY)				
Year	*Uncontrolled VOC*	*Controlled VOC*	*Uncontrolled Methane*	*Controlled Methane*	*CO_2*
2012	9.0	NA	208.4	NA	572
2013	18.7	NA	435.5	NA	1195
2014	NA	0.6	NA	13.9	1903
2015	NA	0.9	NA	21.1	2900
2016	NA	1.1	NA	26.7	3665
2017	NA	1.3	NA	29.6	4055
2018	NA	1.3	NA	31.4	4302
2019	NA	1.4	NA	33.1	4537
2020	NA	1.5	NA	34.7	4763
2021	NA	1.6	NA	36.3	4978
2022	NA	1.6	NA	37.8	5182
2023	NA	1.7	NA	39.2	5377
2024	NA	1.7	NA	40.5	5562
2025	NA	1.8	NA	41.8	5738
2026	NA	1.9	NA	43.0	5905
2027	NA	1.9	NA	44.2	6065
2028	NA	1.9	NA	45.3	6216
2029	NA	2.0	NA	46.4	6360
2030	NA	2.0	NA	47.4	6497
2031	NA	2.1	NA	48.3	6628
2032	NA	2.1	NA	49.2	6752
2033	NA	2.2	NA	50.1	6870
2034	NA	2.2	NA	50.9	6982
2035	NA	2.2	NA	51.7	7089
2036	NA	2.3	NA	52.4	7190
2037	NA	2.3	NA	53.1	7287
2038	NA	2.3	NA	53.8	7379
2039	NA	2.3	NA	54.4	7466
2040	NA	2.4	NA	55.0	7549
2041	NA	2.4	NA	55.6	7628
2042	NA	2.4	NA	56.2	7703
2043	NA	2.4	NA	56.7	7775
2044	NA	2.5	NA	57.2	7843
2045	NA	2.5	NA	57.6	7908
2046	NA	2.5	NA	58.1	7969
2047	NA	2.5	NA	58.5	8028
2048	NA	2.5	NA	58.9	8084
2049	NA	2.5	NA	59.3	8137
2050	NA	2.6	NA	59.7	8187
2051	NA	2.6	NA	60.0	8235

Legend: CO_2 = carbon dioxide; NA = not applicable; TPY = tons per year; VOC = volatile organic compound.

Table 7.2-15. Summary of Potential Air Quality Impacts – Solid Waste

	Basic Alternative 1 / Apra Harbor	*Basic Alternative 1 / Layon*
Solid waste	LSI	LSI

Legend: LSI = Less than significant impact.

7.2.6 Off Base Roadways

Roadway projects are covered by four alternatives for the location of the cantonment area functions and family housing/community support functions, as summarized below. A detailed description of these alternatives is provided in Chapter 2 of this Volume. Alternative 2 (the preferred alternative) with only a limited of number projects that have been identified for funding and implementation (Alternative 2 Constrained) is also included in this analysis:

- Alternative 1. Represents one contiguous location for cantonment area functions and family housing/community support functions. It would include portions of NCTS Finegayan and South Finegayan, as well as acquisition or long-term leasing of non-DoD lands at the Former Federal Aviation Administration (FAA) parcel and the Harmon Annex parcel. A portion of the development would be constructed in the undeveloped Overlay Refuge.
- Alternative 2 (Preferred Alternative). Represents one contiguous land area for the cantonment and family housing/community support functions. It would include portions of NCTS Finegayan, portions of South Finegayan, and the acquisition or long-term leasing of portions of privately-held lands in the Former FAA parcel. A portion of the development would be constructed in the undeveloped Overlay Refuge.
- Alternative 2 Constrained. Similar to Alternatives 1 and 2, this alternative represents one contiguous land area for the Main Cantonment and family housing/community support functions. It would include portions of NCTS Finegayan, portions of South Finegayan, and the acquisition or long-term leasing of portions of privately-held lands in the Former FAA parcel. A portion of the development would be constructed in the undeveloped Overlay Refuge. This alternative would have limited local roadway improvements (already identified for funding under the Defense Access Road program) as compared to Alternative 2.
- Alternative 3. Plans for the Main Cantonment to include portions of NCTS Finegayan, and housing would be located on three geographically separated DoD parcels, including South Finegayan, Air Force Barrigada, and Navy Barrigada. No privately held lands would be acquired. Housing would be located non-contiguous to the Main Cantonment functions and a portion of the Main Cantonment would be constructed in the undeveloped Overlay Refuge.
- Alternative 8. would include portions of NCTS Finegayan, a portion of South Finegayan, the Former FAA parcel, and a portion of the housing would be located on the geographically separated Air Force Barrigada parcel. A portion of privately held lands would be acquired by purchase or long-term lease. A portion of the Main Cantonment would be constructed in the undeveloped Overlay Refuge and a portion of the required housing would be non-contiguous to the Main Cantonment Area.

7.2.6.1 Alternative 1

Mesoscale Emissions Burden

Air quality impacts would also result from the provision of on-road vehicle operations and roadway constructions associated with the proposed action. As shown in Table 7.2-16 and Volume 9, Appendix I, Section 3.3.7.2, regional emissions are predicted to increase from 18% to 19% under Alternative 1 as compared to the no-action alternative. This is primarily due to the estimated 18% increase in VMT under Alternative 1.

Table 7.2-16. Regional Annual Emission Burdens, Alternative 1

			Emission Burden (TPY)						
Scenario	*VMT*	*Speed*	*CO*	*NO_x*	*VOC*	*PM_{10}*	*$PM_{2.5}$*	*SO_2*	*CO_2*
2030 No-Action Alternative	3,535,224	28.6	13,388	478	801	78	57	562	80,499
2030 Alternative 1	4,160,544	28.0	15,813	566	951	91	67	661	94,687
Net Change from No-Action			2,425	88	150	13	10	99	14,188
Percent Change from No-Action			18%	18%	19%	18%	18%	18%	18%

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; VOC = volatile organic compound; $PM_{2.5}$= particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; TPY = tons per year; NOx = nitrogen oxides; VMT = vehicle miles traveled.

North

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-17. Based on these results, the following conclusions can be made:

- Cancer and non-cancer risks at the actual receptors are substantially lower than the values estimated at the sidewalk receptors;
- Maximum estimated increases in cancer risk at any of the receptors due to the project are all less than threshold criteria of 10 in a million. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated increases in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and
- Maximum estimated increases in the total chronic hazard index at any of the receptors due to the project are all less than the threshold limit of 1. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

Table 7.2-17. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 1, North Region

Analysis Site	*Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors ($x10^{-6}$)*		*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors/Actual Receptors*		*USEPA Hazard Index*
	2014	2030		2014	2030	
Route 1/28	1.60 / 0.41	1.00 / 0.03	10	0.19 / 0.05	0.12 / 0.00	1
Route 9/Andersen AFB North Gate	0.97	0.26		0.18	0.07	

Legend: AFB = Air Force Base.

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks under both No Build (i.e., no-action alternative) and Build (Alternative 1) conditions are less than existing risks in most cases.

The criteria to determine if the project is one of air quality concern regarding PM were applied and evaluated as follows:

(i) New or expanded highway projects that have a significant number of or significant increase in diesel vehicles.

The Average Daily Traffic (ADT) on the highest volume roadways under the No Build and Build Alternative 1 are provided in Table 7.2-18. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options.

The largest increase in AADT for the roadways presented in Table 7.2-18 is predicted to occur on Route 3 and the North Commercial Gate in 2014. By applying a 2% truck percentage, the largest daily increase of 66,900 vehicles would result in a daily increase of 1,338 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Table 7.2-18. Average Daily Traffic for Major Roadways in North Project Section under Alternative 1

	2014			*2030*		
Roadway	*No Build*	*Build*	*% Change*	*No Build*	*Build*	*% Change*
Route 3 and North Commercial Gate	0	66,900	NA	0	45,900	NA
Route 3 South of Route 28	11,499	53,100	362%	12,070	34,000	182%

(ii) Projects affecting intersections that are at LOS D, E, or F with a significant number of diesel vehicles, or those that would change to LOS D, E, or F because of increased traffic volumes from a significant number of diesel vehicles related to the project. The proposed project is expected to affect intersections with a LOS of D, E, or F. However, the effect on LOS due to the project options is due to an overall increase in volumes rather than a significant increase in diesel vehicles.

(iii) New bus and rail terminals and transfer points that have a significant number of diesel vehicles congregating at a single location. The project does not involve bus and rail terminals.

(iv) Expanded bus and rail terminals and transfer points that significantly increase the number of diesel vehicles congregating at a single location. The project does not involve bus and rail terminals.

(v) Projects in or affecting locations, areas, or categories of sites which are identified in the PM_{10} or $PM_{2.5}$ applicable implementation plan or implementation plan submission, as appropriate, as sites of violation or possible violation. The area is classified as attainment of the $PM_{2.5}$ NAAQS. There is no applicable implementation plan or implementation plan submission.

Based on the above analysis, it is determined that the project would not involve a significant number or significant increase in the number of diesel vehicles and is not a project of air quality concern with respect to $PM_{2.5}$. A detailed discussion is provided in Volume 9, Appendix I.

Microscale CO Impact Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project examining each ROI. As detailed in Volume 9, Appendix I, Section 3.3.7.2, 10 North ROI locations were screened based on changes in intersection volumes, delay, and LOS between the no-action alternative and build alternatives. Five of these locations failed the screening criteria. The Route 1/28 intersection has the highest overall volume of all the intersections that failed the screening. This site was chosen for detailed analysis. The Route 9/Andersen AFB North Gate intersection was also chosen for analysis due to the extremely high delay predicted in the build scenario and the predicted high volumes at this location. These intersections represent the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from these sites represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-19 and Table 7.2-20 and are described in Volume 9, Appendix I, Section 3.3.7.2. The values in these tables represent the background CO concentration combined with the modeled results from USEPA's CAL3QHC microscale dispersion model using worst-case meteorological parameters, along with a.m. and p.m. peak traffic data. Emission factors were calculated using USEPA's MOBILE6.2 emission factor program. A background value must be added into the results of the dispersion analysis to account for others sources of CO that are not accounted for in the CAL3QHC modeling. Usually a value from a representative local ambient air quality monitor is used. Guam, however, does not have any local monitoring stations, as discussed earlier in this chapter. Due to this, values from Hawaii were examined to determine their applicability to Guam. Using the 2006–2008 monitored data from the Punchbowl monitor, (rated as a middle scale monitor) located in Honolulu, Hawaii, the second highest maximum 1-hour reading was 1.7 parts ppm. This value was conservatively rounded to 2.0 ppm and represents the background CO concentration for this analysis. A persistence factor (that accounts for hourly variation of traffic and meteorological conditions) of 0.7, as recommended by USEPA, was applied to the 1-hour CO concentrations to obtain 8-hour concentrations. As shown in Table 7.2-19 and Table 7.2-20, no violations of the applicable NAAQS are predicted.

Table 7.2-19. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – North, Alternative 1

	Existing		*2014*		*2030*	
Analysis Site	*a.m.*	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 1/28	5.5	6.0	6.9	7.3	6.0	4.2
Route 9/Andersen AFB North Gate	3.8	4.5	4.2	4.5	3.6	4.5

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: AFB = Air Force Base; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards; ppm = parts per million.

Table 7.2-20. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – North Alternative 1

Analysis Site	*Existing*	*2014*	*2030*
Route 1/28	4.2	5.1	4.2
Route 9/Andersen AFB North Gate	3.2	3.2	3.2

Notes: 8-hour CO NAAQS = 9 ppm Includes a background concentration of 1.4 ppm
Legend: AFB = Air Force Base; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards; ppm = parts per million.

Construction Emissions Analysis

To determine the temporary air quality impacts arising from construction of the project, a detailed emission construction analysis was conducted. Using the estimated project schedule, along with typical equipment requirements for specific tasks, emission burden estimates of CO, NO_x, PM_{10}, and $PM_{2.5}$ were calculated. Equipment emissions were presumed to be Tier 3, with high sulfur fuel as confirmed by the construction management team. Based on the preliminary schedule, the highest emissions levels per year, per month, and the year that these emissions are predicted to occur in the North Region are shown in Table 7.2-21 and also presented in Volume 9, Appendix I, Section 3.4.

Table 7.2-21. Estimated Construction Emission Burden – North, Alternative 1

	CO	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*VOC*	*SO_2*	*CO_2*
Maximum Yearly Value (Tons)	13.0	20.3	8.4	4.1	1.4	15.3	3,881
Highest Monthly Emission Burden (Tons)	4.7	7.3	1.8	1.3	0.51	5.4	1,462
Average Daily Emission Burden (Based on Highest Month) (Tons)	0.23	0.36	0.09	0.06	0.03	0.27	73.1
Year Highest Monthly Emission Burden Predicted to Occur	2011	2011	2011	2011	2011	2011	2011

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NOx = nitrogen oxides; $PM_{2.5}$= particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Central

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-22. Based on these results, the following conclusions can be made:

- Cancer and non-cancer risks at the actual receptors are substantially lower than the values estimated at the sidewalk receptors;
- Maximum estimated increases in cancer risk at any of the receptors due to the project are all less than threshold criteria of 10 in a million. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated increases in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and
- Maximum estimated increases in the total chronic hazard index at any of the receptors due to the project are all less than the threshold limit of 1. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

Table 7.2-22. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 1, Central Region

Analysis Site	*Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors ($x10^{-6}$)* 2014	2030	*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors/Actual Receptors* 2014	2030	*USEPA Hazard Index*
Route 1/8	1.64	0.78	10	0.19	0.10	1
Route 4/7A	1.22/0.66	-0.09/-0.01		0.62/0.08	0.00/0.00	
Route 16/27	2.97	1.99		0.32	0.20	
Route 1 West of Route 30	0.26	0.06		0.03	0.01	

Applying a more conservative exposure duration of 70 years, as suggested by USEPA (rather than 30 years) would not cause the maximum estimated increases in cancer risk at any receptor to increase over the threshold criteria of 10 in a million. In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build and Build conditions, are less than existing risks in most cases.

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 1 are provided in Table 7.2-23. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options.

Table 7.2-23. Average Daily Traffic for Major Roadways in Central Project Section under Alternative 1

	2014			*2030*		
Roadway	*No Build*	*Build*	*% Change*	*No Build*	*Build*	*% Change*
Route 1	79,337	100,300	26	84,935	95,600	13
Route 8	48,221	65,600	36	53,248	58,600	10
Route 18	49,196	74,000	50	59,980	70,500	18

The largest increase in AADT for the roadways presented in Table 7.2-24 is predicted to occur at Route 8 in 2014. By applying a 2% truck percentage, the largest daily increase of 20,963 vehicles would result in a daily increase of 4,193 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Microscale CO Analysis

A screening analysis was performed to determine which Central ROI intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in Volume 9, Appendix I, Section 3.3.7.2, 34 locations were screened based on changes in intersection volumes, delay, and LOS between the no-action alternative and build alternatives. Twenty-one (21) of these locations failed the screening criteria. The Route 1/8 intersection has the highest overall volume of all the intersections that failed the screening. This site was chosen for detailed analysis. The Route 4/7A intersection has the highest overall delay of any signalized intersection that failed the screening. This site was chosen for detailed analysis. The Route 16/27 intersection fails the screening criteria in other alternatives and was evaluated in this alternative for consistency. These intersections represent the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from these sites represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-24 and Table 7.2-25 and are presented in Volume 9, Appendix I, Section 3.3.7.2. The values in these tables, using the same analysis techniques and parameters as those applied in the North Region, represent the predicted worst-case CO concentrations. As shown in Table 7.2-24 and Table 7.2-25, no violations of the applicable NAAQS are predicted.

Table 7.2-24. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – Central, Alternative 1

	Existing		*2014*		*2030*	
Analysis Site	*a.m.*	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 1/8	6.0	6.4	7.3	7.6	6.2	6.4
Route 4/7A	5.3	3.8	5.1	5.6	4.6	5.1
Route 16/27	8.4	9.4	8.1	9.0	7.0	7.9

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards; ppm = parts per million.

Table 7.2-25. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – Central, Alternative 1

Analysis Site	*Existing*	*2014*	*2030*
Route 1/8	4.5	5.3	4.5
Route 4/7A	3.7	3.9	3.6
Route 16/27	6.6	6.3	5.5

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards; ppm = parts per million.

Construction Emissions Analysis

To determine the temporary air quality impacts arising from construction of the project, a detailed emission construction analysis was conducted using the same method as described for the North ROI. The highest predicted construction emissions per year, per month, and the year that these emissions are predicted to occur are shown in Table 7.2-26 and also presented in Volume 9, Appendix I, Section 3.4.

Table 7.2-26. Estimated Construction Emission Burden – Central, Alternative 1

	CO	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*VOC*	*SO_2*	*CO_2*
Maximum Yearly Value (Tons)	54.6	84.2	17.2	14.4	5.9	62.4	16,707
Highest Monthly Emission Burden (Tons)	8.5	13.1	2.2	2.2	0.9	9.7	2,590
Average Daily Emission Burden (Based on Highest Month) (Tons)	0.42	0.65	0.11	0.11	0.05	0.48	129
Year Highest Monthly Emission Burden Predicted to Occur	2012	2012 & 2013	2012 & 2013	2012 & 2013	2012 & 2013	2012 & 2013	2012 & 2013

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NOx = nitrogen oxides; $PM_{2.5}$= particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Apra Harbor

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-27. Based on these results, the following conclusions can be made:

- Maximum estimated changes in cancer risk at these locations are expected to decrease at any of the receptors analyzed due to the project. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated changes in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and

- Maximum estimated changes in the total chronic hazard index are expected to decrease at any of the receptors analyzed due to the project. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

Table 7.2-27. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 1, Apra Harbor

Analysis Site	*Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors (x10^{-6})* 2014	2030	*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors* 2014	2030	*USEPA Hazard Index*
Route 1/2A	-0.82	-0.06	10	-0.09	0.00	1

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build and Build conditions are less than existing risks in most cases.

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 1 are provided in Table 7.2-25. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options. As shown in this table, the largest increase in AADT for the roadways presented is predicted to occur at Route 1 near Route 18 in 2030. By applying a 2% truck percentage, the largest daily increase of 7,158 vehicles would result in a daily increase of 143 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Table 7.2-28. Average Daily Traffic for Major Roadways in Apra Harbor Project Section under Alternative 1

Roadway	*2014* *No Build*	*Build*	*% Change*	*2030* *No Build*	*Build*	*% Change*
Route 1 near Route 18	46,407	49,800	11	41,142	48,300	17

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Microscale CO Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in Volume 9, Appendix I, Section 3.3.7.2, three locations were screened based on changes in intersection volumes, delay, and LOS between the no-action alternative and build alternatives. One of these locations failed the screening criteria. The Route 1/2A intersection has the highest overall volume and highest delay of all the signalized intersections that failed the screening. This site was chosen for detailed analysis. This intersection represents the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from this site represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-29 and Table 7.2-30 and are presented in Volume 9, Appendix I, Section 3.3.7.2. The values in these tables, using the same analysis techniques and parameters as those applied in the North Region, represent the predicted worst-case CO concentrations. As shown in Table 7.2-29 and Table 7.2-30, no violations of the applicable NAAQS are predicted.

Table 7.2-29. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – Apra Harbor, Alternative 1

			2014		*2030*	
	Existing		*Alternative 1*		*Alternative 1*	
Analysis Site	*a.m.*	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 1/2A	4.7	4.3	5.3	5.1	4.3	3.9

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-30. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – Apra Harbor, Alternative 1

		2014	*2030*
Analysis Site	*Existing*	*Alternative 1*	*Alternative 1*
Route 1/2A	3.3	3.7	3.0

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Construction Emissions Analysis

To determine the temporary air quality impacts arising from construction of the project, a detailed construction emissions analysis was conducted using the same method as described for the North Region. The highest predicted construction emissions per year, per month, and the year that these emissions are predicted to occur are shown in Table 7.2-31 and presented in Volume 9, Appendix I, Section 3.4.

Table 7.2-31. Estimated Construction Emission Burden – Apra Harbor, Alternative 1

	CO	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*VOC*	*SO_2*	*CO_2*
Maximum Yearly Value (Tons)	13.5	20.9	5.0	3.7	1.2	15.4	4,199
Highest Monthly Emission Burden (Tons)	1.6	2.5	0.59	0.44	0.34	1.82	494
Average Daily Emission Burden (Based on Highest Month) (Tons)	0.08	0.12	0.03	0.02	0.02	0.0.9	24.7
Year Highest Monthly Emission Burden Predicted to Occur	2011	2011	2011	2011	2011	2011	2011

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NOx = nitrogen oxides; $PM_{2.5}$= particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

South

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-32. Based on these results, the following conclusions can be made:

- Maximum estimated increases in cancer risk at any of the receptors due to the project are all less than threshold criteria of 10 in a million. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated changes in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and
- Maximum estimated increases in the total chronic hazard index at any of the receptors due to the project are all less than the threshold limit of 1. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

Table 7.2-32. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 1, South Region

Analysis Site	*Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors ($x10^{-6}$)*		*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors/Actual Receptors*		*USEPA Hazard Index*
	2014	2030		2014	2030	
Route 5/2A	0.46	0.08	10	0.05	0.01	1

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build and Build conditions are less than existing risks in most cases.

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 1 are provided in Table 7.2-33. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options. As shown in this table, the largest increase in AADT for the roadways presented is predicted to occur at Route 4 in 2014. By applying a 2% truck percentage, the largest daily increase of 1,767 vehicles would result in a daily increase of 35 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Table 7.2-33. Average Daily Traffic for Major Roadways in South Project Section under Alternative 1

Roadway	*2014*			*2030*		
	No Build	*Build*	*% Change*	*No Build*	*Build*	*% Change*
Route 4	15,833	17,600	11	21,504	20,100	-7

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Microscale CO Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in Volume 9, Appendix I, Section 3.3.7.2, four locations were screened based on changes in intersection volumes, delay, and LOS between the no-action alternative and build alternatives. Two of these locations failed the screening criteria. The Route 5/2A intersection has the highest overall volume and highest delay of all the signalized intersections that failed the screening. This site was chosen for detailed analysis. This intersection represents the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from this site represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-34 and Table 7.2-35 and are presented in Volume 9, Appendix I, Section 3.3.7.2. The values in these tables, using the same analysis techniques and parameters as those applied in the North Region, represent the predicted worst-case CO concentrations. As shown in Table 7.2-34 and Table 7.2-35 no violations of the applicable NAAQS are predicted.

Table 7.2-34. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – South, Alternative 1

	Existing		*2014*		*2030*	
Analysis Site	*a.m.*	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 5/2A	4.2	3.9	4.5	4.0	4.0	3.7

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-35. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – South, Alternative 1

Analysis Site	*Existing*	*2014*	*2030*
Route 5/2A	2.9	3.2	2.8

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Construction Emissions Analysis

To determine the temporary air quality impacts arising from construction of the project, a detailed construction emissions analysis was conducted using the same method as described for the North Region. As shown in Table 7.2-36 and Volume 9, Appendix I, Section 3.4, construction emissions are negligible.

Proposed Mitigation Measures

Because the alternative is not predicted to cause a significant impact on air quality levels, no mitigation is proposed.

Table 7.2-36. Estimated Construction Emission Burden – South, Alternative 1

	CO	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*VOC*	*SO_2*	*CO_2*
Maximum Yearly Value (Tons)	11.1	17.3	2.9	2.8	1.2	12.9	3310
Highest Monthly Emission Burden (Tons)	3.1	4.9	0.83	0.81	0.34	3.7	957
Average Daily Emission Burden (Based on Highest Month) (Tons)	0.16	0.25	0.04	0.04	0.02	0.18	47.8
Year Highest Monthly Emission Burden Predicted to Occur	2012	2013	2012 & 2013	2012 & 2013	2013	2013	2013

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NOx = nitrogen oxides; $PM_{2.5}$= particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

7.2.6.2 Alternative 2 (Preferred Alternative)

Mesoscale Emissions Burden

As shown in Table 7.2-37 and Volume 9, Appendix I, Section 3.3.7.3, regional emissions are predicted to increase in the range of 18% to 19% under Alternative 2 and are the same as compared to Alternative 1. This is primarily due to the estimated 18% increase in VMT under Alternative 2.

Table 7.2-37. Regional Annual Emission Burdens, Alternative 2

Scenario	*VMT*	*Speed*	*Emission Burden (TPY)*						
			CO	*NO_x*	*VOC*	*PM_{10}*	*$PM_{2.5}$*	*SO_2*	*CO_2*
2030 No-Action Alternative	3,535,224	28.6	13,388	478	801	78	57	562	80,499
2030 Alternative 2	4,160,544	28.0	15,813	566	951	91	67	661	94,687
Net Change from No-Action			2,425	88	150	13	10	99	14,188
Percent Change from No-Action			18	18	19	18	18	18	18

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; NO_x = nitrogen oxides; SO_2 = sulfur dioxide; TPY = tons per year; VMT = vehicle miles traveled; VOC = volatile organic compound.

North

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-38. Based on these results, the following conclusions can be made:

- Cancer and non-cancer risks at the actual receptors are substantially lower than the values estimated at the sidewalk receptors;
- Maximum estimated increases in cancer risk at any of the receptors due to the project are all less than threshold criteria of 10 in a million. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated changes in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and
- Maximum estimated increases in the total chronic hazard index at any of the receptors due to the project are all less than the threshold limit of 1. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

Table 7.2-38. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 2, North Region

Analysis Site	*Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors ($x10^{-6}$)*		*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors/Actual Receptors*		*USEPA Hazard Index*
	2014	2030		2014	2030	
Route 1/28	1.60 / 0.41	1.00 / 0.03	10	0.19 / 0.05	0.12 / 0.00	1
Route 9/Andersen AFB North Gate	0.97	0.26		0.18	0.07	

Legend: AFB = Air Force Base.

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build (i.e., no-action alternative) and Build (i.e., Alternative 2) conditions are less than existing risks in most cases.

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 2 are provided in Table 7.2-39. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options.

Table 7.2-39. Average Daily Traffic for Major Roadways in North Project Section under Alternative 2

	2014			*2030*		
Roadway	*No Build*	*Build*	*% Change*	*No Build*	*Build*	*% Change*
Route 3 and North Commercial Gate	0	66,900	NA	0	45,900	NA
Route 3 South of Route 28	11,499	53,100	362	12,070	34,000	182

The largest increase in AADT for the roadways is predicted to occur on Route 3 and the North Commercial Gate in 2014. By applying a 2% truck percentage, the largest daily increase of 66,900 vehicles would result in a daily increase of 1,338 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Microscale CO Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in Volume 9, Appendix I, Section 3.3.7.3, 10 locations were screened based on changes in intersection volumes, delay, and LOS between the no-action and build alternatives. Five of these locations failed the screening criteria. The Route 1/28 intersection has the highest overall volume of all the intersections that failed the screening. This site was chosen for detailed analysis. The Route 9/Andersen AFB North Gate intersection was also chosen for analysis due to the extremely high delay predicted in the build scenario and the predicted high volumes at this location. These intersections represent the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from these sites represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-40 and Table 7.2-41 and are presented in Volume 9, Appendix I, Section 3.3.7.3. The values in these tables, using the same analysis techniques and parameters as those applied in the North Region under Alternative 1, represent the predicted worst-case CO concentrations. As shown in Table 7.2-40 and Table 7.2-41, no violations of the applicable NAAQS are predicted.

Construction Emissions Analysis

To determine the temporary air quality impacts arising from construction of the project, a detailed construction emissions analysis was conducted using the same method as described for the North Region (Alternative 1). The highest predicted construction emissions per year, per month, and the year that these emissions are predicted to occur are shown in Table 7.2-42 and Volume 9, Appendix I, Section 3.4. These emissions were further combined with those from other project components and discussed in Volume 7 to determine the potential impact significance.

Table 7.2-40. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – North, Alternative 2

Analysis Site	*Existing*		*2014*		*2030*	
	a.m.	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 1/28	5.5	6.0	6.9	7.3	6.0	4.2
Route 9/Andersen AFB North Gate	3.8	4.5	4.2	4.5	3.6	4.5

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: AFB = Air Force Base; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-41. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – North Region, Alternative 2

Analysis Site	*Existing*	*2014*	*2030*
Route 1/28	4.2	5.1	4.2
Route 9/Andersen AFB North Gate	3.2	3.2	3.2

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: AFB = Air Force Base; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-42. Estimated Construction Emission Burden – North, Alternative 2

	CO	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*VOC*	*SO_2*	*CO_2*
Maximum Yearly Value (Tons)	13.0	20.3	8.4	4.1	1.4	15.3	3,881
Highest Monthly Emission Burden (Tons)	4.7	7.3	1.8	1.3	0.51	5.4	1,462
Average Daily Emission Burden (Based on Highest Month) (Tons)	0.23	0.36	0.09	0.06	0.03	0.27	73.1
Year Highest Monthly Emission Burden Predicted to Occur	2011	2011	2011	2011	2011	2011	2011

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NOx = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; TPY = tons per year; VMT = vehicle miles traveled; VOC = volatile organic compound.

Central

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-43. Based on these results, the following conclusions can be made:

- Cancer and non-cancer risks at the actual receptors are substantially lower than the values estimated at the sidewalk receptors;
- Maximum estimated increases in cancer risk at any of the receptors due to the project are all less than threshold criteria of 10 in a million. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated changes in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and
- Maximum estimated increases in the total chronic hazard index at any of the receptors due to the project are all less than the threshold limit of 1. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build and Build conditions are less than existing risks in most cases.

Table 7.2-43. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 2, Central Region

	Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors (x10^{-6})			*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors/Actual Receptors*		
Analysis Site	2014	2030	*Cancer Risk Threshold*	2014	2030	*USEPA Hazard Index*
Route 1/8	1.64	0.78	10	0.19	0.10	1
Route 4/7A	1.22/0.66	-0.09/-0.01		0.62/0.08	0.00/0.00	
Route 16/27	2.97	1.99		0.32	0.20	
Route 1 West of Route 30	0.26	0.06		0.03	0.01	

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 2 are provided in Table 7.2-44. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options.

The largest increase in AADT for the roadways presented in Table 7.2-44 is predicted to occur under Route 8 in 2014. By applying a 2% truck percentage, the largest daily increase of 20,963 vehicles would result in a daily increase of 4,193 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Table 7.2-44. Average Daily Traffic for Major Roadways in Central Project Section under Alternative 2

	2014			*2030*		
Roadway	*No Build*	*Build*	*% Change*	*No Build*	*Build*	*% Change*
Route 1	79,337	100,300	26	84,935	95,600	13
Route 8	48,221	65,600	36	53,248	58,600	10
Route 18	49,196	74,000	50	59,980	70,500	18

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Microscale CO Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in Volume 9, Appendix I, Section 3.3.7.3, 34 locations were screened based on changes in intersection volumes, delay, and LOS between the no-action and build alternatives. Twenty-one (21) of these locations failed the screening criteria. The Route 1/8 intersection has the highest overall volume of all the intersections that failed the screening. This site was chosen for detailed analysis. The Route 4/7A intersection has the highest overall delay of any signalized intersection that failed the screening. This site was chosen for detailed analysis. The Route 16/27 intersection fails the screening criteria in other alternatives and was evaluated in this alternative for consistency. These intersections represent the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from these sites represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-45 and Table 7.2-46 and are presented in Volume 9, Appendix I, Section 3.3.7.3. The values in these tables, using the same analysis techniques and parameters as those applied in the North Region (Alternative 1), represent the predicted worst-case CO concentrations. As shown in Table 7.2-45 and Table 7.2-46, no violations of the applicable NAAQS are predicted.

Table 7.2-45. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – Central, Alternative 2

Analysis Site	*Existing*		*2014*		*2030*	
	a.m.	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 1/8	6.0	6.4	7.3	7.6	6.2	6.4
Route 4/7A	5.3	3.8	5.1	5.6	4.6	5.1
Route 16/27	8.4	9.4	8.1	9.0	7.0	7.9

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-46. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – Central, Alternative 2

Analysis Site	*Existing*	*2014*	*2030*
Route 1/8	4.5	5.3	4.5
Route 4/7A	3.7	3.9	3.6
Route 16/27	6.6	6.3	5.5

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Construction Emissions Analysis

To determine the temporary air quality impacts arising from construction of the project, a detailed emission construction analysis was conducted using the same method as described for the North Region (Alternative 1). The highest emissions per year, per month, and the year that these emissions are predicted to occur are shown in Table 7.2-47 and Volume 9, Appendix I, Section 3.4. These emissions were further combined with those from other project components and discussed in Volume 7 to determine the potential impact significance.

Apra Harbor

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-48. Based on these results, the following conclusions can be made:

- Maximum estimated changes in cancer risk at these locations are expected to decrease at any of the receptors analyzed due to the project. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated changes in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and

- Maximum estimated changes in the total chronic hazard index are expected to decrease at any of the receptors analyzed due to the project. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

Table 7.2-47. Estimated Construction Emission Burden – Central, Alternative 2

	CO	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*VOC*	*SO_2*	*CO_2*
Maximum Yearly Value (Tons)	54.6	84.2	17.2	14.4	5.9	62.4	16,707
Highest Monthly Emission Burden (Tons)	8.5	13.1	2.2	2.2	0.9	9.7	2,590
Average Daily Emission Burden (Based on Highest Month) (Tons)	0.42	0.65	0.11	0.11	0.05	0.48	129
Year(s) Highest Monthly Emission Burden Predicted to Occur	2012	2012 & 2013	2012 & 2013	2012 & 2013	2012 & 2013	2012 & 2013	2012 & 2013

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NOx = nitrogen oxides; $PM_{2.5}$= particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Table 7.2-48. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 2 Apra Harbor

Analysis Site	*Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors ($x10^{-6}$)*		*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors/Actual Receptors*		*USEPA Hazard Index*
	2014	2030		2014	2030	
Route 1/2A	-0.82	-0.06	10	-0.09	0.00	1

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build and Build conditions are less than existing risks in most cases.

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 2 are provided in Table 7.2-49. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options. As shown in this table, the largest increase in AADT for the roadways presented is predicted to occur at Route 1 near Route 18 in 2030. By applying a 2% truck percentage, the largest daily increase of 7,158 vehicles would result in a daily increase of 143 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Table 7.2-49. Average Daily Traffic for Major Roadways in Apra Harbor Project Section under Alternative 2

Roadway	*2014*			*2030*		
	No Build	*Build*	*% Change*	*No Build*	*Build*	*% Change*
Route 1 near Route 18	46,407	49,800	11	41,142	48,300	0.0

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Microscale CO Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in Volume 9, Appendix I, Section 3.3.7.3, three locations were screened based on changes in intersection volumes, delay, and LOS between the no-action and build alternatives. One of these locations failed the screening criteria. The Route 1/2A intersection has the highest overall volume and highest delay of all the signalized intersections that failed the screening. This site was chosen for detailed analysis. This intersection represents the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from this site represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-50 and Table 7.2-51 and are presented in Volume 9, Appendix I, Section 3.3.7.3. The values in these tables, using the same analysis techniques and parameters as those applied in the North Region (Alternative 1), represent the predicted worst-case CO concentrations. As shown in Table 7.2-50 and Table 7.2-51, no violations of the applicable NAAQS are predicted.

Table 7.2-50. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – Apra Harbor, Alternative 2

	Existing		*2014*		*2030*	
Analysis Site	*a.m.*	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 1/2A	4.7	4.3	5.3	5.1	4.3	3.9

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-51. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – Apra Harbor, Alternative 2

Analysis Site	*Existing*	*2014*	*2030*
Route 1/2A	3.3	3.7	3.0

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Construction Emissions Analysis

To determine the temporary air quality impacts arising from construction of the project, a detailed construction emissions analysis was conducted using the same method as described for the North Region (Alternative 1). The highest predicted construction emissions per year, per month, and the year that these emissions are predicted to occur are shown in Table 7.2-52 and Volume 9, Appendix I, Section 3.4. These emissions were further combined with those from other project components and discussed in Volume 7 to determine the potential impact significance.

Table 7.2-52. Estimated Construction Emission Burden – Apra Region, Alternative 2

	CO	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*VOC*	*SO_2*	*CO_2*
Maximum Yearly Value (Tons)	13.5	20.9	5.0	3.7	1.2	15.4	4,199
Highest Monthly Emission Burden (Tons)	1.6	2.5	0.59	0.44	0.34	1.82	494
Average Daily Emission Burden (Based on Highest Month) (Tons)	0.08	0.12	0.03	0.02	0.02	0.0.9	24.7
Year Highest Monthly Emission Burden Predicted to Occur	2011	2011	2011	2011	2011	2011	2011

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NOx = nitrogen oxides; $PM_{2.5}$= particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

South

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-53. Based on these results, the following conclusions can be made:

- Maximum estimated increases in cancer risk at any of the receptors due to the project are all less than threshold criteria of 10 in a million. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated changes in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and
- Maximum estimated increases in the total chronic hazard index at any of the receptors due to the project are all less than the threshold limit of 1. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build and Build conditions are less than existing risks in most cases.

Table 7.2-53. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 2, South Region

Analysis Site	*Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors ($x10^{-6}$)*		*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors/Actual Receptors*		*USEPA Hazard Index*
	2014	2030		2014	2030	
Route 5/2A	0.46	0.08	10	0.05	0.01	1

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 2 are provided in Table 7.2-54. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options. As shown in this table, the largest increase in AADT for the roadways presented is predicted to occur at Route 4 in 2014. By applying a 2% truck percentage, the largest daily increase of 1,767 vehicles would result in a daily increase of 35 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Table 7.2-54. Average Daily Traffic for Major Roadways in South Project Section under Alternative 2

Roadway	*2014*			*2030*		
	No Build	*Build*	*% Change*	*No Build*	*Build*	*% Change*
Route 4	15,833	17,600	11	21,504	20,100	-7

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Microscale CO Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in Volume 9, Appendix I, Section 3.3.7.3, four locations were screened based on changes in intersection volumes, delay, and LOS between the no-action and build alternatives. Two of these locations failed the screening criteria. The Route 5/2A intersection has the highest overall volume and highest delay of all the signalized intersections that failed the screening. This site was chosen for detailed analysis. This intersection represents the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from this site represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-55 and Table 7.2-56 and are presented in Volume 9, Appendix I, Section 3.3.7.3. The values in these tables, using the same analysis techniques and parameters as those applied for the North Region (Alternative 1), represent the predicted worst-case CO concentrations. As shown in Table 7.2-55 and Table 7.2-56, no violations of the applicable NAAQS are predicted.

Table 7.2-55. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – South, Alternative 2

	Existing		*2014*		*2030*	
Analysis Site	*a.m.*	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 5/2A	4.2	3.9	4.5	4.0	4.0	3.7

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-56. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – South, Alternative 2

Analysis Site	*Existing*	*2014*	*2030*
Route 5/2A	2.9	3.2	2.8

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Construction Emissions Analysis

To determine the temporary air quality impacts arising from construction of the project, a detailed construction emissions analysis was conducted using the same method as described for the North Region (Alternative 1). As shown in Table 7.2-57 and Volume 9, Appendix I, Section 3.4, construction emissions are negligible.

Table 7.2-57. Estimated Construction Emission Burden – South, Alternative 2

	CO	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*VOC*	*SO_2*	*CO_2*
Maximum Yearly Value (Tons)	11.1	17.3	2.9	2.8	1.2	12.9	3310
Highest Monthly Emission Burden (Tons)	3.1	4.9	0.83	0.81	0.34	3.7	957
Average Daily Emission Burden (Based on Highest Month) (Tons)	0.16	0.25	0.04	0.04	0.02	0.18	47.8
Year Highest Monthly Emission Burden Predicted to Occur	2012	2013	2012 & 2013	2012 & 2013	2013	2013	2013

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NOx = nitrogen oxides; $PM_{2.5}$= particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Proposed Mitigation Measures

Because the alternative is not predicted to cause a significant impact on air quality levels, no mitigation is proposed.

7.2.6.3 Alternative 2 Constrained

Mesoscale Emissions Burden

As shown in Table 7.2-58 and Volume 9, Appendix I, Section 3.3.7.3, regional emissions are predicted to increase in the range of 18% to 19% under Alternative 2 Constrained and are the same as compared to Alternative 1and Alternative 2. This is primarily due to the estimated 18% increase in VMT under Alternative 2 Constrained.

Table 7.2-58. Regional Annual Emission Burdens, Alternative 2 Constrained

			Emission Burden (TPY)						
Scenario	*VMT*	*Speed*	*CO*	*NO_x*	*VOC*	*PM_{10}*	*$PM_{2.5}$*	*SO_2*	*CO_2*
2030 No-Action Alternative	3,535,224	28.6	13,388	478	801	78	57	562	80,499
2030 Alternative 2 Constrained	4,160,544	28.0	15,813	566	951	91	67	661	94,687
Net Change from No-Action			2,425	88	150	13	10	99	14,188
Percent Change from No-Action			18	18	19	18	18	18	18

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; VOC = volatile organic compound; $PM_{2.5}$= particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; TPY = tons per year; NOx = nitrogen oxides; VMT = vehicle miles traveled.

North

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-59. Based on these results, the following conclusions can be made:

- Cancer and non-cancer risks at the actual receptors are substantially lower than the values estimated at the sidewalk receptors;
- Maximum estimated increases in cancer risk at any of the receptors due to the project are all less than threshold criteria of 10 in a million. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated changes in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and
- Maximum estimated increases in the total chronic hazard index at any of the receptors due to the project are all less than the threshold limit of 1. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

Table 7.2-59. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 2 Constrained, North Region

Analysis Site	*Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors (x10^{-6})* 2014	2030	*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors/Actual Receptors* 2014	2030	*USEPA Hazard Index*
Route 1/28	1.14 / 0.29	1.00 / 0.14	10	0.15 / 0.04	0.07 / 0.02	1
Route 9/Andersen AFB North Gate	0.99	0.26		0.23	0.23	

Legend: AFB = Air Force Base.

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build (i.e., no-action alternative) and Build (i.e., Alternative 2 Constrained) conditions are less than existing risks in most cases.

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 2 Constrained are provided in Table 7.2-60. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options.

Table 7.2-60. Average Daily Traffic for Major Roadways in North Project Section under Alternative 2 Constrained

	2014			*2030*		
Roadway	*No Build*	*Build*	*% Change*	*No Build*	*Build*	*% Change*
Route 3 and North Commercial Gate	0	66,900	NA	0	45,900	NA
Route 3 South of Route 28	11,499	53,100	362	12,070	34,000	182

The largest increase in AADT for the roadways presented in Table 7.2-60 is predicted to occur on Route 3 and the North Commercial Gate in 2014. By applying a 2% truck percentage, the largest daily increase of 66,900 vehicles would result in a daily increase of 1,338 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Microscale CO Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in Volume 9, Appendix I, Section 3.3.7.3, 10 locations were screened based on changes in intersection volumes, delay, and LOS between the no-action and build alternatives. Five of these locations failed the screening criteria. The Route 1/28 intersection has the highest overall volume of all the intersections that failed the screening. This site was chosen for detailed analysis. The Route 9/Andersen AFB North Gate intersection was also chosen for analysis due to the extremely high delay predicted in the build scenario and the predicted high volumes at this location. These intersections represent the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from these sites represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-61 and Table 7.2-62 and are presented in Volume 9, Appendix I, Section 3.3.7.3. The values in these tables, using the same analysis techniques and parameters as those applied in the North Region under Alternative 1, represent the predicted worst-case CO concentrations. As shown in Table 7.2-61 and Table 7.2-62, no violations of the applicable NAAQS are predicted.

Table 7.2-61. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – North, Alternative 2 Constrained

Analysis Site	*Existing*		*2014*		*2030*	
	a.m.	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 1/28	5.5	6.0	7.0	7.5	5.8	6.2
Route 9/Andersen AFB North Gate	3.8	4.5	4.2	4.4	3.6	4.5

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: AFB = Air Force Base; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-62. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – North Region, Alternative 2 Constrained

Analysis Site	*Existing*	*2014*	*2030*
Route 1/28	4.2	5.3	4.3
Route 9/Andersen AFB North Gate	3.2	3.1	3.2

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: AFB = Air Force Base; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Construction Emissions Analysis

Alternative 2 Constrained would involve less construction activity than proposed for Alternative 2. As such, construction emissions for this alternative are expected to be lower than those predicted for Alternative 2.

Central

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-63. Based on these results, the following conclusions can be made:

- Cancer and non-cancer risks at the actual receptors are substantially lower than the values estimated at the sidewalk receptors;
- Maximum estimated increases in cancer risk at any of the receptors due to the project are all less than threshold criteria of 10 in a million. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated changes in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and
- Maximum estimated increases in the total chronic hazard index at any of the receptors due to the project are all less than the threshold limit of 1. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

Table 7.2-63. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 2 Constrained, Central Region

Analysis Site	*Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors* ($x10^{-6}$)		*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors /Actual Receptors*		*USEPA Hazard Index*
	2014	2030		2014	2030	
Route 1/8	2.60	1.21	10	0.27	0.11	1
Route 4/7A	1.56/0.81	1.21/0.27		0.66/0.10	0.01/0.01	
Route 16/27	1.58	0.69		0.20	0.09	
Route 1 West of Route 30	0.26	0.06		0.03	0.01	

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build and Build conditions are less than existing risks in most cases.

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 2 Constrained are provided in Table 7.2-64. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options.

The largest increase in AADT for the roadways presented in Table 7.2-64 is predicted to occur under Route 8 in 2014. By applying a 2% truck percentage, the largest daily increase of 20,963 vehicles would result in a daily increase of 4,193 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Table 7.2-64. Average Daily Traffic for Major Roadways in Central Project Section under Alternative 2 Constrained

Roadway	*2014*			*2030*		
	No Build	*Build*	*% Change*	*No Build*	*Build*	*% Change*
Route 1	79,337	100,300	26	84,935	95,600	13
Route 8	48,221	65,600	36	53,248	58,600	10
Route 18	49,196	74,000	50	59,980	70,500	18

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Microscale CO Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in Volume 9, Appendix I, Section 3.3.7.3, 34 locations were screened based on changes in intersection volumes, delay, and LOS between the no-action and build alternatives. Twenty-one (21) of these locations failed the screening criteria. The Route 1/8 intersection has the highest overall volume of all the intersections that failed the screening. This site was chosen for detailed analysis. The Route 4/7A intersection has the highest overall delay of any signalized intersection that failed the screening. This site was chosen for detailed analysis. The Route 16/27 intersection fails the screening criteria in other alternatives and was evaluated in this alternative for consistency. These intersections represent the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from these sites represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-65 and Table 7.2-66 and are presented in Volume 9, Appendix I, Section 3.3.7.3. The values in these tables, using the same analysis techniques and parameters as those applied in the North Region (Alternative 1), represent the predicted worst-case CO concentrations. As shown in Table 7.2-65 and Table 7.2-66, no violations of the applicable NAAQS are predicted.

Table 7.2-65. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – Central, Alternative 2 Constrained

Analysis Site	*Existing*		*2014*		*2030*	
	a.m.	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 1/8	6.0	6.4	6.7	7.6	5.6	6.2
Route 4/7A	5.3	3.8	6.0	6.1	5.4	5.3
Route 16/27	8.4	9.4	7.9	8.4	6.7	7.3

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-66. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – Central, Alternative 2 Constrained

Analysis Site	*Existing*	*2014*	*2030*
Route 1/8	4.5	5.3	4.3
Route 4/7A	3.7	4.3	3.8
Route 16/27	6.6	5.9	5.1

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Construction Emissions Analysis

Alternative 2 Constrained would involve less construction activity than proposed for Alternative 2. As such, construction emissions for this alternative are expected to be lower than those predicted for Alternative 2.

Apra Harbor

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-67. Based on these results, the following conclusions can be made:

- Maximum estimated changes in cancer risk at these locations are expected to decrease at any of the receptors analyzed due to the project. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated changes in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and
- Maximum estimated changes in the total chronic hazard index are expected to decrease at any of the receptors analyzed due to the project. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build and Build conditions, are less than existing risks in most cases.

Table 7.2-67. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 2 Constrained Apra Harbor

	Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors ($x10^{-6}$)		*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors/Actual Receptors*		*USEPA Hazard Index*
Analysis Site	2014	2030		2014	2030	
Route 1/2A	-0.82	-0.06	10	-0.09	-0.00	1

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 2 Constrained are provided in Table 7.2-68. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options. As shown in this table, the largest increase in AADT for the roadways presented is predicted to occur at Route 1 near Route 18 in 2030. By applying a 2% truck percentage, the largest daily increase of 7,158 vehicles would result in a daily increase of 143 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Table 7.2-68. Average Daily Traffic for Major Roadways in Apra Harbor Project Section under Alternative 2 Constrained

	2014			*2030*		
Roadway	*No Build*	*Build*	*% Change*	*No Build*	*Build*	*% Change*
Route 1 near Route 18	46,407	49,800	11	41,142	48,300	0.0

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Microscale CO Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in Volume 9, Appendix I, Section 3.3.7.3, three locations were screened based on changes in intersection volumes, delay, and LOS between the no-action and build alternatives. One of these locations failed the screening criteria. The Route 1/2A intersection has the highest overall volume and highest delay of all the signalized intersections that failed the screening. This site was chosen for detailed analysis. This intersection represents the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from this site represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-69 and Table 7.2-70 and are presented in Volume 9, Appendix I, Section 3.3.7.3. The values in these tables, using the same analysis techniques and parameters as those applied in the North Region (Alternative 1), represent the predicted worst-case CO concentrations. As shown in Table 7.2-69 and Table 7.2-70, no violations of the applicable NAAQS are predicted.

Table 7.2-69. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – Apra Harbor, Alternative 2 Constrained

Analysis Site	*Existing*		*2014*		*2030*	
	a.m.	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 1/2A	4.7	4.3	5.3	5.1	4.3	3.9

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-70. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – Apra Harbor, Alternative 2 Constrained

Analysis Site	*Existing*	*2014*	*2030*
Route 1/2A	3.3	3.7	3.0

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Construction Emissions Analysis

Alternative 2 Constrained would involve less construction activity than proposed for Alternative 2. As such, construction emissions for this alternative are expected to be lower than those predicted for Alternative 2.

<u>South</u>

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-71. Based on these results, the following conclusions can be made:

- Maximum estimated increases in cancer risk at any of the receptors due to the project are all less than threshold criteria of 10 in a million. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated changes in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and
- Maximum estimated increases in the total chronic hazard index at any of the receptors due to the project are all less than the threshold limit of 1. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build and Build conditions, are less than existing risks in most cases.

Table 7.2-71. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 2 Constrained, South Region

Analysis Site	*Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors ($x10^{-6}$)* 2014	2030	*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors/Actual Receptors* 2014	2030	*USEPA Hazard Index*
Route 5/2A	0.46	0.08	10	0.05	0.01	1

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 2 Constrained are provided in Table 7.2-72. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options. As shown in this table, the largest increase in AADT for the roadways presented is predicted to occur at Route 4 in 2014. By applying a 2% truck percentage, the largest daily increase of 1,767 vehicles would result in a daily increase of 35 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Table 7.2-72. Average Daily Traffic for Major Roadways in South Project Section under Alternative 2 Constrained

	2014			*2030*		
Roadway	*No Build*	*Build*	*% Change*	*No Build*	*Build*	*% Change*
Route 4	15,833	17,600	11	21,504	20,100	-7

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Microscale CO Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in Volume 9, Appendix I, Section 3.3.7.3, four locations were screened based on changes in intersection volumes, delay, and LOS between the no-action and build alternatives. Two of these locations failed the screening criteria. The Route 5/2A intersection has the highest overall volume and highest delay of all the signalized intersections that failed the screening. This site was chosen for detailed analysis. This intersection represents the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from this site represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-73 and Table 7.2-74 and are presented in Volume 9, Appendix I, Section 3.3.7.3. The values in these tables, using the same analysis techniques and parameters as those applied for the North Region (Alternative 1), represent the predicted worst-case CO concentrations. As shown in Table 7.2-73 and Table 7.2-74, no violations of the applicable NAAQS are predicted.

Table 7.2-73. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – South, Alternative 2 Constrained

Analysis Site	Existing		2014		2030	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Route 5/2A	4.2	3.9	4.5	4.0	4.0	3.7

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-74. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – South, Alternative 2 Constrained

Analysis Site	Existing	2014	2030
Route 5/2A	2.9	3.2	2.8

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Construction Emissions Analysis

Alternative 2 Constrained would involve less construction activity than proposed for Alternative 2. As such, construction emissions for this alternative are expected to be lower than those predicted for Alternative 2.

Proposed Mitigation Measures

Because the alternative is not predicted to cause a significant impact on air quality levels, no mitigation is proposed.

7.2.6.4 Alternative 3

Mesoscale Emissions Burden

As shown in Table 7.2-75 and presented in Volume 9, Appendix I, Section 3.3.7.4, regional emissions are predicted to increase in the range of 20% to 23% under Alternative 3, as compared to the no-action alternative. This is primarily due to the estimated 20% increase in VMT under Alternative 3.

Table 7.2-75. Regional Annual Emission Burdens, Alternative 3

Scenario	VMT	Speed	Emission Burden (TPY)						
			CO	NOx	VOC	PM_{10}	$PM_{2.5}$	SO_2	CO_2
2030 No-Action Alternative	3,535,224	28.6	13,388	478	801	78	57	562	80,499
2030 Alternative 3	4,249,190	27.4	16,211	580	982	93	68	675	96,705
Net Change from No-Action			2,823	102	181	15	11	113	16,206
Percent Change from No-Action			21	21	23	20	20	20	20

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; TPY = tons per year; VMT = vehicle miles traveled; VOC = volatile organic compound.

North

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-76. Based on these results, the following conclusions can be made:

- Cancer and non-cancer risks at the actual receptors are substantially lower than the values estimated at the sidewalk receptors;
- Maximum estimated increases in cancer risk at any of the receptors due to the project are all less than threshold criteria of 10 in a million. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated changes in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and
- Maximum estimated increases in the total chronic hazard index at any of the receptors due to the project are all less than the threshold limit of 1. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build (i.e. no-action alternative) and Build (i.e., Alternative 3) conditions are less than existing risks in most cases.

Table 7.2-76. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 3, North Region

Analysis Site	*Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors ($x10^{-6}$)* 2014	2030	*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors/Actual Receptors* 2014	2030	*USEPA Hazard Index*
Route 1/28	2.36 / 0.46	0.89 / 0.09	10	0.27 /0.06	0.11 / 0.01	1
Route 9/Andersen AFB North Gate	0.97	0.26		0.18	0.07	

Legend: AFB = Air Force Base.

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 3 are provided in Table 7.2-77. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options.

The largest increase in AADT for the roadways presented in Table 7.2-77 is predicted to occur on Route 3 South of Route 28 in 2014. By applying a 2% truck percentage, the largest daily increase of 45,101 vehicles would result in a daily increase of 902 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Table 7.2-77. Average Daily Traffic for Major Roadways in North Project Section under Alternative 3

	2014			*2030*		
Roadway	*No Build*	*Build*	*% Change*	*No Build*	*Build*	*% Change*
Route 3 and North Commercial Gate	0	24,300	NA	0	18,800	2.7
Route 3 South of Route 28	11,499	56,600	392	12,070	43,000	13

Microscale CO Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in Volume 9, Appendix I, Section 3.3.7.4, 10 locations were screened based on changes in intersection volumes, delay, and LOS between the no-action and build alternatives. Nine of these locations failed the screening criteria. The Route 1/28 intersection has the highest overall volume of all the intersections that failed the screening. This site was chosen for detailed analysis. The Route 9/Andersen AFB North Gate intersection was also chosen for analysis due to the extremely high delay predicted in the build scenario and the predicted high volumes at this location. These intersections represent the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from these sites represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-78 and Table 7.2-79 and are presented in Volume 9, Appendix I, Section 3.3.7.3. The values in these tables, using the same analysis techniques and parameters as those applied for the North Region (Alternative 1), represent the predicted worst-case CO concentrations. As shown in these tables, no violations of the applicable NAAQS are predicted.

Table 7.2-78. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – North, Alternative 3

	Existing		*2014*		*2030*	
Analysis Site	*a.m.*	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 1/28	5.5	6.0	7.1	7.5	5.6	5.9
Route 9/Andersen AFB North Gate	3.8	4.5	4.2	4.5	3.6	4.5

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: AFB = Air Force Base; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-79. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – North, Alternative 3

Analysis Site	*Existing*	*2014*	*2030*
Route 1/28	4.2	5.3	4.1
Route 9/Andersen AFB North Gate	3.2	3.2	3.2

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: AFB = Air Force Base; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Construction Emissions Analysis

To determine the temporary air quality impacts arising from construction of the project, a detailed construction emissions analysis was conducted using the same method as described for the North Region under Alternative 1. The highest predicted construction emissions per year, per month, and the year that these emissions are predicted to occur are shown in Table 7.2-80 and Volume 9, Appendix I, Section 3.4.

Table 7.2-80. Estimated Construction Emission Burden – North, Alternative 3

	CO	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*VOC*	*SO_2*	*CO_2*
Maximum Yearly Value (Tons)	13.0	20.3	8.4	4.1	1.4	15.3	3,881
Highest Monthly Emission Burden (Tons)	4.7	7.3	1.8	1.3	0.51	5.4	1,462
Average Daily Emission Burden (Based on Highest Month) (Tons)	0.23	0.36	0.09	0.06	0.03	0.27	73.1
Year Highest Monthly Emission Burden Predicted to Occur	2011	2011	2011	2011	2011	2011	2011

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NOx = nitrogen oxides; $PM_{2.5}$= particulate matter less than 2.5microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Central

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis shown in Table 7.2-81.

Based on these results, the following conclusions can be made:

- Maximum estimated increases in cancer risk at any of the receptors due to the project are all less than threshold criteria of 10 in a million. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable.
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would cause the receptor at the intersection of Route 16 and Route 17 to increase over the threshold of 10 in a million by 0.2, in 2014. Given the projected decrease in emission rates of MSAT, this increase is not expected to occur in 2030 and the site is predicted to be below the threshold criteria. As this is not the preferred alternative, further refined modeling has not been conducted at this location. It is anticipated that applying refined modeling procedures and receptor placement, as suggested by USEPA, would result in levels below the threshold criteria. If this alternative becomes the preferred alternative, further analysis of this site would be conducted.
- At all other analysis sites in this area, applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated changes in cancer risk at any of the receptors to increase over the threshold of 10 in a million.
- Maximum estimated increases in the total chronic hazard index at any of the receptors due to the project are all less than the threshold limit of 1. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build and Build conditions are less than existing risks in most cases.

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 3 are provided in Table 7.2-82. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options.

Table 7.2-81. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 3, Central Region

	Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors ($x10^{-6}$)		*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors*		*USEPA Hazard Index*
Analysis Site	2014	2030		2014	2030	
Route 1/8	3.54	1.01	10	0.38	0.09	1
Route 4/7A	1.24/1.49	-0.15/0.64		0.62/0.17	-0.02/0.07	
Route 16/27	4.31	2.12		0.46	0.22	
Route 1 West of Route 30	0.24	0.04		0.03	0.01	

The largest increase in AADT for the roadways presented in Table 7.2-82 is predicted to occur under Route 18 in 2014. By applying a 2% truck percentage, the largest daily increase of 43,604 vehicles would result in a daily increase of 872 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Table 7.2-82. Average Daily Traffic for Major Roadways in Central Project Section under Alternative 3

	2014			*2030*		
Roadway	*No Build*	*Build*	*% Change*	*No Build*	*Build*	*% Change*
Route 1	79,337	97,400	23	84,935	93,100	10
Route 8	48,221	68,000	41	53,248	60,400	13
Route 18	49,196	92,800	89	59,980	89,200	49

Microscale CO Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in Volume 9, Appendix I, Section 3.3.7.4, 34 locations were screened based on changes in intersection volumes, delay, and LOS between the no-action and build alternatives. Twenty-eight of these locations failed the screening criteria. The Route 16/27 intersection has the highest overall volume of all the intersections that failed the screening. This site was chosen for detailed analysis. The Route 4/7A intersection has the highest overall delay of any signalized intersection that failed the screening. This site was chosen for detailed analysis. These intersections represent the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from these sites represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-83 and Table 7.2-84 and are presented in Volume 9, Appendix I, Section 3.3.7.4. The values in these tables, using the same analysis techniques and parameters as those applied for the North Region (Alternative 1), represent the predicted worst-case CO concentrations. As shown in Table 7.2-83 and Table 7.2-84 no violations of the applicable NAAQS are predicted.

Table 7.2-83. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – Central, Alternative 3

	Existing		*2014*		*2030*	
Analysis Site	*a.m.*	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 1/8	6.0	6.4	7.3	7.6	6.2	6.4
Route 4/7A	5.3	3.8	5.1	5.6	4.6	5.1
Route 16/27	8.4	9.4	8.1	9.0	7.0	7.9

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Construction Emissions Analysis

To determine the temporary air quality impacts arising from construction of the project, a detailed construction emissions analysis was conducted using the same method as described for the North Region (Alternative 1). The highest predicted construction emissions per year, per month, and the year that these emissions are predicted to occur are shown in Table 7.2-85 and Volume 9, Appendix I, Section 3.4.

Table 7.2-84. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – Central, Alternative 3

Analysis Site	*Existing*	*2014*	*2030*
Route 1/8	4.5	5.3	4.5
Route 4/7A	3.7	3.9	3.6
Route 16/27	6.6	6.3	5.5

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-85. Estimated Construction Emission Burden – Central, Alternative 3

	CO	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*VOC*	*SO_2*	*CO_2*
Maximum Yearly Value (Tons)	54.6	84.2	17.2	14.4	5.9	62.4	16,707
Highest Monthly Emission Burden (Tons)	8.5	13.1	2.2	2.2	0.9	9.7	2,590
Average Daily Emission Burden (Based on Highest Month) (Tons)	0.42	0.65	0.11	0.11	0.05	0.48	129
Year(s) Highest Monthly Emission Burden Predicted to Occur	2012	2012 & 2013	2012 & 2013	2012 & 2013	2012 & 2013	2012 & 2013	2012 & 2013

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NOx = nitrogen oxides; $PM_{2.5}$= particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Apra Harbor

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-86. Based on these results, the following conclusions can be made:

- Maximum estimated changes in cancer risk at these locations are expected to decrease at any of the receptors analyzed due to the project. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated changes in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and
- Maximum estimated changes in the total chronic hazard index are expected to decrease at any of the receptors analyzed due to the project. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build and Build conditions, are less than existing risks in most cases.

Table 7.2-86. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 3 Apra Harbor

Analysis Site	*Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors ($x10^{-6}$)*		*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors/Actual Receptors*		*USEPA Hazard Index*
	2014	2030		2014	2030	
Route 1/2A	-0.88	-0.06	10	-0.09	0.00	1

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 3 are provided in Table 7.2-87. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options. As shown in this table, the largest increase in AADT for the roadways presented is predicted to occur at Route 1 near Route 18 in 2030. By applying a 2% truck percentage, the largest daily increase of 7,258 vehicles would result in a daily increase of 145 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Table 7.2-87. Average Daily Traffic for Major Roadways in Apra Harbor Project Section under Alternative 3

	2014			*2030*		
Roadway	*No Build*	*Build*	*% Change*	*No Build*	*Build*	*% Change*
Route 1 near Route 18	46,407	49,800	7	41,142	48,400	18

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Microscale CO Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in Volume 9, Appendix I, Section 3.3.7.4, three locations were screened based on changes in intersection volumes, delay, and LOS between the no-action and build alternatives. One of these locations failed the screening criteria. The Route 1/2A intersection has the highest overall volume and highest delay of all the signalized intersections that failed the screening. This site was chosen for detailed analysis. This intersection represents the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from this site represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-88 and Table 7.2-89 and are presented in Volume 9, Appendix I, Section 3.3.7.4. The values in these tables, using the same analysis techniques and parameters as those applied for the North Region (Alternative 1), represent the predicted worst-case CO concentrations. As shown in Table 7.2-88 and Table 7.2-89 no violations of the applicable NAAQS are predicted.

Table 7.2-88. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – Apra Harbor, Alternative 3

	Existing		*2014*		*2030*	
Analysis Site	*a.m.*	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 1/2A	4.7	4.3	5.3	5.1	4.3	3.8

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-89. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – Apra Harbor, Alternative 3

Analysis Site	*Existing*	*2014*	*2030*
Route 1/2A	3.3	3.7	3.0

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Construction Emissions Analysis

To determine the temporary air quality impacts arising from construction of the project, a detailed construction emissions analysis was conducted using the same method as described for the North Region (Alternative 1). The highest predicted construction emissions per year, per month, and the year that these emissions are predicted to occur are shown in Table 7.2-90 and Volume 9, Appendix I, Section 3.4.

Table 7.2-90. Estimated Construction Emission Burden – Apra Harbor, Alternative 3

	CO	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*VOC*	*SO_2*	*CO_2*
Maximum Yearly Value (Tons)	13.5	20.9	5.0	3.7	1.2	15.4	4,199
Highest Monthly Emission Burden (Tons)	1.6	2.5	0.59	0.44	0.34	1.82	494
Average Daily Emission Burden (Based on Highest Month) (Tons)	0.08	0.12	0.03	0.02	0.02	0.0.9	24.7
Year Highest Monthly Emission Burden Predicted to Occur	2011	2011	2011	2011	2011	2011	2011

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NOx = nitrogen oxides; $PM_{2.5}$= particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

South

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-91. Based on these results, the following conclusions can be made:

- Maximum estimated increases in cancer risk at any of the receptors due to the project are all less than threshold criteria of 10 in a million. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated changes in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and
- Maximum estimated increases in the total chronic hazard index at any of the receptors due to the project are all less than the threshold limit of 1. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build and Build conditions are less than existing risks in most cases.

Table 7.2-91. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 3, South Region

Analysis Site	*Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors ($x10^{-6}$)* 2014	2030	*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors* 2014	2030	*USEPA Hazard Index*
Route 5/2A	0.39	0.00	10	0.05	0.00	1

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 3 are provided in Table 7.2-92. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options. As shown in this table, the largest increase in AADT for the roadways presented is predicted to occur at Route 4 in 2014. By applying a 2% truck percentage, the largest daily increase of 1,767 vehicles would result in a daily increase of 35 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Table 7.2-92. Average Daily Traffic for Major Roadways in South Project Section under Alternative 3

Roadway	*2014* *No Build*	*Build*	*% Change*	*2030* *No Build*	*Build*	*% Change*
Route 4	15,833	17,600	11	21,504	20,000	-7

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Microscale CO Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in Volume 9, Appendix I, Section 3.3.7.4, four locations were screened based on changes in intersection volumes, delay, and LOS between the no-action and build alternatives. Two of these locations failed the screening criteria. The Route 5/2A intersection has the highest overall volume of all the signalized intersections that failed the screening. This site was chosen for detailed analysis. This intersection represents the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from this site represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-93 and Table 7.2-94 and are presented in Volume 9, Appendix I, Section 3.3.7.4. The values in these tables, using the same analysis techniques and parameters as those applied for the North Region (Alternative 1), represent the predicted worst-case CO concentrations As shown in Table 7.2-93 and Table 7.2-94, no violations of the applicable NAAQS are predicted.

Table 7.2-93. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – South, Alternative 3

Analysis Site	*Existing*		*2014*		*2030*	
	a.m.	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 5/2A	4.2	3.9	4.5	3.9	3.8	3.5

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-94. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – South, Alternative 3

Analysis Site	*Existing*	*2014*	*2030*
Route 5/2A	2.9	3.2	2.7

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Construction Emissions Analysis

To determine the temporary air quality impacts arising from construction of the project, a detailed construction emissions analysis was conducted using the same method as described for the North Region (Alternative 1). As shown in Table 7.2-95 and Volume 9, Appendix I, Section 3.4, construction emissions are negligible.

Table 7.2-95. Estimated Construction Emission Burden – South, Alternative 3

	CO	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*VOC*	*SO_2*	*CO_2*
Maximum Yearly Value (Tons)	11.1	17.3	2.9	2.8	1.2	12.9	3310
Highest Monthly Emission Burden (Tons)	3.1	4.9	0.83	0.81	0.34	3.7	957
Average Daily Emission Burden (Based on Highest Month) (Tons)	0.16	0.25	0.04	0.04	0.02	0.18	47.8
Year(s) Highest Monthly Emission Burden Predicted to Occur	2012	2013	2012 & 2013	2012 & 2013	2013	2013	2013

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NOx = nitrogen oxides; $PM_{2.5}$= particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Proposed Mitigation Measures

Because the alternative is not predicted to cause a significant impact on air quality levels, no mitigation is proposed.

7.2.6.5 Alternative 8

Mesoscale Emissions Burden

As shown in Table 7.2-96 and Volume 9, Appendix I, Section 3.3.7.5, regional emissions are predicted to increase in the range of 19% to 21% under Alternative 8, as compared to the no-action alternative. This is primarily due to the estimated 20% increase in VMT under Alternative 8.

Table 7.2-96. Regional Annual Emission Burdens, Alternative 8

Scenario	*VMT*	*Speed*	*Emission Burden (TPY)*						
			CO	*NO_x*	*VOC*	*PM_{10}*	*$PM_{2.5}$*	*SO_2*	*CO_2*
2030 No-Action Alternative	3,535,224	28.6	13,388	478	801	78	57	562	80,499
2030 Alternative 8	4,247,334	28.0	16,143	578	971	93	68	675	96,662
Net Change from No-Action			2,755	100	170	15	11	113	16,163
Percent Change from No-Action			21	21	21	19	19	20%	20

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; TPY = tons per year; VMT = vehicle miles traveled; VOC = volatile organic compound.

North

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-97. Based on these results, the following conclusions can be made:

- Cancer and non-cancer risks at the actual receptors are substantially lower than the values estimated at the sidewalk receptors;
- Maximum estimated increases in cancer risk at any of the receptors due to the project are all less than threshold criteria of 10 in a million. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated changes in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and
- Maximum estimated increases in the total chronic hazard index at any of the receptors due to the project are all less than the threshold limit of 1. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

Table 7.2-97. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 8, North Region

Analysis Site	*Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors (x10^{-6})*		*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors/Actual Receptors*		*USEPA Hazard Index*
	2014	2030		2014	2030	
Route 1/28	2.50 / 0.39	0.32 / 0.11	10	0.28 /0.05	0.05 / 0.01	1
Route 9/Andersen AFB North Gate	0.96	0.26		0.17	0.07	

Legend: AFB = Air Force Base.

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build (i.e., no-action alternative) and Build (i.e., Alternative 8) conditions are less than existing risks in most cases.

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 8 are provided in Table 7.2-98. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options.

Table 7.2-98. Average Daily Traffic for Major Roadways in North Project Section under Alternative 8

Roadway	*2014*			*2030*		
	No Build	*Build*	*% Change*	*No Build*	*Build*	*% Change*
Route 3 and North Commercial Gate	0	65,500	NA	0	45,200	NA
Route 3 South of Route 28	11,499	57,000	15.9	12,070	25,000	107

The largest increase in AADT for the roadways presented in Table 7.2-98 is predicted to occur on Route 3 and North Commercial Gate in 2014. By applying a 2% truck percentage, the largest daily increase of

65,500 vehicles would result in a daily increase of 1,310 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Microscale CO Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in Volume 9, Appendix I, Section 3.3.7.5, 10 locations were screened based on changes in intersection volumes, delay, and LOS between the no-action and build alternatives. Five of these locations failed the screening criteria. The Route 1/28 intersection has the highest overall volume of all the intersections that failed the screening. This site was chosen for detailed analysis. The Route 9/Andersen AFB North Gate intersection was also chosen for analysis due to the extremely high delay predicted in the build scenario and the predicted high volumes at this location. These intersections represent the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from these sites represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-99 and Table 7.2-100 and are presented in Volume 9, Appendix I, Section 3.3.7.5. The values in these tables, using the same analysis techniques and parameters as those applied for the North Region (Alternative 1), represent the predicted worst-case CO concentrations. As shown in Table 7.2-99 and Table 7.2-100, no violations of the applicable NAAQS are predicted.

Construction Emissions Analysis

To determine the temporary air quality impacts arising from construction of the project, a detailed construction emissions analysis was conducted. Using the estimated project schedule along with typical equipment requirements for specific tasks, emission burden estimates of CO, NO_x, PM_{10}, and $PM_{2.5}$ were calculated. Equipment emissions were presumed to be Tier 3, with high sulfur fuel as confirmed by the construction management team. Based on the preliminary schedule, the highest emissions per year, per month, and the year that these emissions are predicted to occur are shown in Table 7.2-101 and Volume 9, Appendix I, Section 3.4.

Table 7.2-99. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – North, Alternative 8

	Existing		*2014*		*2030*	
Analysis Site	*a.m.*	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 1/28	5.5	6.0	7.1	7.4	5.8	5.7
Route 9/Andersen AFB North Gate	3.8	4.5	4.2	4.5	3.6	4.5

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: AFB = Air Force Base; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-100. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – North, Alternative 8

Analysis Site	*Existing*	*2014*	*2030*
Route 1/28	4.2	5.2	4.1
Route 9/Andersen AFB North Gate	3.2	3.2	3.2

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: AFB = Air Force Base; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-101. Estimated Construction Emission Burden – North, Alternative 8

	CO	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*VOC*	*SO_2*	*CO_2*
Maximum Yearly Value (Tons)	13.0	20.3	8.4	4.1	1.4	15.3	3,881
Highest Monthly Emission Burden (Tons)	4.7	7.3	1.8	1.3	0.51	5.4	1,462
Average Daily Emission Burden (Based on Highest Month) (Tons)	0.23	0.36	0.09	0.06	0.03	0.27	73.1
Year Highest Monthly Emission Burden Predicted to Occur	2011	2011	2011	2011	2011	2011	2011

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Central

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-102. Based on these results, the following conclusions can be made:

- Maximum estimated increases in cancer risk at any of the receptors due to the project are all less than threshold criteria of 10 in a million. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated changes in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and
- Maximum estimated increases in the total chronic hazard index at any of the receptors due to the project are all less than the threshold limit of 1. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build and Build conditions, are less than existing risks in most cases.

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 8 are provided in Table 7.2-103. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options.

Table 7.2-102. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 8, Central Region

Analysis Site	*Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors (x^{-6})*		*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors/Actual Receptors*		*USEPA Hazard Index*
	2014	2030		2014	2030	
Route 1/8	3.56	1.31	10	0.31	0.13	1
Route 4/7A	0.63/1.74	-0.08/0.80		0.55/0.20	0.00/0.09	
Route 16/27	3.70	3.37		0.42	0.29	
Route 1 West of Route 30	0.29	0.05		0.04	0.01	

Table 7.2-103. Average Daily Traffic for Major Roadways in Central Project Section under Alternative 8

Roadway	*2014*			*2030*		
	No Build	*Build*	*% Change*	*No Build*	*Build*	*% Change*
Route 1	79,337	100,500	27	84,935	95,300	12
Route 8	48,221	66,800	39	53,248	59,700	12
Route 18	49,196	80,100	63	59,980	75,100	25

The largest increase in AADT for the roadways presented in Table 7.2-103 is predicted to occur under Route 18 in 2014. By applying a 2% truck percentage, the largest daily increase of 30,904 vehicles would result in a daily increase of 618 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Microscale CO Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in Volume 9, Appendix I, Section 3.3.7.5, 34 locations were screened based on changes in intersection volumes, delay, and LOS between the no-action and build alternatives. Twenty of these locations failed the screening criteria. The Route 16/27 intersection has the third highest overall volume and the worst delay of the three highest volume intersections. This site was chosen for detailed analysis. The Route 4/7A intersection has the highest overall delay of any signalized intersection that failed the screening. This site was chosen for detailed analysis. These intersections represent the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from these sites represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-104 and Table 7.2-105 and are presented in Volume 9, Appendix I, Section 3.3.7.5. The values in these tables, using the same analysis techniques and parameters as those applied for the North Region (Alternative 1), represent the predicted worst-case CO concentrations. As shown in Table 7.2-104 and Table 7.2-105, no violations of the applicable NAAQS are predicted.

Table 7.2-104. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – Central, Alternative 8

Analysis Site	*Existing*		*2014*		*2030*	
	a.m.	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 1/8	6.0	6.4	7.3	7.4	5.6	6.0
Route 4/7A	5.3	3.8	5.2	5.3	4.6	5.0
Route 16/27	8.4	9.4	8.3	9.4	7.1	8.0

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: AFB = Air Force Base; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-105. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – Central, Alternative 8

Analysis Site	*Existing*	*2014*	*2030*
Route 1/8	4.5	5.2	4.2
Route 4/7A	3.7	3.7	3.5
Route 16/27	6.6	6.6	5.6

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: AFB = Air Force Base; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Construction Emissions Analysis

To determine the temporary air quality impacts arising from construction of the project, a detailed construction emissions analysis was conducted using the same method as described for the North Region (Alternative 1). The highest predicted construction emissions per year, per month, and the year that these emissions are predicted to occur are shown in Table 7.2-106 and Volume 9, Appendix I, Section 3.4.

Table 7.2-106. Estimated Construction Emission Burden – Central, Alternative 8

	CO	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*VOC*	*SO_2*	*CO_2*
Maximum Yearly Value (Tons)	54.6	84.2	17.2	14.4	5.9	62.4	16,707
Highest Monthly Emission Burden (Tons)	8.5	13.1	2.2	2.2	0.9	9.7	2,590
Average Daily Emission Burden (Based on Highest Month) (Tons)	0.42	0.65	0.11	0.11	0.05	0.48	129
Year Highest Monthly Emission Burden Predicted to Occur	2012	2012 & 2013	2012 & 2013	2012 & 2013	2012 & 2013	2012 & 2013	2012 & 2013

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Apra Harbor

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-107**.** Based on these results, the following conclusions can be made:

- Maximum estimated changes in cancer risk at these locations are expected to decrease at any of the receptors analyzed due to the project. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated changes in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and
- Maximum estimated changes in the total chronic hazard index are expected to decrease at any of the receptors analyzed due to the project. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build and Build conditions, are less than existing risks in most cases.

Table 7.2-107. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 8 Apra Harbor

Analysis Site	*Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors ($x10^{-6}$)*		*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors/Actual Receptors*		*USEPA Hazard Index*
	2014	2030		2014	2030	
Route 1/2A	-0.82	-0.06	10	-0.09	0.00	1

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 8 are provided in Table 7.2-108.

The largest increase in AADT for the roadways presented in Table 7.2-108 is predicted to occur under Route 1 near Route 18 in 2030. By applying a 2% truck percentage, the largest daily increase of 7,458 vehicles would result in a daily increase of 149 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Table 7.2-108. Average Daily Traffic for Major Roadways in Apra Harbor Project Section under Alternative 8

Roadway	*2014*			*2030*		
	No Build	*Build*	*% Change*	*No Build*	*Build*	*% Change*
Route 1 near Route 18	46,407	49,800	7	41,142	48,600	18

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Microscale CO Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in Volume 9, Appendix I, Section 3.3.7.5, three locations were screened based on changes in intersection volumes, delay, and LOS between the no-action and build alternatives. One of these locations failed the screening criteria. The Route 1/2A intersection has the highest overall volume and highest delay of all the signalized intersections that failed the screening. This site was chosen for detailed analysis. This intersection represents the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from this site represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-109 and Table 7.2-110 and are presented in Volume 9, Appendix I, Section 3.3.7.5. The values in these tables, using the same analysis techniques and parameters as those applied for the North Region (Alternative 1), represent the predicted worst-case CO concentrations. As shown in Table 7.2-109 and Table 7.2-110, no violations of the applicable NAAQS are predicted.

Table 7.2-109. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – Apra Harbor, Alternative 8

Analysis Site	*Existing*		*2014*		*2030*	
	a.m.	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 1/2A	4.7	4.3	5.3	5.1	4.3	3.9

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: AFB = Air Force Base; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-110. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – Apra Harbor, Alternative 8

Analysis Site	*Existing*	*2014*	*2030*
Route 1/2A	3.3	3.7	3.0

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: AFB = Air Force Base; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Construction Emissions Analysis

To determine the temporary air quality impacts arising from construction of the project, a detailed construction emissions analysis was conducted using the same method as described for the North Region (Alternative 1). The highest predicted construction emissions per year, per month, and the year that these emissions are predicted to occur are shown in Table 7.2-111 and Volume 9, Appendix I, Section 3.4.

Table 7.2-111. Estimated Construction Emission Burden – Apra Harbor, Alternative 8

	CO	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*VOC*	*SO_2*	*CO_2*
Maximum Yearly Value (Tons)	13.5	20.9	5.0	3.7	1.2	15.4	4,199
Highest Monthly Emission Burden (Tons)	1.6	2.5	0.59	0.44	0.34	1.82	494
Average Daily Emission Burden (Based on Highest Month) (Tons)	0.08	0.12	0.03	0.02	0.02	0.0.9	24.7
Year Highest Monthly Emission Burden Predicted to Occur	2011	2011	2011	2011	2011	2011	2011

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

South

MSATs and PM

The screening-level MSAT dispersion modeling analysis was conducted using both sidewalk and actual receptors. The results of this analysis are shown in Table 7.2-112. Based on these results, the following conclusions can be made:

- Maximum estimated increases in cancer risk at any of the receptors due to the project are all less than threshold criteria of 10 in a million. Therefore, the project impacts of all carcinogenic MSATs are considered acceptable;
- Applying a more conservative exposure duration of 70 years, rather than 30 years, would not cause the maximum estimated changes in cancer risk at any of the receptors to increase over the threshold of 10 in a million; and
- Maximum estimated increases in the total chronic hazard index at any of the receptors due to the project are all less than the threshold limit of 1. Therefore, the project impacts of all non-carcinogenic MSATs are considered acceptable.

In addition, based on proposed USEPA regulations to reduce air toxics, future cancer and non-cancer risks, under both No Build and Build conditions, are less than existing risks in most cases.

Table 7.2-112. Estimated Project Related Impacts Compared to Cancer Risk Threshold and Hazard Index, Alternative 8, South Region

Analysis Site	*Estimated Cancer Risk Increase or Decrease at Sidewalk Receptors/Actual Receptors ($x10^{-6}$)* 2014	2030	*Cancer Risk Threshold*	*Estimated Non-Cancer Chronic Hazard Index Increase or Decrease at Sidewalk Receptors/Actual Receptors* 2014	2030	*USEPA Hazard Index*
Route 5/2A	0.50	0.09	10	0.06	0.01	1

PM impacts would be the same as those for the North Region, Alternative 1. The ADT on the highest volume roadways under the No Build and Build Alternative 8 are provided in Table 7.2-113. As detailed in the traffic analysis for the project, truck percentages on all roadways have been estimated to be approximately 2% for both the No Build and Build options. As shown in this table, the largest increase in AADT for the roadways presented is predicted to occur at Route 4 in 2014. By applying a 2% truck percentage, the largest daily increase of 1,767 vehicles would result in a daily increase of 35 trucks. This is substantially below the FHWA example for a new highway project of 125,000 AADT with 8% trucks, which would translate to an increase of 10,000 trucks. Thus, the project is not considered to be a project of air quality concern (i.e., an expanded highway with a significant number of or significant increase in diesel vehicles).

Based on this and the discussion in the North Region Alternative 1, the project does not qualify as a project of air quality concern with respect to $PM_{2.5}$.

Table 7.2-113. Average Daily Traffic for Major Roadways in South Project Section under Alternative 8

Roadway	*2014* *No Build*	*Build*	*% Change*	*2030* *No Build*	*Build*	*% Change*
Route 4	15,833	17,600	11	21,504	19,900	-1.0

Microscale CO Analysis

A screening analysis was performed to determine which intersections could potentially degrade air quality levels due to increased delay, volume, or worsening LOS due to the project. As detailed in and Volume 9, Appendix I, Section 3.3.7.5, four locations were screened based on changes in intersection volumes, delay, and LOS between the no-action and build alternatives. One of these locations failed the screening criteria. The Route 5/2A intersection has the highest overall volume of all the signalized intersections that failed the screening. This site was chosen for detailed analysis. This intersection represents the worst-case combination of volumes, LOS, and delay of the intersections screened. As such, the predicted CO levels from this site represent the worst-case microscale CO impacts expected from the project.

The results of the microscale analysis are shown in Table 7.2-114 and Table 7.2-115 and are presented in Volume 9, Appendix I, Section 3.3.7.5. The values in these tables, using the same analysis techniques and parameters as those applied for the North Region (Alternative 1), represent the predicted worst-case CO concentrations. As shown in Table 7.2-114 and Table 7.2-115 no violations of the applicable NAAQS are predicted.

Table 7.2-114. Predicted Worst-Case 1-Hour CO Concentrations (ppm) – South Region, Alternative 8

	Existing		*2014*		*2030*	
Analysis Site	*a.m.*	*p.m.*	*a.m.*	*p.m.*	*a.m.*	*p.m.*
Route 5/2A	4.2	3.9	4.5	4.0	3.9	3.7

Notes: 1-hour CO NAAQS = 35 ppm. Includes a background concentration of 2 ppm.
Legend: AFB = Air Force Base; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Table 7.2-115. Predicted Worst-Case 8-Hour CO Concentrations (ppm) – South Region, Alternative 8

Analysis Site	*Existing*	*2014*	*2030*
Route 5/2A	2.9	3.2	2.7

Notes: 8-hour CO NAAQS = 9 ppm. Includes a background concentration of 1.4 ppm.
Legend: AFB = Air Force Base; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards, ppm = parts per million.

Construction Emissions Analysis

To determine the temporary air quality impacts arising from construction of the project, a detailed emission construction analysis was conducted using the same method as described for the North Region (Alternative 1). As shown in Table 7.2-116 and Volume 9, Appendix I, Section 3.4, construction emissions are negligible.

Table 7.2-116. Estimated Construction Emission Burden – South, Alternative 8

	CO	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*VOC*	*SO_2*	*CO_2*
Maximum Yearly Value (Tons)	11.1	17.3	2.9	2.8	1.2	12.9	3310
Highest Monthly Emission Burden (Tons)	3.1	4.9	0.83	0.81	0.34	3.7	957
Average Daily Emission Burden (Based on Highest Month) (Tons)	0.16	0.25	0.04	0.04	0.02	0.18	47.8
Year Highest Monthly Emission Burden Predicted to Occur	2012	2013	2012 & 2013	2012 & 2013	2013	2013	2013

Legend: CO = carbon monoxide; CO_2 = carbon dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Proposed Mitigation Measures

Because the alternative is not predicted to cause a significant impact on air quality levels, no mitigation is proposed.

7.2.6.6 Summary of Impacts

Table 7.2-117 summarizes the potential air quality impacts associated with each of the roadway project alternatives.

Table 7.2-117. Summary of Potential Impacts to Air Quality -Roadway Projects

Potentially Impacted Resource	*Alternative 1*	*Alternative 2*	*Alternative 2 Constrained*	*Alternative 3*	*Alternative 8*
Regional Air Quality	LSI	LSI	LSI	LSI	LSI
Mobile Source Air Toxics	LSI	LSI	LSI	PI	LSI
Local Carbon Monoxide Levels	LSI	LSI	LSI	LSI	LSI
Air Quality during Construction	LSI	LSI	LSI	LSI	LSI

Legend: LSI = Less than significant impact. PI = Potential impact.

Construction activities for all alternatives would result in less than a significant impact to air quality resources because the roadway construction associated emissions were predicted to be below the significance criterion of 250 TPY.

The proposed project would increase regional operation VMT by approximately 18% to 20%, compared to the no-action alternative. This would increase regional pollutant levels (i.e., CO, HC, PM_{10}, $PM_{2.5}$, NO_x) under the build alternatives by approximately 18% to 23%. However, the predicted operational emissions would be below the significance criteria of 250 TPY with an exception of CO under each alternative. However, since the 250 TPY threshold is selected in the context of the *de minimis* threshold established in the CAA GCR providing only an indication of potential significant impact, a formal impact analysis was conducted with respect to potential CO impact. Based on a refined CO concentration modeling analysis for on road vehicle operational impact described in this Volume, no exceedances of the CO NAAQS were predicted at the location of anticipated highest emissions. Therefore, each proposed alternative would not result in a significant CO impact even though the regional emissions would exceed 250 TPY. Consequently, the proposed alternatives would result in a less than significant impact on air quality.

- MSAT levels are predicted to increase under the build alternatives at specific locations and decrease at others, as compared to the no-action alternative. Applying a 30-year exposure duration to the predicted MSAT levels results in no significant carcinogenic or noncarcinogenic impacts at any of the locations analyzed. Applying a more conservative 70-year exposure duration to the predicted MSAT levels results in a potential increase over the threshold of 10 in a million in cancer risk at one location, the intersection of Route 16 and Route 17. This increase over the threshold level is predicted to occur in 2014 under Alternative 3. Given the projected decrease in emission rates of MSAT, this increase is not expected to occur in 2030 and the MSAT emissions at this site are predicted to be below the threshold criteria. As Alternative 3 is not the preferred alternative, further refined modeling has not been conducted at this location. It is anticipated that applying refined modeling procedures, as suggested by USEPA, would result in levels below the threshold criteria. If this alternative becomes the preferred alternative, further analysis of this site would be conducted. All other locations analyzed are predicted to have no significant carcinogenic or noncarcinogenic impacts due to the project alternatives when applying the 70-year exposure duration.

7.2.6.7 Summary of Proposed Mitigation Measures

No mitigation measures are required for impacts to air quality from roadway improvement projects. It is anticipated that the predicted increase in cancer risk at the location of Route 16 and Route 27 under Alternative 3, using screening level analysis methodology and an exposure duration of 70 years, would be negated with the use of refined analysis procedures.

Implementation of the adaptive program management and force flow mitigation measures could further reduce impacts to air quality by lowering peak population levels during construction. See Volume 7 for a full description of these two mitigation measures.

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CHAPTER 8.
NOISE

8.1 INTRODUCTION

This chapter describes the potential utilities and traffic noise-related consequences associated with implementing the alternatives. Refer to the respective chapters of Volume 2 for a description of the affected environment for all resources. The locations described in that Volume include the region of influence for the utilities and off base roadway projects component of the proposed action. Analysis of long-term alternatives was not done because those alternatives are not yet ripe for project specific analysis.

8.2 ENVIRONMENTAL CONSEQUENCES

8.2.1 Approach to Analysis

Potential sound-generating events associated with the proposed action were identified and the potential sound levels that could result from these activities were estimated on the basis of published military information on sound sources. These estimated sound levels were reviewed to determine whether they would represent a significant increase in the current ambient sound level, would have an adverse impact on a substantial population of sensitive receptors, or would be inconsistent with any relevant and applicable standards. Detailed descriptions of activities and analysis of noise resulting from them are provided in their respective chapters.

8.2.1.1 Methodology

Utilities

Construction

Construction noise is generated from heavy equipment on job sites and Table 8.2–1 provides a list of representative samples of construction equipment and associated noise levels. Impact devices typically generate more noise than non-impact devices. Acoustical usage factor refers to the percentage of time the equipment is running at full power on the job site. The Federal Highway Administration (FHWA) published a Roadway Construction Noise Model to predict noise levels adjusted from empirical data for construction operations to the actual distance of a receptor (FHWA 2006b).

Table 8.2–1. Samples of Construction Noise Equipment

Equipment Description	*Impact Device*[1]	*Acoustical Usage Factor*[2] *(%)*	*Actual Measured L_{max} @ 50 feet*[3] *(dBA, slow) (Samples Averaged)*	*Number of Actual Data Samples*[4] *(Count)*
All Other Equipment > 5 HP	No	50	NA	0
Backhoe	No	40	78	372
Clam Shovel (dropping)	Yes	20	87	4
Compactor (ground)	No	20	83	57
Compressor (air)	No	40	78	18
Concrete Mixer Truck	No	40	79	40
Concrete Saw	No	20	90	55
Crane	No	16	81	405
Dozer	No	40	82	55
Dump Truck	No	40	76	31
Excavator	No	40	81	170
Front End Loader	No	40	79	96
Generator	No	50	81	19
Grader	No	40	NA	0
Impact Pile Driver	Yes	20	101	11
Jackhammer	Yes	20	89	133
Pavement Scarifier	No	20	90	2
Paver	No	50	77	9
Pneumatic Tools	No	50	85	90
Roller	No	20	80	16
Scraper	No	40	84	12
Tractor	No	40	NA	0
Vibratory Pile Driver	No	20	101	44

Notes: [1] Indicates whether or not the equipment is an impact device.

[2] The acoustical usage factor refers to the percentage of time the equipment is running at full power on the job site and is assumed at a typical construction site for modeling purposes.

[3] The measured "Actual" emission level at 50 feet for each piece of equipment based on hundreds of emission measurements performed on Central Artery/Tunnel, Boston, MA work sites.

[4] The number of samples that were averaged together to compute the "Actual" emission level.

Legend: dBA = A-weighted decibel; HP = horsepower; L_{max} = Maximum Sound Level; NA = not applicable.

Source: FHWA 2006a.

Maximum sound levels (L_{max}) are the greatest sound pressure level generated by the source. Another way of describing fluctuating sound is to describe the fluctuating sound heard over specific periods as if it had been a steady, unchanging sound. For this condition, the equivalent sound level (L_{eq}) can be computed. L_{eq} is the constant sound level that, in a given situation and period (e.g., 1 hour, denoted by $L_{eq(1)}$, or 24 hours, denoted as $L_{eq(24)}$), conveys the same sound energy as the actual time-varying sound. Sound pressure levels reported in this chapter are L_{max} and 1 hour L_{eq}.

The decibel (dB) level of a sound decreases (or attenuates) exponentially as the distance from the source increases. For a single point source, like a construction bulldozer, the sound level decreases by approximately 6 dB for each doubling of distance from the source. Sound that originates from a linear, or 'line' source, such as a passing aircraft, attenuates by about 3 dB for each doubling of distance where no other features such as vegetation, topography, or walls absorb or deflect the sound. Depending on their nature, such features can range from minimal to substantial ability to reduce noise levels.

Operational Noise

Operational noise associated with utility and roadway projects would be noise levels for operating conditions of power generation facilities, water treatment facilities, wastewater facilities, and landfills.

Operational roadway noise would be due to the traffic on the roadways. FHWA has prepared a traffic study and road traffic noise is included in Volume 2, Chapter 6, Section 6.2. Power transmission lines carrying high voltage can make a buzzing noise, but generally at low levels and is not discussed further in this Environmental Impact Statement.

Off Base Roadways

Noise analysis for the proposed roadway improvement projects is performed following FHWA procedures outlined in 23 Code of Federal Regulations 772 and Guam Department of Public Works (GDPW) Traffic Noise Abatement Policy (GDPW 2009). The following paragraphs provide a brief description of:

- Noise characteristics
- Applicable policies on noise on Guam
- Noise modeling procedures performed as part of the noise analysis

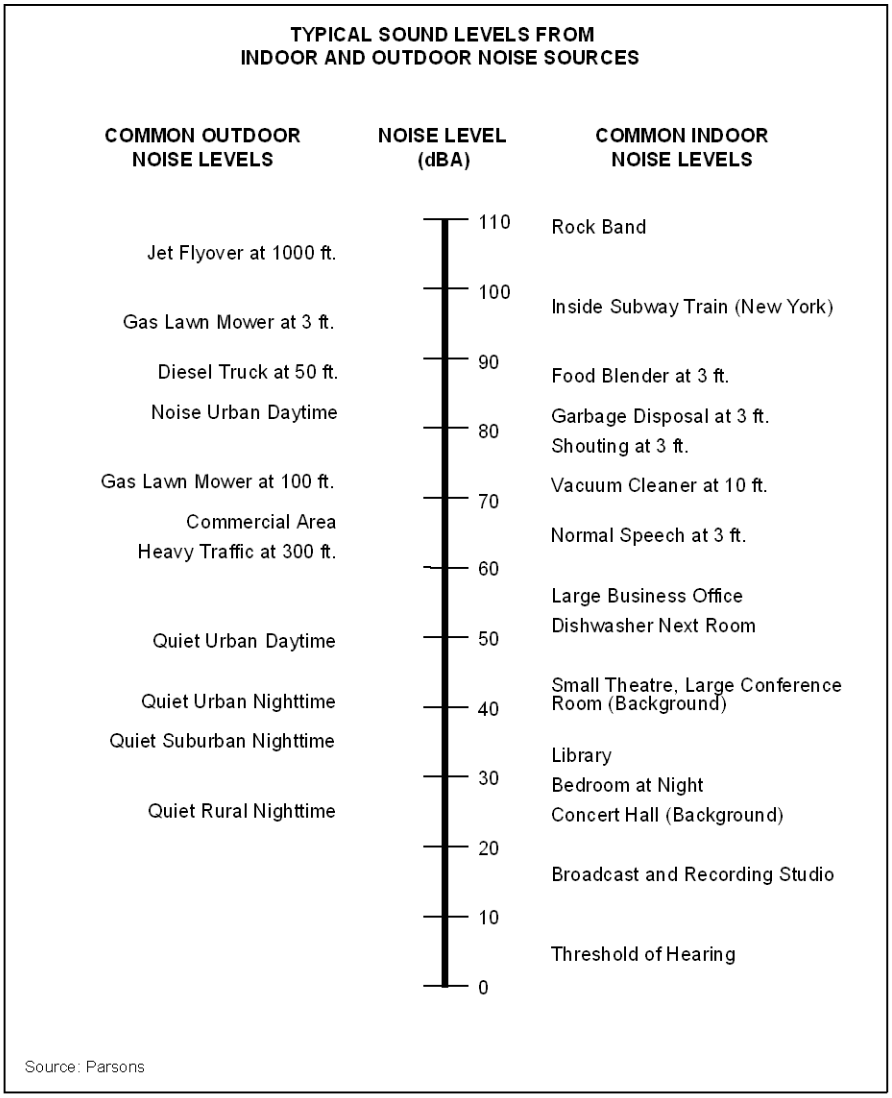
As required by FHWA, the noise analysis presented in this section includes year 2030 no-action alternative, Alternatives 1, 2, 3, and 8 traffic noise level predictions, noise impact evaluation, and noise abatement for primary noise sources in the project study area resulting from local traffic.

Noise Characteristics

Sound is a disturbance created by a moving or vibrating source in a gaseous or liquid medium or the elastic stage of a solid, and it is capable of being detected by the hearing organs. Noise is defined as unwanted sound. It is emitted from many sources, including airplanes, factories, railroads, power generation plants, and highway vehicles. Highway noise or traffic noise is usually a composite of noise from engine, exhaust, and tire-roadway interaction. The magnitude of noise is usually described by its sound pressure. Because the range of sound pressure varies greatly, the logarithmic scale dB is used to relate sound pressure. Sound pressures described in decibels are often defined in terms of frequency-weighted scales (i.e., A, B, C, or D). The A-weighted decibel (dBA) scale is used in vehicle noise measurements because it reflects the frequency range to which the human ear is most sensitive (i.e., 500 to 6,000 Hertz). Sound measured using an A-weighted decibel scale is generally expressed as dBA. Throughout this chapter, all noise levels are expressed in dBAs. Several examples of sound pressure levels in dBA scale are listed in Figure 8.2-1. The degree of disturbance or annoyance of unwanted sound depends essentially on three factors:

- The amount and nature of the intruding noise
- The relationship between background noise and the intruding noise
- The type of activity occurring where the noise is heard

Because sound is described in a logarithmic scale, sound levels cannot be added by ordinary arithmetic means. In fact, a doubling of the sound energy produces only a 3-dBA increase in the decibel level. Studies have shown that this increase is barely perceptible to the human ear, whereas a change of 5 dBA is readily perceptible. As a general rule, an increase or decrease of 10 dBA in sound level is perceived by an observer to be a doubling or halving of the sound, respectively.



Source: Parsons

Figure 8.2-1. Typical A-Weighted Noise Levels

Decibels measure sound levels at just one moment, and because very few sounds are constant in nature, other ways of describing sound over more extended periods have been developed. One way of describing fluctuating sound is to describe the fluctuating sound heard over specific periods, as if it had been a steady, unchanging sound. For this condition, a descriptor called the L_{eq} can be computed. L_{eq} is the constant sound level that, in a given situation and period (e.g., 1 hour, denoted by $L_{eq(1)}$, or 24 hours, denoted as $L_{eq(24)}$), conveys the same sound energy as the actual time-varying sound. All sound pressure levels reported in this chapter would be $L_{eq(1)}$.

Noise Model

The FHWA Traffic Noise Model version 2.5 was used for noise computations (FHWA 2004). Traffic Noise Model input data are based on a three-dimensional model created for the terrain of the study area being modeled. All roadway, barrier, and receiver points are defined by their x, y, and z coordinates.

Roadways and barriers are coded into Traffic Noise Model as line segments defined by their end points. Receptors, defined as single points in an array perpendicular to the alignment for each Guam Road Network (GRN), were used to determine the distance from the alignment center line at which the future traffic-generated noise for different alternatives could impact a noise-sensitive receiver. Receivers were modeled at a height of 5 feet (ft) (2 meters [m]) above ground elevation. After noise impacts were determined, mitigation analysis was completed by adding an array of receptors parallel to alignment for noise impacted areas that were determined to be feasible for mitigation.

Morning and evening (a.m. and p.m.) peak-hour traffic volumes were used in the noise model. However, for most of the modeled cases, the p.m. peak traffic volumes were used because the future peak afternoon traffic volumes are typically larger than the future traffic volumes for the morning. Where future traffic peak-hour traffic volumes were Level of Service (LOS) D or worse, LOS C was used to represent the worst-case future noise condition because highest traffic noise levels occur when traffic is heavy, but remains free-flowing. Studies have demonstrated that high LOS C or low LOS D volumes and related speeds create the highest traffic noise levels. While normal stop-and-go situations at intersections could generate localized instantaneous elevated noise levels, noise impacts are determined from the average hourly noise levels. Stop-and-go conditions near intersections produce lower traffic noise levels than similar conditions in congested peak hour traffic (i.e., free flowing traffic results in higher noise levels than at intersections). Volumes and speeds used in the traffic analysis represent the highest traffic noise levels associated with each roadway.

8.2.1.2 Determination of Significance

Noise impacts result from perceptible changes in the overall noise environment that increase annoyance or affect human health. Annoyance is a subjective impression of noise and is subject to both physical and emotional variables. To increase annoyance, the cumulative noise energy must increase measurably. Human health effects, such as hearing loss and noise-related awakenings can result from noise. For this Environmental Impact Statement, noise is evaluated for both construction and operational activities. It is not anticipated that maintenance activities would noticeably contribute to the noise environment due to their intermittent nature and short duration. The threshold level of significant impacts for noise is:

- Facility construction noise resulting in an hourly L_{eq} of 75 dBA (based on United States Environmental Protection Agency data for construction noise) at a sensitive receptor (such noise exposure would be equivalent to noise Zone III) or consistent exposure to noise levels at 85 dBA, over an 8-hour period, the National Institute for Occupational Safety and Health recommended exposure limit.
- Road construction noise uses a significance threshold based on Federal Transit Authority guidelines of 80 dBA during daylight hours and 70 dBA during nighttime (10 p.m. to 7 a.m.). This threshold differs from facility construction thresholds because facility construction is concentrated at the same location and typically lasts for longer durations. In contrast, road construction proceeds along the road alignment and sensitive receptors are affected for shorter durations.

For road traffic noise, federal and Guam regulations, standards, and policies relating to traffic noise are discussed in detail in the GDPW Traffic Noise Abatement Policy (2009). The following is a brief discussion of Guam regulations, standards, and policies.

GDPW Traffic Noise Abatement Policy

The purpose of this Traffic Noise Abatement Policy is to protect the public from traffic noise associated with highways and maintain quality of life for the public by setting forth methods to: (a) identify potential noise-sensitive areas; (b) provide the basis for uniformity in analysis of traffic noise; and (c) determine feasibility and reasonableness of noise abatement measures. This policy adopted by the GDPW is in reference to the currently accepted practices and procedures used by FHWA to assess highway-related traffic noise levels.

The Traffic Noise Abatement Policy has seven sections: Introduction, Definitions, Noise Abatement Criteria, Noise Impact Determination, Feasibility and Reasonableness of Abatement, Noise Abatement Implementation and Public Involvement, and Extenuating Circumstances.

Under the GDPW policy, future traffic noise levels would be considered as posing an impact, if any noise sensitive receiver that has a loudest hourly noise level $L_{eq(h)}$ approaching (within 1 dB) or exceeding the Noise Abatement Criteria (NAC) as summarized in Table 8.2–2 for the corresponding land use category, or exceeding existing noise levels by 12 dB.

Table 8.2–2. Activity Categories and Noise Abatement Criteria

Activity Category	*$L_{eq(h)}$ dBA*	*Description of Activity Category*
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, places of worship, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	NA	Undeveloped lands.
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Legend: dBA = A-weighted decibel; L_{eq} = equivalent sound level.
Source: Guam Department of Public Works.

When potential impacts are identified, GDPW would consider noise abatement measures and make a determination regarding the feasibility and reasonableness of such measures. GDPW policies provide that only abatement measures that have been determined to be feasible and reasonable would be incorporated in projects. Feasibility depends primarily on engineering considerations, such as the local topography, safety, road maintenance requirements, or the ability to achieve at least a 5 dBA reduction in noise at an impacted receptor. Findings based on common sense and good judgment should be cited in the determination of reasonableness. Factors such as the ability to achieve at least a 5 dBA reduction in noise for at least one first row receptor, the number of receptors that would benefit from the noise barrier, the cost of the noise barrier per benefited receptor (with a maximum allowance of $35,000 per benefited receptor), neighborhood opinions, and environmental effects are considered when determining reasonableness. Each benefited nonresidential receptor, such as schools, parks, and cemeteries, would be counted as one benefited residential receptor per 100 ft (30 m) of frontage outdoor land use along the roadway. A memo disseminated by FHWA in 1995 added cemeteries to NAC Category B (FHWA 1995). GDPW coordinates with local governments to support compatible land use development. GDPW would identify noise receptors within project corridors that are on or along developed land. GDPW would also identify noise receptors on undeveloped land for which development is planned, provided such development includes activity sites of the types described in the NAC and provided that local permits for the development have been acquired or applied for on or before commencement of the noise analysis. GDPW would furnish the results of highway traffic noise analyses to local government officials and would encourage local communities and developers to practice noise-compatible development. Local government coordination would be accomplished through the distribution of highway project environmental documents and noise study reports.

The significance criteria expressed in this section applies to human receptors, but noise could also affect biological resources, land use, and cultural resources. Refer to specific resource sections for details about the noise impacts to biological and other resources.

8.2.1.3 Issues Identified During Public Scoping

The Scoping Summary Meeting Report did not specifically mention public concerns about increased noise pollution due to the proposed action for the utility and roadway construction.

8.2.2 Power

8.2.2.1 Basic Power Alternative 1 (Preferred Alternative)

Basic Power Alternative 1 would recondition up to five existing Guam Power Authority permitted facilities to provide peaking power/reserve capacity and would not require new construction at or enlargement of the existing footprint of the facility. This work would be undertaken by the Guam Power Authority on its existing permitted facilities. Reconditioning would be made to existing permitted facilities at the Marbo, Yigo, Dededo (2 units), and Macheche Combustion Turbines (CTs). These CTs are not currently being used up to permit limits. In addition, Transmission and Distribution (T&D) system upgrades would be on existing above ground and underground transmission lines. This alternative supports Main Cantonment Alternatives 1 and 2. Main Cantonment Alternatives 3 and 8 would require additional upgrades to the T&D system.

Construction

The only construction activities associated with this alternative would be installing transmission lines. Power transmission line installation typically does not involve a concentration of heavy equipment. Specifically, for overhead transmission line upgrades there is usually a grader for site preparation, concrete work for foundations, and a crane for tower installation. The footprint of transmission towers are usually small and the equipment would not remain in place for long periods of time. Therefore, there are less than significant noise impacts because the construction of transmission lines is expected to be minimal and very short-term.

Some of the transmission lines would be installed underground. Construction equipment associated with installing underground utilities primarily includes backhoes and trenchers for digging the trench and backhoes, pavers, and rollers for refilling and finishing the surface creating noise levels of about 80 dBA at 50 ft (15 m) from the source attenuating to 68 dBA L_{eq} at 250 ft (76 m). Installing transmission lines involves excavating a portion of the trench, installing a segment of the line and backfilling the trench. Usually this occurs in segments anywhere from 100 ft (31 m) to 1,000 ft (305 m) or more and the activities move relatively rapidly along the corridor, thus not impacting any single receptor for much more than a couple of days. Therefore, impacts would be considered less than significant.

Operation

CTs generate noise similar to jet aircraft engines, but sound generation can be controlled by the facility since the turbine is located inside a building. Since Basic Power Alternative 1 would be for reconditioning only, the expected sound levels would remain about the same as the existing noise levels. Therefore, there would be no new noise impacts.

Proposed Mitigation Measures

The only noise impacts identified for Basic Power Alternative 1 would be due to installing transmission lines and be less than significant (Table 8.2–3); therefore, no mitigation is proposed.

Table 8.2–3. Summary of Potential Noise Impacts – Power

Potentially Impact	*Basic Power Alternative 1**
Construction (direct and indirect same)	LSI
Operation (direct and indirect same)	NI

Legend: LSI= Less than significant impact; NI = No impact. *Preferred Alternative.

The Basic Power Alternative 1 would have minimal noise impacts because this project predominately uses existing facilities. No mitigation would be required for Basic Power Alternative 1 of this proposed action.

8.2.3 Potable Water

8.2.3.1 Basic Alternative 1 (Preferred Alternative)

Basic Alternative 1 would provide additional water capacity of 11.3 MGd (42.8 MLd), which is anticipated to be met by an estimated 22 new wells at Andersen Air Force Base (AFB), rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 2.5 MG (9.5 ML) water storage tanks would be constructed at ground level at NCTS Finegayan. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

Construction

At Andersen AFB, the anticipated new water wells (including one contingency well) would be drilled. A 1,000-ft (305-m) wellhead protection arc is generated at each well that constrains land use within the arc. Drill rig augers create noise levels of 84.4 dBA L_{max}. At 1,000 ft (305 m), the noise would attenuate to a level of 58.3 L_{max} and 52.5 L_{eq}, both well under the acceptable standard limits of 75 dBA.

New storage tanks are proposed on Naval Computer and Telecommunications Station Finegayan and Air Force Barrigada. Erecting storage tanks would involve using graders, cranes, man-lifts, welders, and other equipment generating noise levels up to about 80 dBA. At 250 ft (76 m), this would attenuate to 64 dBA L_{eq} and about 58 dBA at 500 ft (152 m).

Distribution pipelines would be installed underground. The alignment of the pipelines would be along the southern boundary of Andersen AFB and along Route 3. Water main replacement would occur at numerous locations throughout Guam. Construction equipment associated with installing pipelines primarily includes backhoes and trenchers for digging the trench, and backhoes, pavers, and rollers for refilling and finishing the surface. This equipment would create noise levels of about 80 dBA at 50 ft (15 m) from the source attenuating to 68 dBA L_{eq} at 250 ft (76 m). Installing pipelines involves excavating a portion of the trench, installing a segment of pipeline, and backfilling the trench. Usually this work occurs in segments anywhere from 100 ft (31 m) to 1,000 ft (305 m) or more and the activities move relatively rapidly along the work corridor. Consequently, any single receptor would not be impacted for much more than a couple of days. Therefore, potential noise impacts would be less than significant.

Operation

Wells would be located within the property. Overhead tanks do not create operational noise, and once installed, the pipeline would not make any noise. Although nowhere near as noisy, similar to power plant design, design engineers would take into consideration noise producing equipment and design appropriate sound dampening equipment, if necessary. Therefore, potential noise impacts would be less than significant.

Proposed Mitigation Measures

No long-term adverse noise impacts were identified. No mitigation is proposed.

8.2.3.2 Basic Alternative 2

Basic Alternative 2 would provide additional water capacity of 11.7 MGd (44.3 MLd), which is anticipated to be met by an estimated 20 new wells at Andersen Air Force Base (AFB) and 11 new wells at Air Force Base Barrigada, rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 1.8 MG (6.8 ML) water storage tanks would be constructed at ground level at NCTS Finegayan and one 1 MG (3.8 ML) water storage tank would be construction at Air Force Base Barrigada. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

Construction

Construction noise would be the same as Alternative 1.

Operation

Operational noise would be the same as Alternative 1.

Proposed Mitigation Measures

No long-term adverse noise impacts were identified. No mitigation is proposed.

8.2.3.3 Summary of Impacts

Table 8.2–4 summarizes the potential impacts of each basic alternative. A text summary is provided below.

Table 8.2–4. Summary of Potential Noise Impacts – Potable Water

Potentially Impact	*Basic Alternative 1**	*Basic Alternative 2*
Construction (direct and indirect same)	LSI	LSI
Operation (direct and indirect same)	NI	NI

Legend: LSI= Less than significant impact; NI= No impact; *Preferred Alternative.

Noise impacts associated with the potable water installation projects would be limited to pipeline installation and replacement. Construction noise could approach 68 dBA as the construction progresses, but would be short-term, lasting only a few days or weeks in the particular section of pipeline being installed at the time. Therefore, based on the above noise analysis, both Potable Water Alternatives 1 and

2 are deemed to have less than significant impacts from additional noise during construction and no impact during operation to the inhabitants and environment of Guam.

8.2.4 Wastewater

8.2.4.1 Basic Alternative 1a (Preferred Alternative) and 1b

Basic Alternative 1 (Alternative 1a supports Main Cantonment Alternatives 1 and 2; and Alternative 1b supports Main Cantonment Alternatives 3 and 8) combines upgrades to the existing primary treatment facilities and expansion to secondary treatment at the Northern District Wastewater Treatment Plant (NDWWTP). The difference between Alternatives 1a and 1b is a requirement for a new sewer line from Barrigada housing to NDWWTP for Alternative 1b.

Construction

Sewer lines would be placed within areas where there are no sensitive noise receptors, such as residential areas, schools, and hospitals. Similarly, the sewer lines would not be constructed in the threatened and endangered species sensitive areas. As such, construction noise impacts associated with refurbishing the existing NDWWTP would be temporary and short-term, resulting in less than significant noise impact.

Constructing the secondary treatment portion of the NDWWTP would be in an area where there are no sensitive noise receptors, such as residential areas, schools, and hospitals. This area is not in any threatened and endangered species sensitive areas. As such, construction noise impacts associated with the new secondary treatment portion of the NDWWTP would be temporary and short-term, resulting in less than significant noise impact.

Operation

There would be no operational noise impacts associated with refurbishing the existing NDWWTP and expanding the secondary treatment portion to the existing NDWWTP.

Proposed Mitigation Measures

No adverse noise impacts were identified and no mitigation is proposed.

8.2.4.2 Summary of Impacts

Table 8.2–5 summarizes the potential impacts of each interim alternative. A text summary is provided below.

Table 8.2–5. Summary of Potential Noise Impacts – Wastewater Projects

Potentially Impact	*Basic Alternative 1a**	*Basic Alternative 1b*
Construction (direct and indirect same)	LSI	LSI
Operation (direct and indirect same)	NI	NI

Legend: LSI= Less than significant impact; NI= No impact; *Preferred Alternative.

The only noise impacts associated with the wastewater projects would be during installation of pipelines, refurbishment of the primary treatment capability at the existing NDWWTP, and construction of the new secondary treatment portion at the existing NDWWTP, which would be less than significant as these impacts would be short-term and not elevate noise in any particular area for more than several days.

8.2.5 Solid Waste

8.2.5.1 Basic Alternative 1 (Preferred Alternative)

The Preferred Alternative would be to continue to use the Navy landfill at Apra Harbor for municipal solid waste (MSW) until the new GovGuam Layon Landfill at Dandan is available for use. Disposal of other waste streams excluded from Layon Landfill would continue at the Navy landfill. Construction and demolition (C&D) debris would continue to be disposed of at the Navy hardfill.

Construction

Since there is no new construction involved in this alternative, there would be no noise impacts from construction.

Operation

For operations, there would be a higher solid waste generation from the Department of Defense relocation. Thus, there could be additional hours of operations required and additional truck traffic for hauling solid waste. The operations are adequately isolated to prevent significant noise impacts to the surrounding environment. Increased noise from traffic is analyzed in the traffic section in this chapter.

8.2.5.2 Summary of Impacts

Table 8.2–6 summarizes the potential impacts of the basic alternative.

An analysis of long-term alternatives was not developed because the alternatives are not ready for project-specific analysis. A text summary is provided below.

Table 8.2–6. Summary of Potential Noise Impacts – Solid Waste Projects

Potentially Impact	*Basic Alternative 1**
Construction (direct and indirect same)	NI
Operation (direct and indirect same)	LSI

Legend: LSI= Less than significant impact; NI= No impact. *Preferred Alternative.

The only noise impacts associated with the solid waste alternative would be during operations, which would be less than significant as these impacts are a small increase to the current situation and adequately isolated from the surrounding environment.

8.2.6 Off Base Roadways

Noise impacts for each alternative were analyzed by first calculating the distance from the alignment center line at which each GRN future traffic would cause noise impacts at noise-sensitive receptor locations. Then, a 66-dBA noise contour line was placed along each alternative alignment to determine the number of noise-impacted areas per alternative. The 66-dBA noise contour line was used because 66 dBA is considered to approach the NAC of 67 dBA as defined in Guam's Noise Abatement Policy. Each nonresidential receptor, such as schools and parks, is considered as one outdoor use receptor per 100 ft (30 m) of frontage outdoor use area along the roadway. Within each geographic region, impacted noise-sensitive receptors were then grouped together as representative areas adjacent to the alignment. The noise abatement evaluation was then conducted for these identified areas.

8.2.6.1 Alternative 1

Year 2014 (Peak Construction and Peak Population)

Noise impacts during year 2014 would mostly be derived from construction activities. Construction noise impacts in each geographical region would be similar. Because the Territory of Guam does not have an ordinance covering construction noise, the FHWA daytime construction noise limit for residential land uses is to be used for this project, as recommended in the 2006 FHWA Construction Noise Handbook (FHWA 2006a). Table 8.2–7 summarizes the FHWA allowable construction noise levels. These limits are for 8-hour average noise levels (L_{eq}) at the property line of the nearest location to the construction site.

Table 8.2–7. Allowable Construction Noise Levels

Land Use	*Daytime (7 a.m. to 10 p.m.) L_{eq}, dBA*	*Nighttime (10 p.m. to 7 a.m.) L_{eq}, dBA*
Residential	80	70

Legend: dBA = A-weighted decibel; L_{eq} = equivalent sound level.
Source: FHWA 2006a.

Construction noise varies greatly depending on the construction process, type and condition of equipment used, and layout of the construction site. Many of these factors are traditionally left to the contractor's discretion, making it difficult to accurately estimate levels of construction noise. Overall, construction noise levels are governed primarily by the noisiest pieces of equipment. The engine, that is usually diesel, is the dominant noise source for most construction equipment.

Table 8.2–8 summarizes typical construction noise emission levels (L_{max}) of construction equipment operating at full power at a reference distance of 50 ft (15 m), and an estimated equipment usage factor (UF) based on experience with other similar construction projects. The UF is a fraction that accounts for the total time during an 8-hour day in which a piece of construction equipment is producing noise under full power. Although the noise levels in Table 8.2–8 represent typical values, there can be wide fluctuations in the noise emissions of similar equipment. Distance (D) is also considered in the construction noise analysis. In all areas between the alignment and noise sensitive receptors, a ground factor (G) of 0.0 was used. This factor represents an acoustically hard ground cover, representing the ground effect as the sound propagates from the source to the receptor. The calculation used to determine average construction noise exposure for each piece of equipment is based on the above factors using the following equation:

$$L_{eq} = L_{max} + 10\ \mathrm{Log}(UF) - 20\ \mathrm{Log}(D/50) - 10\ G\ \mathrm{Log}(D/50)$$

Where:

- L_{eq} is the 8-hour average noise level in dBA
- L_{max} is the maximum noise level at 50 ft in dBA
- UF is the usage factor of the construction equipment
- D is the distance to the affected noise sensitive area
- G is the ground factor characterizing the sound absorption of the ground between the source and the receiver

After calculating noise exposure for each piece of equipment, the noise exposures for all equipment being used in a construction stage were combined together to determine the total noise impact. The equipment noise levels within a particular stage were combined together to obtain a total noise exposure for each stage (listed as shaded entries in Table 8.2–8). This total noise evaluation process does not combine noise levels of different stages because they would not occur at the same time in a given area. Because the distance between most of the noise-sensitive receptors and the construction site is greater than 75 ft (23 m), no noise impacts due to construction activities are anticipated except for a few areas where residences are located next to the roadway.

Table 8.2–8. Estimated Construction Noise Levels

No. of Items	*Equipment Type*	*Maximum Equipment of Noise Level at 50 ft, dBA*	*8 Hour Equivalent Noise Level at 50 ft, dBA*	*8 Hour Equivalent Noise Level at 75 ft, dBA*	*8 Hour Equivalent Noise Level at 100 ft, dBA*
Full-Depth Reconstruction					
1	Wheel Loader	74	69	65	63
1	Scraper	76	71	67	65
1	Asphalt Zipper	80	72	68	66
2	Grader	76	68	64	62
2	Roller	78	73	69	67
2	Backhoe	81	76	72	70
1	Paving Machine	79	74	70	68
		Combined $L_{eq(h)}$	**83**	**79**	**77**
Mill and Overlay					
1	Milling Machine	81	73	69	67
2	Roller	78	73	69	67
1	Backhoe	81	76	72	70
1	Paving Machine	79	74	70	68
		Combined $L_{eq(h)}$	**81**	**77**	**75**
Widening					
1	Wheel Loader	74	69	65	63
2	Scraper	76	71	67	65
1	Grader	76	68	64	62
2	Roller	78	73	69	67
2	Backhoe	81	76	72	70
1	Paving Machine	79	74	70	68
		Combined $L_{eq(h)}$	**82**	**79**	**76**

Legend: dBA = A-weighted decibel; ft = feet; L_{eq} = equivalent sound level.
Source: Parsons Transportation Group.

Abatement Measures

During the construction period, some of the sensitive receptors that are close to the roadway may be exposed to noise levels greater than 80 dBA. A combination of noise abatement techniques with equipment noise control and administrative measures may be selected to provide the most effective means to minimize effects of the construction activity noise as discussed below.

Equipment noise control:

- Ensure that all equipment items have the manufacturers' recommended noise abatement measures, such as mufflers, engine enclosures, and engine vibration isolators, intact and operational.
- Inspect all construction equipment at periodic intervals to ensure proper maintenance and presence of noise control devices (e.g., mufflers and shrouding).
- Turn off idling equipment.

Administrative measures:

- Implement a construction noise monitoring program to limit the impacts.
- Plan noisier operations during times least sensitive to receptors.

- Avoid scheduling construction during nighttime hours (10:00 p.m. to 7:00 a.m.) and on weekends.
- Keep noise levels relatively uniform and avoid impulsive noises.
- Maintain good public relations with the community to minimize objections to the unavoidable construction impacts. Provide frequent activity updates of all construction activities.

Application of these potential noise abatement measures would reduce the construction noise at the sensitive receptors; however, a temporary increase in noise would likely occur.

Year 2030

North

Under Alternative 1, potential traffic noise impacts on noise-sensitive receptors were assessed for 16 representative areas within the North Region, and the number of impacts per area is shown in Table 8.2–9. There are 88 noise sensitive receptor areas (indicated as number of receptors in the table) that would experience sound levels approaching or exceeding the NAC of 67 dBA compared to 49 receptors that experience sound levels approaching or exceeding the NAC of 67 dBA under the no-action alternative. While impacts from the no-action alternative are not caused by the project because these impacts are within the project area, FHWA requires that they be considered for abatement.

Table 8.2–9. Number of Potentially Impacted Receptors within the North Region, Alternative 1

	Number of Predicted Impacted Receptors	
Type of Noise Sensitive Receptors	*Alternative 1*	*No-Action Alternative*
Area 1: Single Family Residences and a Church	17	17
Area 2: Multi-Family Residences	0	0
Area 3: Single Family Residences	2	0
Area 4: Single Family Residences	4	0
Area 5: Single and Multi-Family Residences	0	0
Area 6: Military Outdoor Physical Training Area	4	0
Area 7: Single Family Residences	0	0
Area 8: Military Outdoor Recreational Area	12	0
Area 9: Single Family Residences and Golf Course	0	0
Area 10: Single Family Residences	1	0
Area 11: Single Family Residences, Multi-Family Residences, and a School	10	0
Area 12: Single Family Residences	7	7
Area 13: Single Family Residences	8	4
Area 14: Single and Multi-Family Residences	13	11
Area 15: School	0	0
Area 16: Single Family Residences and a Church	10	10
Total	**88**	**49**

Source: Parsons Transportation Group.

The type and number of impacted noise-sensitive receptors for each area are described as follows:

- Area 1: Outdoor use areas for 16 single-family residences and one church within Area 1 would be impacted from traffic noise under Alternative 1. Sheets 1 and 2 in Appendix G show the location of Area 1.

- Area 2: None of the outdoor use areas for the multi-family residences within Area 2 would be impacted from traffic noise under Alternative 1. Sheet 4 in Appendix G shows the location of Area 2.
- Area 3: Outdoor use areas for two single-family residences within Area 3 would be impacted from traffic noise under Alternative 1. Sheets 3 and 4 in Appendix G show the location of Area 3.
- Area 4: Outdoor use areas for four single-family residences within Area 4 would be impacted from traffic noise under Alternative 1. Sheets 4 and 5 in Appendix G show the location of Area 4.
- Area 5: None of the outdoor use areas for single- and multi-family residences within Area 5 would be impacted from traffic noise under Alternative 1. Sheets 5, 6, and 7 in Appendix G show the location of Area 5.
- Area 6: This area represents a military outdoor physical training site and has four frontage outdoor use areas. The four frontage outdoor use areas within Area 6 would be impacted from traffic noise under Alternative 1. Sheet 6 in Appendix G shows the location of Area 6.
- Area 7: None of the outdoor use areas for the single-family residences within Area 7 would be impacted from traffic noise under Alternative 1. Sheets 7 and 8 in Appendix G show the location of Area 7.
- Area 8: This area represents a military outdoor recreational site and has 12 frontage outdoor use areas. The 12 frontage outdoor use areas within Area 8 would be impacted from traffic noise under Alternative 1. Sheets 7 and 8 in Appendix G show the location of Area 8.
- Area 9: None of the outdoor use areas for the single-family residences and the golf course within Area 9 would be impacted from traffic noise under Alternative 1. Sheets 9, 10, and 11 in Appendix G show the location of Area 9.
- Area 10: Outdoor use areas for one single-family residence within Area 10 would be impacted from traffic noise under Alternative 1. Sheets 11 and 12 in Appendix G show the location of Area 10.
- Area 11: Outdoor use areas for 10 single-family residences within Area 11 would be impacted from traffic noise under Alternative 1. Sheets 12, 13, and 14 in Appendix G show the location of Area 11.
- Area 12: Outdoor use areas for seven single-family residences within Area 12 would be impacted from traffic noise under Alternative 1. Sheets 15 and 16 in Appendix G show the location of Area 12.
- Area 13: Outdoor use areas for eight single-family residences within Area 13 would be impacted from traffic noise under Alternative 1. Sheets 15, 16, and 17 in Appendix G show the location of Area 13.
- Area 14: Outdoor use areas for nine single- and four multi-family residences within Area 14 would be impacted from traffic noise under Alternative 1. Sheets 17, 18, and 19 in Appendix G show the location of Area 14.
- Area 15: This area represents a school and has three frontage outdoor use areas. None of the school's outdoor recreational areas or its indoor use areas within Area 15 would be impacted from traffic noise under Alternative 1. Sheet 18 in Appendix G shows the location of Area 15.

- Area 16: Outdoor use areas for nine single-family residences and one church within Area 16 would be impacted from traffic noise under Alternative 1. Sheet 19 in Appendix G shows the location of Area 16.

Central

Under Alternative 1, potential traffic noise impacts to noise-sensitive receptors were assessed for 48 representative areas within the Central Region. Table 8.2–10 shows the number of impacts per area. As shown on this table, there are 378 noise sensitive receptors that would experience sound levels approaching or exceeding the NAC of 67 dBA compared to 342 receptors that experience sound levels approaching or exceeding the NAC of 67 dBA under the no-action alternative. While the no-action impacts are not caused by the project because these impacts are within the project area, FHWA requires that they be considered for abatement.

The type and number of impacted noise-sensitive receptors for each area are described in the following text:

- Area 17: Outdoor use areas for 13 single- and two multi-family residences within Area 17 would be impacted from traffic noise under Alternative 1. Sheets 20, 21, and 22 in Appendix G show the location of Area 17.
- Area 18: Outdoor use areas for seven single-family residences and 10 frontage outdoor use areas for a park within Area 18 would be impacted from traffic noise under Alternative 1. Sheets 20, 21, and 22 in Appendix G show the location of Area 18.
- Area 19: A park within Area 19 would have eight frontage outdoor use areas that would be impacted from traffic noise under Alternative 1. Sheets 22 and 23 in Appendix G show the location of Area 19.
- Area 20: Outdoor use areas for two single- and two multi-family residences within Area 20 would be impacted from traffic noise under Alternative 1. Sheets 22 and 23 in Appendix G show the location of Area 20.
- Area 21: Outdoor use areas for one single- and two multi-family residences and three frontage outdoor use areas for a park within Area 21 would be impacted from traffic noise under Alternative 1. Sheet 23 in Appendix G shows the location of Area 21.
- Area 22: Outdoor use areas for seven single- and two multi-family residences, as well as one frontage outdoor use area for a playground, within Area 22 would be impacted from traffic noise under Alternative 1. Sheets 23 and 24 in Appendix G show the location of Area 22.
- Area 23: Outdoor use area for one single-family residence and six frontage outdoor use areas for a park within Area 23 would be impacted from traffic noise under Alternative 1. Sheets 24 and 25 in Appendix G show the location of Area 23.
- Area 24: Outdoor use areas for two multi-family residences within Area 24 would be impacted from traffic noise under Alternative 1. Sheet 25 in Appendix G shows the location of Area 24.
- Area 25: Outdoor use areas for two single-family residences and four frontage outdoor use areas for a park within Area 25 would be impacted from traffic noise under Alternative 1. Sheets 25 and 26 in Appendix G show the location of Area 25.
- Area 26: A cemetery within Area 26 would have six frontage outdoor use areas that would be impacted from traffic noise under Alternative 1. Sheet 25 in Appendix G shows the location the location of Area 26.

Table 8.2–10. Number of Potentially Impacted Receptors within the Central Region, Alternative 1

Type of Noise Sensitive Receptors	*Number of Predicted Impacted Receptors*	
	Alternative 1	*No-Action Alternative*
Area 17: Single Family Residences and a Multi-Family Residence	15	15
Area 18: Single Family Residences and a Park	17	17
Area 19: Park	8	0
Area 20: Single Family Residences and a Multi-Family Residence	4	4
Area 21: Park, a Single Family Residence, and a Multi-Family Residence	6	3
Area 22: Playground, a Single Family Residence, and a Multi-Family Residence	10	10
Area 23: Park and a Single Family Residence	7	4
Area 24: Multi-Family Residences	3	3
Area 25: Park and Single Family Residences	6	2
Area 26: Cemetery	6	0
Area 27: Park	20	11
Area 28: Park	2	2
Area 29: Park	4	4
Area 30: Park	9	9
Area 31: Park	4	4
Area 32: Multi-Family Residence	4	4
Area 33: Multi-Family Residence	0	0
Area 34: School	8	8
Area 35: Park, a Single Family Residence, and Multi-Family Residences	15	15
Area 36: One School and Two Churches	6	6
Area 37: Multi-Family Residences	0	0
Area 38: Multi-Family Residences	1	1
Area 39: Single Family Residences	21	21
Area 40: Multi-Family Residences	0	0
Area 41: Single Family Residences	0	0
Area 42: Single Family Residences	0	0
Area 43: Single Family Residences	18	18
Area 44: Single Family Residences	0	0
Area 45: Park, Single Family Residences, and Multi-Family Residences	30	30
Area 46: Single Family Residences	0	0
Area 47: Single Family Residences	12	12
Area 48: Single Family Residence, and Multi-Family Residences	9	7
Area 49: Single Family Residences and Multi-Family Residences	21	21
Area 50: Outdoor Sport Complex	9	9
Area 51: School	0	0
Area 52: Multi-Family Residence and Motel	9	8
Area 53: Multi-Family Residences	10	10
Area 54: Multi-Family Residences	0	0
Area 55: Single Family Residence and a Motel	1	1
Area 56: Single Family Residences and Multi-Family Residences	11	11
Area 57: Single Family Residences and Multi-Family Residences	11	11
Area 58: Military Outdoor Recreational Area	0	0
Area 59: Single Family Residences	6	6
Area 60: Single Family Residences	3	3
Area 61: Single Family Residences, Multi-Family Residences, and a Funeral Home	7	7
Area 62: Multi-Family Residences	0	0
Area 63: Single Family Residences, a Multi-Family Residence, and a Church	23	23
Area 64: Single Family Residences, Multi-Family Residences, and a School	22	22
Total	**378**	**342**

Source: Parsons Transportation Group.

- Area 27: A park within Area 27 would have 20 frontage outdoor use areas that would be impacted from traffic noise under Alternative 1. Sheets 27 and 28 in Appendix G show the location of Area 27.
- Area 28: A park within Area 28 would have two frontage outdoor use areas that would be impacted from traffic noise under Alternative 1. Sheet 28 in Appendix G shows the location of Area 28.
- Area 29: A park within Area 29 would have four frontage outdoor use areas that would be impacted from traffic noise under Alternative 1. Sheets 28 and 29 in Appendix G show the location of Area 29.
- Area 30: A park within Area 30 would have nine frontage outdoor use areas that would be impacted from traffic noise under Alternative 1. Sheets 29, 30, and 31 in Appendix G show the location of Area 30.
- Area 31: A park within Area 31 would have four frontage outdoor use areas that would be impacted from traffic noise under Alternative 1. Sheet 32 in Appendix G shows the location of Area 31.
- Area 32: Outdoor use areas for four multi-family residences within Area 32 would be impacted from traffic noise under Alternative 1. Sheet 33 in Appendix G shows the location of Area 32.
- Area 33: None of the multi-family residences outdoor use areas within Area 33 would be impacted from traffic noise under Alternative 1. Sheet 34 in Appendix G shows the location of Area 33.
- Area 34: A school within Area 34 would have eight frontage outdoor use areas that would be impacted from traffic noise under Alternative 1; however, none of the school’s indoor use areas would be impacted from traffic noise under Alternative 1. Sheets 34 and 35 in Appendix G show the location of Area 34.
- Area 35: Outdoor use areas for 11 multi-family residences and four frontage outdoor use areas for a park within Area 35 would be impacted from traffic noise under Alternative 1. Sheets 35 and 36 in Appendix G show the location of Area 35.
- Area 36: A park with four frontage outdoor use areas and two churches within Area 36 would be impacted from traffic noise under Alternative 1. Sheets 36 and 37 in Appendix G show the location of Area 36.
- Area 37: None of the multi-family residences outdoor use areas within Area 37 would be impacted from traffic noise under Alternative 1. Sheets 37 and 38 in Appendix G show the location of Area 37.
- Area 38: None of the multi-family residences outdoor use areas and one frontage outdoor use area for a church within Area 38 would be impacted from traffic noise under Alternative 1. Sheet 38 in Appendix G shows the location of Area 38.
- Area 39: Outdoor use areas for 21 single-family residences within Area 39 would be impacted from traffic noise under Alternative 1. Sheets 39 and 40 in Appendix G show the location of Area 39.
- Area 40: None of the multi-family residences outdoor use areas within Area 40 would be impacted from traffic noise under Alternative 1. Sheet 41 in Appendix G shows the location of Area 40.

- Area 41: None of the single-family residences outdoor use areas within Area 41 would be impacted from traffic noise under Alternative 1. Sheet 41 in Appendix G shows the location of Area 41.
- Area 42: None of the single-family residences outdoor use areas within Area 42 would be impacted from traffic noise under Alternative 1. Sheets 41 and 42 in Appendix G show the location of Area 42.
- Area 43: Outdoor use areas for 18 single-family residences within Area 43 would be impacted from traffic noise under Alternative 1. Sheet 42 in Appendix G shows the location of Area 43.
- Area 44: None of the single-family residences outdoor use areas within Area 44 would be impacted from traffic noise under Alternative 1. Sheet 42 in Appendix G shows the location of Area 44.
- Area 45: A park within Area 45 would have 30 frontage outdoor use areas that would be impacted from traffic noise under Alternative 1. Sheets 42, 43, and 44 in Appendix G show the location of Area 45.
- Area 46: None of the single-family residences outdoor use areas within Area 46 would be impacted from traffic noise under Alternative 1. Sheet 44 in Appendix G shows the location of Area 46.
- Area 47: Outdoor use areas for 12 single-family residences within Area 47 would be impacted from traffic noise under Alternative 1. Sheet 46 in Appendix G shows the location of Area 47.
- Area 48: Outdoor use areas for seven single- and two multi-family residences within Area 48 would be impacted from traffic noise under Alternative 1. Sheet 48 in Appendix G shows the location of Area 48.
- Area 49: Outdoor use areas for 17 single- and four multi-family residences within Area 49 would be impacted from traffic noise under Alternative 1. Sheets 50 and 51 in Appendix G show the location of Area 49.
- Area 50: An outdoor sports complex within Area 50 would have nine frontage outdoor use areas that would be impacted from traffic noise under Alternative 1. Sheets 50 and 51 in Appendix G show the location of Area 50.
- Area 51: None of the recreational outdoor use areas or indoor use areas for a school within Area 51 would be impacted from traffic noise under Alternative 1. Sheet 51 in Appendix G shows the location of Area 51.
- Area 52: Outdoor use areas for eight multi-family residences and a motel within Area 52 would be impacted from traffic noise under Alternative 1. Sheet 53 in Appendix G shows the location of Area 52.
- Area 53: Outdoor use areas for 10 multi-family residences within Area 53 would be impacted from traffic noise under Alternative 1. Sheet 53 in Appendix G shows the location of Area 53.
- Area 54: None of the multi-family residences outdoor use areas within Area 54 would be impacted from traffic noise under Alternative 1. Sheet 54 in Appendix G shows the location of Area 54.
- Area 55: Outdoor use area for one single-family residence within Area 55 would be impacted from traffic noise under Alternative 1. Sheet 56 in Appendix G shows the location of Area 55.

- Area 56: Outdoor use areas for nine single- and two multi-family residences within Area 56 would be impacted from traffic noise under Alternative 1. Sheets 57 and 58 in Appendix G show the location of Area 56.
- Area 57: Outdoor use areas for 10 single- and one multi-family residences within Area 57 would be impacted from traffic noise under Alternative 1. Sheets 59 and 60 in Appendix G show the location of Area 57.
- Area 58: None of the 28 frontage outdoor use areas for a military outdoor recreational area within Area 58 would be impacted from traffic noise under Alternative 1. Sheets 59 and 60 in Appendix G show the location of Area 58.
- Area 59: Outdoor use areas for six single-family residences within Area 59 would be impacted from traffic noise under Alternative 1. Sheet 62 in Appendix G shows the location of Area 59.
- Area 60: Outdoor use areas for three single-family residences within Area 60 would be impacted from traffic noise under Alternative 1. Sheet 63 in Appendix G shows the location of Area 60.
- Area 61: Outdoor use areas for five single- and two multi-family residences within Area 61 would be impacted from traffic noise under Alternative 1. Sheets 63 and 64 in Appendix G show the location of Area 61.
- Area 62: None of the multi-family residences outdoor use areas within Area 62 would be impacted from traffic noise under Alternative 1. Sheets 65 and 66 in Appendix G show the location of Area 62.
- Area 63: Outdoor use areas for 21 single- and two multi-family residences and a church within Area 63 would be impacted from traffic noise under Alternative 1. Sheets 67, 68, and 69 in Appendix G show the location of Area 63.
- Area 64: Outdoor use areas for 18 single- and four multi-family residences within Area 64 would be impacted from traffic noise under Alternative 1. Sheets 67, 68, and 69 in Appendix G show the location of Area 64.

Apra Harbor

No noise sensitive receptors are located within the proposed roadway improvement area in the Apra Harbor Region; therefore, no impacts from traffic noise under Alternative 1 would occur in this region.

South

While there are noise-sensitive land uses along the proposed roadway improvement routes in the South Region, noise from traffic would not impact the noise sensitive land uses as a result of Alternative 1 implementation.

<u>Abatement Measures</u>

North

Although many receptors within the North Region are expected to experience future traffic noise impacts under Alternative 1, noise abatement modeling was not performed for most of the impacted receptors because the locations where impacts would occur would require abatement measures that would not be feasible. Specifically, the land adjacent to Routes 1, 3, and 9 consists of several residential areas where many residences have driveways that provide direct access to the routes, resulting in issues of sound wall discontinuity. For a sound wall to provide sufficient noise reduction, it must be high enough and long enough to shield the receptor from the road. Access openings in the noise barrier for streets, driveways, and maintenance severely reduce the effectiveness of the noise barrier to the point that it would not be feasible to construct a barrier. Furthermore, for most of the locations, there are not enough residences per area to allow a noise barrier to be reasonable due to the cost per benefitted receptor. Noise abatement analysis was not conducted for areas where there are no noise impacts due to traffic.

Noise abatement was analyzed for three locations within the North Region for Alternative 1 where predicted year 2030 noise levels would cause an impact and where existing topography conditions and future roadway alignment would not prevent the construction of continuous sound walls. The results of this noise abatement analysis are shown in Table 8.2–11 through Table 8.2–13. All of the barrier heights and locations are based on the latest available alignment information at the time of this study. These tables provide a summary of the barriers, the number of benefited residences, cost per benefited residence, and total cost per barrier. The three sound walls that were analyzed for noise impacts were for Areas 1, 6, and 8. Only the sound wall for Area 1 met both the feasible and reasonable requirements under the Traffic Noise Abatement Policy to be considered for construction.

- Area 1: Most of the Area 1 impacted residences have direct-access driveways to Route 3 that would prevent the construction of continuous sound walls required to provide feasible noise abatement; however, for the 11 single-family residences outdoor use areas between Lobo and Inda Roads, a sound wall 8 ft (2 m) in height and 775 ft (236 m) long located along the right-of-way of the northbound side of Route 3 would provide feasible noise abatement for the outdoor use areas for these residences. Furthermore, the cost per benefited receptor is $22,487, which is below the GDPW $35,000 cost per benefited receptor requirement for a sound wall to be considered reasonable. The results of the noise abatement analysis for this sound wall are shown in Table 8.2–9, Sheet 2 in Appendix G shows the location of the recommended sound wall for Area 1.
- Area 3: Outdoor use areas for two single-family residences within Area 3 are impacted from traffic noise under Alternative 1; however, these residences have direct-access driveways to Route 3 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheets 3 and 4 in Appendix G show the location of Area 3.
- Area 4: Outdoor use areas for three single-family residences within Area 4 are impacted from traffic noise under Alternative 1; however, these residences have direct-access driveways to Route 3 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheets 4 and 5 in Appendix G show the location of Area 4.

Table 8.2–11. Predicted Future Noise and Barrier Analysis for Area 1

REC. NO.	LAND USE[2]	FUTURE PEAK HOUR NOISE LEVELS, Leq(h), dBA[1, 4]														
		EXISTING	PROJECT "NO BUILD" WITHOUT BARRIER	PROJECT "BUILD" WITHOUT BARRIER	ACTIVITY CATEGORY and NAC ( )	IMPACT TYPE (A/E or NONE)[3]	NOISE PREDICTION WITH BARRIER AND BARRIER INSERTION LOSS (I.L.)									
							8 ft		10 ft		12 ft		14 ft		16 ft	
							Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
Area 1																
R 1	SFR	68	68	71	B (67)	A/E	65 [R]	6	64	7	64	7	64	7	63	8
R 2	SFR	68	68	71	B (67)	A/E	62 [R]	9	60	11	59	12	58	13	57	14
R 3	SFR	68	68	71	B (67)	A/E	65 [R]	6	60	11	64	7	64	7	63	8
Number of benefited receptors							11		11		11		11		11	
Total barrier cost							$247,360		$309,200		$371,040		$432,880		$494,720	
Cost per benefited receptor							$22,487		$28,109		$33,731		$39,353		$44,975	

Notes:

1 - Leq(h) are A-weighted, peak hour noise levels in decibels.

2 - Land Use: SFR - single-family residence; MFR multi-family residences; REC - Outdoor recreational areas.

3 - A/E = Approach or exceed NAC.

4 - Traffic noise from Route 3; other local noise sources are not included.

R - Recommended height to meet feasibility requirements of the Guam Public Works Noise Abatement Policy.

Legend: dBA = A-weighted decibel; ft = feet; L_{eq} = equivalent sound level; NAC = Noise Abatement Criteria.

Source: Parsons Transportation Group.

Table 8.2–12. Predicted Future Noise and Barrier Analysis for Area 6

		FUTURE PEAK HOUR NOISE LEVELS, Leq(h), dBA[1, 4]														
REC. NO.	LAND USE[2]	EXISTING	PROJECT "NO BUILD" WITHOUT BARRIER	PROJECT "BUILD" WITHOUT BARRIER	ACTIVITY CATEGORY and NAC ( )	IMPACT TYPE (A/E or NONE)[3]	NOISE PREDICTION WITH BARRIER AND BARRIER INSERTION LOSS (I.L.)									
							8 ft		10 ft		12 ft		14 ft		16 ft	
							Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
Area 6																
R 4	REC	59	60	68	B (67)	A/E	58 [R]	10	56	12	55	13	54	14	52	16
R 5	REC	59	60	68	B (67)	A/E	59 [R]	9	57	11	55	13	54	14	53	15
R 6	REC	59	60	68	B (67)	A/E	59 [R]	9	57	11	55	13	54	14	53	15
Number of benefited receptors							4		4		4		4		4	
Total barrier cost							$246,080		$307,600		$369,120		$430,640		$492,160	
Cost per benefited receptor							$61,520		$76,900		$92,280		$107,660		$123,040	

Notes:

1 - Leq(h) are A-weighted, peak hour noise levels in decibels.
2 - Land Use: SFR - single-family residence; MFR multi-family residences; REC - Outdoor recreational areas.
3 - A/E = Approach or exceed NAC.
4 - Traffic noise from Route 3; other local noise sources are not included.
R - Recommended height to meet feasibility requirements of the Guam Public Works Noise Abatement Policy.

Legend: dBA = A-weighted decibel; ft = feet; L_{eq} = equivalent sound level; NAC = Noise Abatement Criteria.
Source: Parsons Transportation Group.

Table 8.2–13. Predicted Future Noise and Barrier Analysis for Area 8

REC. NO.	LAND USE[2]	FUTURE PEAK HOUR NOISE LEVELS, Leq(h), dBA[1, 4]														
		EXISTING	PROJECT "NO BUILD" WITHOUT BARRIER	PROJECT "BUILD" WITHOUT BARRIER	ACTIVITY CATEGORY and NAC ( )	IMPACT TYPE (A/E or NONE)[3]	NOISE PREDICTION WITH BARRIER AND BARRIER INSERTION LOSS (I.L.)									
							8 ft		10 ft		12 ft		14 ft		16 ft	
							Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
Area 8																
R 7	REC	59	60	68	B (67)	A/E	60 [R]	8	58	10	57	11	57	11	56	12
R 8	REC	59	60	68	B (67)	A/E	59 [R]	9	57	11	55	13	54	14	53	15
R 9	REC	59	60	68	B (67)	A/E	60 [R]	8	58	10	57	11	57	11	56	12
Number of benefited receptors							12		12		12		12		12	
Total barrier cost							$529,280		$661,600		$793,920		$926,240		$1,058,560	
Cost per benefited receptor							$44,107		$55,133		$66,160		$77,187		$88,213	

Notes:

1 - Leq(h) are A-weighted, peak hour noise levels in decibels.
2 - Land Use: SFR - single-family residence; MFR multi-family residences; REC - Outdoor recreational areas.
3 - A/E = Approach or exceed NAC.
4 - Traffic noise from Route 3; other local noise sources are not included.
R - Recommended height to meet feasibility requirements of the Guam Public Works Noise Abatement Policy.

Legend: dBA = A-weighted decibel; ft = feet; L_{eq} = equivalent sound level; NAC = Noise Abatement Criteria.
Source: Parsons Transportation Group.

- Area 6: A sound wall 8 ft (2 m) in height and 770 ft (235 m) long located along the shoulder of the southbound side of Route 3 would provide feasible noise abatement for four impacted frontage outdoor use areas for the military outdoor physical training area within Area 6 from traffic noise under Alternative 1. However, the cost per benefited receptor is $61,520, which is above the GDPW $35,000 cost per benefited receptor requirement for a sound wall to be considered reasonable. The results of the noise abatement analysis for this sound wall are shown in Sheet 6 in Appendix G. Plus, Appendix G also shows the location of the sound wall for Area 6.
- Area 8: A sound wall 8 ft (2 m) in height and 1,655 ft (504 m) long located along the shoulder of the southbound side of Route 3 would provide feasible noise abatement for the 12 impacted frontage outdoor use areas for the military outdoor physical training area within Area 6 from traffic noise under Alternative 1. However, the cost per benefited receptor is $44,107, which is above the GDPW $35,000 cost per benefited receptor requirement for a sound wall to be considered reasonable. The results of the noise abatement analysis for this sound wall are shown in Table 8.2–13. Sheets 7 and 8 in Appendix G show the location of the sound wall for Area 8.
- Area 10: Outdoor use area for one single-family residence within Area 10 would be impacted from traffic noise under Alternative 1. However, because there is only one impacted residence, a sound wall would have to be extended beyond the residence’s property to provide feasible abatement. This solution is not possible because there are crossroads accessing Route 3 on the north and south side of this property. Sheets 11 and 12 in Appendix G show the location of Area 10.
- Area 11: Outdoor use areas for 10 single- and multi-family residences within Area 11 would be impacted from traffic noise under Alternative 1. However, most of these residences have direct-access driveways to Route 9 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. In addition, building a sound wall for these residences would not be reasonable because they are scattered along the alignment and would exceed the cost per benefited receptor requirement. Sheets 12, 13, and 14 in Appendix G show the location of Area 11.
- Area 12: Outdoor use areas for seven single-family residences within Area 12 would be impacted from traffic noise under Alternative 1. However, building a sound wall for these scattered residences along the alignment would not be reasonable because the sound wall cost would exceed the cost per benefited receptor requirement. Sheets 15 and 16 in Appendix G show the location of Area 12.
- Area 13: Outdoor use areas for eight single-family residences within Area 13 would be impacted from traffic noise under Alternative 1. However, building a sound wall for these scattered residences along the alignment would not be reasonable because the sound wall cost would exceed the cost per benefited receptor requirement. Sheets 15, 16, and 17 in Appendix G show the location of Area 13.
- Area 14: Outdoor use areas for 13 single- and multi-family residences within Area 14 would be impacted from traffic noise under Alternative 1. However, most of these residences have direct-access driveways to Route 1 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. In addition, building a sound wall for these scattered residences along the alignment would not be reasonable because the sound wall cost would exceed the cost per benefited receptor requirement. Sheets 17, 18, and 19 in Appendix G show the location of Area 14.

- Area 16: Outdoor use areas for nine single-family residences and one church within Area 16 would be impacted from traffic noise under Alternative 1. However, most of these residences, as well as the church, have direct-access driveways to Route 1 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheet 19 in Appendix G shows the location of Area 16.

Central

Although many receptors within the Central Region are expected to experience future traffic noise impacts under Alternative 1, noise abatement modeling was not performed for most of the impacted receptors because the locations where impacts would occur would require abatement measures that would not be feasible. Specifically, the land adjacent to Routes 1, 8, 10, 16, and 27 consists of several residential areas where many residences have driveways that provide direct access to the routes, thereby resulting in issues of sound wall discontinuity.

Noise abatement was analyzed for nine locations within the Central Region for Alternative 1 where predicted year 2030 noise levels would cause an impact and existing topography conditions and future roadway alignment would not prevent the construction of continuous sound walls. The results of this noise abatement analysis are shown in Table 8.2–14 through Table 8.2–22. All barrier heights and locations are based on the latest available alignment information at the time of this study. These tables provide a summary of the barriers, the number of benefited residences, cost per benefited residence, and total cost per barrier. The 12 sound walls that were analyzed for noise impacts were for Areas 18, 23, 27, 34, 39, 43, 45, 49, and 53.

- Area 17: Outdoor use areas for 15 single- and multi-family residences within Area 17 would be impacted from traffic noise under Alternative 1. However, most of these residences have direct-access driveways to Route 1 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheets 20, 21, and 21 in Appendix G show the location of Area 17.
- Area 18: Outdoor use areas for seven single-family residences within Area 18 that are impacted have direct-access driveways to Route 1 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. However, a sound wall 8 ft (2 m) in height and 1,060 ft (323 m) long located along the shoulder of the southbound side of Route 1 would provide feasible noise abatement for the 10 impacted frontage outdoor use areas for a park within Area 18 from traffic noise under Alternative 1. Furthermore, the cost per benefited receptor is $33,880, which is below the GDPW $35,000 cost per benefited receptor requirement for a sound wall to be considered reasonable. The results of the noise abatement analysis for this sound wall are shown in Table 8.2–14. Sheet 21 in Appendix G shows the location of the sound wall for Area 18.
- Area 19: There are eight impacted frontage outdoor use areas for a park within Area 19 from traffic noise under Alternative 1. However, most of these outdoor use areas have parking lots with direct access to Route 1 next to them that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheets 22 and 23 in Appendix G show the location of Area 19.

Table 8.2–14. Predicted Future Noise and Barrier Analysis for Area 18

REC. NO.	LAND USE[2]	FUTURE PEAK HOUR NOISE LEVELS, Leq(h), dBA[1, 4]															
		EXISTING	PROJECT "NO BUILD" WITHOUT BARRIER	PROJECT "BUILD" WITHOUT BARRIER	ACTIVITY CATEGORY and NAC ( )	IMPACT TYPE (A/E or NONE)[3]	NOISE PREDICTION WITH BARRIER AND BARRIER INSERTION LOSS (I.L.)									
							8 ft		10 ft		12 ft		14 ft		16 ft	
							Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
Area 18																
R 10	REC	66	66	69	B (67)	A/E	62 [R]	7	61	8	61	8	60	9	60	9
R 11	REC	66	66	69	B (67)	A/E	61 [R]	8	60	9	58	11	58	11	57	12
R 12	REC	66	66	69	B (67)	A/E	64 [R]	5	63	6	63	6	63	6	63	6
Number of benefited receptors							10		10		10		10		10	
Total barrier cost							$338,880		$423,600		$508,320		$593,040		$677,760	
Cost per benefited receptor							$33,888		$42,360		$50,832		$59,304		$67,776	

Notes:

1 - Leq(h) are A-weighted, peak hour noise levels in decibels.
2 - Land Use: SFR - single-family residence; MFR multi-family residences; REC - Outdoor recreational areas.
3 - A/E = Approach or exceed NAC.
4 - Traffic noise from Route 1; other local noise sources are not included.
R - Recommended height to meet feasibility requirements of the Guam Public Works Noise Abatement Policy.

Legend: dBA = A-weighted decibel; ft = feet; L_{eq} = equivalent sound level; NAC = Noise Abatement Criteria.
Source: Parsons Transportation Group.

Table 8.2–15. Predicted Future Noise and Barrier Analysis for Area 23

REC. NO.	LAND USE[2]	FUTURE PEAK HOUR NOISE LEVELS, Leq(h), dBA[1, 4]														
		EXISTING	PROJECT "NO BUILD" WITHOUT BARRIER	PROJECT "BUILD" WITHOUT BARRIER	ACTIVITY CATEGORY and NAC ( )	IMPACT TYPE (A/E or NONE)[3]	NOISE PREDICTION WITH BARRIER AND BARRIER INSERTION LOSS (I.L.)									
							8 ft		10 ft		12 ft		14 ft		16 ft	
							Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
Area 23																
R 13	REC	70	70	70	B (67)	A/E	60 [R]	10	58	12	57	13	56	14	55	15
R 14	REC	66	66	67	B (67)	A/E	59 [R]	8	58	9	56	11	56	11	55	12
R 15	REC	66	66	67	B (67)	A/E	61 [R]	6	60	7	60	7	60	7	59	8
Number of benefited receptors							8		8		8		8		8	
Total barrier cost							$267,200		$334,000		$400,800		$467,600		$534,400	
Cost per benefited receptor							$33,400		$41,750		$50,100		$58,450		$66,800	

Notes:

1 - Leq(h) are A-weighted, peak hour noise levels in decibels.
2 - Land Use: SFR - single-family residence; MFR multi-family residences; REC - Outdoor recreational areas.
3 - A/E = Approach or exceed NAC.
4 - Traffic noise from Route 1; other local noise sources are not included.
R - Recommended height to meet feasibility requirements of the Guam Public Works Noise Abatement Policy.

Legend: dBA = A-weighted decibel; ft = feet; L_{eq} = equivalent sound level; NAC = Noise Abatement Criteria.
Source: Parsons Transportation Group.

Table 8.2–16. Predicted Future Noise and Barrier Analysis for Area 27

REC. NO.	LAND USE[2]	FUTURE PEAK HOUR NOISE LEVELS, Leq(h), dBA[1, 4]														
		EXISTING	PROJECT "NO BUILD" WITHOUT BARRIER	PROJECT "BUILD" WITHOUT BARRIER	ACTIVITY CATEGORY and NAC ( )	IMPACT TYPE (A/E or NONE)[3]	NOISE PREDICTION WITH BARRIER AND BARRIER INSERTION LOSS (I.L.)									
							8 ft		10 ft		12 ft		14 ft		16 ft	
							Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
Area 27																
R 16	REC	68	68	68	B (67)	A/E	61 [R]	7	59	9	59	9	58	10	57	11
R 17	REC	68	68	68	B (67)	A/E	60 [R]	8	58	10	57	11	55	13	55	13
R 18	REC	68	68	68	B (67)	A/E	62 [R]	6	61	7	61	7	60	8	60	8
Number of benefited receptors							12		12		12		12		12	
Total barrier cost							$404,160		$505,200		$606,240		$707,280		$808,320	
Cost per benefited receptor							$33,680		$42,100		$50,520		$58,940		$67,360	

Notes:

1 - Leq(h) are A-weighted, peak hour noise levels in decibels.
2 - Land Use: SFR - single-family residence; MFR multi-family residences; REC - Outdoor recreational areas.
3 - A/E = Approach or exceed NAC.
4 - Traffic noise from Route 1; other local noise sources are not included.
R - Recommended height to meet feasibility requirements of the Guam Public Works Noise Abatement Policy.

Legend: dBA = A-weighted decibel; ft = feet; L_{eq} = equivalent sound level; NAC = Noise Abatement Criteria.
Source: Parsons Transportation Group.

Table 8.2–17. Predicted Future Noise and Barrier Analysis for Area 34

REC. NO.	LAND USE^2	FUTURE PEAK HOUR NOISE LEVELS, Leq(h), dBA^{1,4}														
		EXISTING	PROJECT "NO BUILD" WITHOUT BARRIER	PROJECT "BUILD" WITHOUT BARRIER	ACTIVITY CATEGORY and NAC ( )	IMPACT TYPE (A/E or NONE)^3	NOISE PREDICTION WITH BARRIER AND BARRIER INSERTION LOSS (I.L.)									
							8 ft		10 ft		12 ft		14 ft		16 ft	
							Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
Area 34																
R 19	REC	67	68	71	B (67)	A/E	64 R	7	63	8	63	8	62	9	62	9
R 20	REC	67	68	71	B (67)	A/E	62 R	9	61	10	60	11	59	12	58	13
R 21	REC	67	68	71	B (67)	A/E	63 R	8	61	10	60	11	59	12	59	12
Number of benefited receptors							8		8		8		8		8	
Total barrier cost							$267,840		$334,800		$401,760		$468,720		$535,680	
Cost per benefited receptor							$33,480		$41,850		$50,220		$58,590		$66,960	

Notes:

1 - Leq(h) are A-weighted, peak hour noise levels in decibels.
2 - Land Use: SFR - single-family residence; MFR multi-family residences; REC - Outdoor recreational areas.
3 - A/E = Approach or exceed NAC.
4 - Traffic noise from Route 1; other local noise sources are not included.
R - Recommended height to meet feasibility requirements of the Guam Public Works Noise Abatement Policy.

Legend: dBA = A-weighted decibel; ft = feet; L_{eq} = equivalent sound level; NAC = Noise Abatement Criteria.

Source: Parsons Transportation Group.

Table 8.2–18. Predicted Future Noise and Barrier Analysis for Area 39

REC. NO.	LAND USE[2]	FUTURE PEAK HOUR NOISE LEVELS, Leq(h), dBA[1, 4]														
		EXISTING	PROJECT "NO BUILD" WITHOUT BARRIER	PROJECT "BUILD" WITHOUT BARRIER	ACTIVITY CATEGORY and NAC ( )	IMPACT TYPE (A/E or NONE)[3]	NOISE PREDICTION WITH BARRIER AND BARRIER INSERTION LOSS (I.L.)									
							8 ft		10 ft		12 ft		14 ft		16 ft	
							Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
Area 39																
R 22	SFR	62	68	71	B (67)	A/E	62 R	9	60	11	59	12	58	13	57	14
R 23	SFR	61	67	70	B (67)	A/E	61 R	9	60	10	59	11	58	12	57	13
R 24	SFR	62	68	71	B (67)	A/E	62 R	9	61	10	59	12	58	13	57	14
R 25	SFR	62	68	71	B (67)	A/E	62 R	9	61	10	59	12	58	13	58	13
R 26	SFR	62	68	71	B (67)	A/E	64 R	7	63	8	62	9	62	9	62	9
Number of benefited receptors							33		33		33		33		33	
Total barrier cost							$631,680		$789,600		$947,520		$1,105,440		$1,263,360	
Cost per benefited receptor							$19,142		$23,927		$28,713		$33,498		$38,284	

Notes:

1 - Leq(h) are A-weighted, peak hour noise levels in decibels.

2 - Land Use: SFR - single-family residence; MFR multi-family residences; REC - Outdoor recreational areas.

3 - A/E = Approach or exceed NAC.

4 - Traffic noise from Route 1; other local noise sources are not included.

R - Recommended height to meet feasibility requirements of the Guam Public Works Noise Abatement Policy.

Legend: dBA = A-weighted decibel; ft = feet; L_{eq} = equivalent sound level; NAC = Noise Abatement Criteria.

Source: Parsons Transportation Group.

Table 8.2–19. Predicted Future Noise and Barrier Analysis for Area 43

REC. NO.	LAND USE[2]	FUTURE PEAK HOUR NOISE LEVELS, Leq(h), dBA[1, 4]														
		EXISTING	PROJECT "NO BUILD" WITHOUT BARRIER	PROJECT "BUILD" WITHOUT BARRIER	ACTIVITY CATEGORY and NAC ( )	IMPACT TYPE (A/E or NONE)[3]	NOISE PREDICTION WITH BARRIER AND BARRIER INSERTION LOSS (I.L.)									
							8 ft		10 ft		12 ft		14 ft		16 ft	
							Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
Area 43																
R 27	SFR	63	65	66	B (67)	A/E	59	7	58	8	57 R	9	57	9	57	9
R 28	SFR	63	65	66	B (67)	A/E	58	8	56	10	55 R	11	54	12	53	13
R 29	SFR	63	65	66	B (67)	A/E	57	9	56	10	54 R	12	53	13	52	14
R 30	SFR	63	65	66	B (67)	A/E	57	9	56	10	54 R	12	53	13	52	14
R 31	SFR	61	63	64	B (67)	NONE	57	7	55	9	54 R	10	53	11	53	11
R 32	SFR	63	65	66	B (67)	A/E	60	6	59	7	59 R	7	59	7	59	7
Number of benefited receptors							18		22		29		29		29	
Total barrier cost							$447,040		$558,800		$670,560		$782,320		$894,080	
Cost per benefited receptor							$24,836		$25,400		$23,123		$26,977		$30,830	

Notes:

1 - Leq(h) are A-weighted, peak hour noise levels in decibels.
2 - Land Use: SFR - single-family residence; MFR multi-family residences; REC - Outdoor recreational areas.
3 - A/E = Approach or exceed NAC.
4 - Traffic noise from Route 1; other local noise sources are not included.
R - Recommended height to meet feasibility requirements of the Guam Public Works Noise Abatement Policy.

Legend: dBA = A-weighted decibel; ft = feet; L_{eq} = equivalent sound level; NAC = Noise Abatement Criteria.
Source: Parsons Transportation Group.

Table 8.2–20. Predicted Future Noise and Barrier Analysis for Area 45

REC. NO.	LAND USE[2]	FUTURE PEAK HOUR NOISE LEVELS, Leq(h), dBA[1, 4]														
		EXISTING	PROJECT "NO BUILD" WITHOUT BARRIER	PROJECT "BUILD" WITHOUT BARRIER	ACTIVITY CATEGORY and NAC ( )	IMPACT TYPE (A/E or NONE)[3]	NOISE PREDICTION WITH BARRIER AND BARRIER INSERTION LOSS (I.L.)									
							8 ft		10 ft		12 ft		14 ft		16 ft	
							Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
Area 45																
R 33	REC	63	66	67	B (67)	A/E	59[R]	8	57	10	56	11	55	12	54	13
R 34	REC	63	66	67	B (67)	A/E	59[R]	8	57	10	56	11	55	12	54	13
R 35	REC	63	66	67	B (67)	A/E	58[R]	9	57	10	55	12	54	13	54	13
R 36	REC	63	66	66	B (67)	A/E	58[R]	8	56	10	55	11	54	12	53	13
R 37	REC	63	65	67	B (67)	A/E	59[R]	8	57	10	56	11	55	12	54	13
R 38	REC	63	66	67	B (67)	A/E	59[R]	8	57	10	56	11	56	11	55	12
Number of benefited receptors							28		28		28		28		28	
Total barrier cost							$932,160		$1,165,200		$1,398,240		$1,631,280		$1,864,320	
Cost per benefited receptor							$33,291		$41,614		$49,937		$58,260		$66,583	

Notes:

1 - Leq(h) are A-weighted, peak hour noise levels in decibels.
2 - Land Use: SFR - single-family residence; MFR multi-family residences; REC - Outdoor recreational areas.
3 - A/E = Approach or exceed NAC.
4 - Traffic noise from Route 1; other local noise sources are not included.
R - Recommended height to meet feasibility requirements of the Guam Public Works Noise Abatement Policy.

Legend: dBA = A-weighted decibel; ft = feet; L_{eq} = equivalent sound level; NAC = Noise Abatement Criteria.
Source: Parsons Transportation Group.

Table 8.2–21. Predicted Future Noise and Barrier Analysis for Area 49

REC. NO.	LAND USE^{2}	FUTURE PEAK HOUR NOISE LEVELS, Leq(h), dBA^{1,4}																
		EXISTING	PROJECT "NO BUILD" WITHOUT BARRIER	PROJECT "BUILD" WITHOUT BARRIER	ACTIVITY CATEGORY and NAC ( )	IMPACT TYPE (A/E or NONE)^{3}	NOISE PREDICTION WITH BARRIER AND BARRIER INSERTION LOSS (I.L.)									
							8 ft		10 ft		12 ft		14 ft		16 ft	
							Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
Area 49																
R 39	SFR	63	65	66	B (67)	A/E	60	6	59	7	58 ^{R}	8	58	8	58	8
R 40	SFR	63	65	66	B (67)	A/E	59	7	58	8	57 ^{R}	9	56	10	56	10
R 41	SFR	63	65	66	B (67)	A/E	59	7	58	8	58 ^{R}	8	57	9	57	9
R 42	SFR	63	65	66	B (67)	A/E	59	7	58	8	57 ^{R}	9	57	9	57	9
R 43	SFR	63	65	66	B (67)	A/E	58	8	57	9	55 ^{R}	11	55	11	54	12
R 44	SFR	63	64	64	B (67)	NONE	57	7	56	8	55 ^{R}	9	54	10	54	10
Number of benefited receptors							10		10		15		15		16	
Total barrier cost							$338,240		$422,800		$507,360		$591,920		$676,480	
Cost per benefited receptor							$33,824		$42,280		$33,824		$39,461		$42,280	

Notes:

1 - Leq(h) are A-weighted, peak hour noise levels in decibels.
2 - Land Use: SFR - single-family residence; MFR multi-family residences; REC - Outdoor recreational areas.
3 - A/E = Approach or exceed NAC.
4 - Traffic noise from Route 27; other local noise sources are not included.
R - Recommended height to meet feasibility requirements of the Guam Public Works Noise Abatement Policy.

Legend: dBA = A-weighted decibel; ft = feet; L_{eq} = equivalent sound level; NAC = Noise Abatement Criteria.
Source: Parsons Transportation Group.

Table 8.2–22. Predicted Future Noise and Barrier Analysis for Area 53

REC. NO.	LAND USE[2]	FUTURE PEAK HOUR NOISE LEVELS, Leq(h), dBA[1,4]														
		EXISTING	PROJECT "NO BUILD" WITHOUT BARRIER	PROJECT "BUILD" WITHOUT BARRIER	ACTIVITY CATEGORY and NAC ( )	IMPACT TYPE (A/E or NONE)[3]	NOISE PREDICTION WITH BARRIER AND BARRIER INSERTION LOSS (I.L.)									
							8 ft		10 ft		12 ft		14 ft		16 ft	
							Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
Area 53																
R 45	REC	69	69	71	B (67)	A/E	64[R]	7	63	8	62	9	62	9	61	10
R 46	REC	69	69	71	B (67)	A/E	62[R]	9	60	11	59	12	58	13	57	14
R 47	REC	64	64	65	B (67)	NONE	60[R]	5	60	5	59	6	59	6	59	6
Number of benefited receptors							10		10		10		10		10	
Total barrier cost							$249,600		$312,000		$374,400		$436,800		$499,200	
Cost per benefited receptor							$24,960		$31,200		$37,440		$43,680		$49,920	

Notes:

1 - Leq(h) are A-weighted, peak hour noise levels in decibels.
2 - Land Use: SFR - single-family residence; MFR multi-family residences; REC - Outdoor recreational areas.
3 - A/E = Approach or exceed NAC.
4 - Traffic noise from Route 8; other local noise sources are not included.
R - Recommended height to meet feasibility requirements of the Guam Public Works Noise Abatement Policy.

Legend: dBA = A-weighted decibel; ft = feet; L_{eq} = equivalent sound level; NAC = Noise Abatement Criteria.
Source: Parsons Transportation Group.

- Area 20: Outdoor use areas for two single- and two multi-family residences within Area 20 would be impacted from traffic noise under Alternative 1. However, these residences have direct-access driveways to Route 1 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheets 22 and 23 in Appendix G show the location of Area 20.
- Area 21: Outdoor use areas for three single-family residences and three frontage outdoor use areas for a park within Area 21 would be impacted from traffic noise under Alternative 1. However, these residences have direct-access driveways to Route 1, and the park's outdoor use areas have parking with direct access to Route 1 next to them that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheet 23 in Appendix G shows the location of Area 21.
- Area 22: Outdoor use areas for nine single- and multi-family residences and one frontage outdoor use area for a playground within Area 22 would be impacted from traffic noise under Alternative 1. However, building a sound wall for these scattered residences along the alignment would not be reasonable because the sound wall cost would exceed the cost per benefited receptor requirement. Sheets 23 and 24 in Appendix G show the location of Area 22.
- Area 23: A sound wall 8 ft (2 m) in height and 835 ft (255 m) long located along the shoulder of the southbound side of Route 1 would provide feasible noise abatement for seven impacted frontage outdoor use areas for a park within Area 23 from traffic noise under Alternative 1. Furthermore, the cost per benefited receptor is $33,400, which is below the GDPW $35,000 cost per benefited receptor requirement for a sound wall to be considered reasonable. The results of the noise abatement analysis for this sound wall are shown in Table 8.2–15. Sheet 25 in Appendix G shows the location of the sound wall for Area 23.
- Area 24: Outdoor use areas for three of the multi-family residences within Area 24 are impacted from traffic noise under Alternative 1. However, these residences have direct-access driveways to Route 1 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheet 25 in Appendix G show the location of Area 24.
- Area 25: Outdoor use areas for two single-family residences and four frontage outdoor use areas for a park within Area 25 would be impacted from traffic noise under Alternative 1. However, these residences have direct-access driveways to Route 1, and the park's outdoor use areas have parking lots with direct access to Route 1 between them and the alignment that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheets 25 and 26 in Appendix G show the location of Area 25.
- Area 26: There are six impacted frontage outdoor use areas for a cemetery within Area 26 from traffic noise under Alternative 1. However, most of these outdoor use areas have parking lots with direct access to Route 1 next to them that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheet 25 in Appendix G shows the location of Area 26.
- Area 27: A sound wall 8 ft (2 m) in height and 1,265 ft (386 m) long located along the shoulder of the southbound side of Route 1 would provide feasible noise abatement for 12 impacted frontage outdoor use areas for a park within Area 27 from traffic noise under Alternative 1. Furthermore, the cost per benefited receptor is $33,680, which is below the GDPW $35,000 cost per benefited receptor requirement for a sound wall to be considered reasonable. The results of the noise abatement analysis for this sound wall are shown in Table 8.2–16. Sheet 27 in Appendix G shows the location of the sound wall for Area 27.

- Area 28: There are two impacted frontage outdoor use areas for a park within Area 28 from traffic noise under Alternative 1. However, because there are only two impacted areas, a sound wall would have to be extended beyond the park's property to provide feasible abatement, which would exceed the cost per benefited receptor requirement. Sheet 28 in Appendix G shows the location of Area 28.
- Area 29: There are four impacted frontage outdoor use areas for a park within Area 29 from traffic noise under Alternative 1. However, because there are only four impacted areas, a sound wall would have to be extended beyond the park's property to provide feasible abatement, which would exceed the cost per benefited receptor requirement. Sheets 28 and 29 in Appendix G show the location of Area 29.
- Area 30: There are nine impacted frontage outdoor use areas for a park within Area 30 from traffic noise under Alternative 1. However, building a sound wall for these scattered areas along the alignment would not be reasonable because the sound wall cost would exceed the cost per benefited receptor requirement. Sheets 29, 30, and 31 in Appendix G show the location of Area 30.
- Area 31: There are four impacted frontage outdoor use areas for a park within Area 31 from traffic noise under Alternative 1. However, because there are only four impacted areas, a sound wall would have to be extended beyond the park's property to provide feasible abatement, which would exceed the cost per benefited receptor requirement. Sheet 32 in Appendix G shows the location of Area 31.
- Area 32: Outdoor use areas for four of the multi-family residences within Area 32 are impacted from traffic noise under Alternative 1. However, these residences have direct-access driveways to Route 1 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheet 33 in Appendix G show the location of Area 32.
- Area 34: A sound wall 8 ft (2 m) in height and 840 ft (256 m) long located along the shoulder of the southbound side of Route 1 would provide feasible noise abatement for eight impacted frontage outdoor use areas for a school within Area 34 from traffic noise under Alternative 1. Furthermore, the cost per benefited receptor is $33,480, which is below the GDPW $35,000 cost per benefited receptor requirement for a sound wall to be considered reasonable. The results of the noise abatement analysis for this sound wall are shown in Table 8.2–17. Sheet 35 in Appendix G shows the location of the sound wall for Area 34.
- Area 35: Outdoor use areas for 11 multi-family residences and four frontage outdoor use areas for a park within Area 35 would be impacted from traffic noise under Alternative 1. However, these residences have direct-access driveways to Route 1, and the park's outdoor use areas have parking lots with direct access to Route 1 next to them that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheets 35 and 36 in Appendix G show the location of Area 35.
- Area 36: A park with four frontage outdoor use areas and two churches within Area 36 would be impacted from traffic noise under Alternative 1. However, the churches have direct-access driveways to Route 1, and the park's outdoor use areas have parking lots between them and the alignment with direct access to Route 1 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheets 36 and 37 in Appendix G show the location of Area 36.
- Area 38: There is one impacted frontage outdoor use areas for a church within Area 38 from traffic noise under Alternative 1. However, the church has a direct-access driveway to Route

1 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheet 38 in Appendix G shows the location of Area 38.

- Area 39: A sound wall 8 ft (2 m) in height and 1,975 ft (602 m) long located along the shoulder of the southbound side of Route 1 would provide feasible noise abatement for 33 outdoor use areas for single-family residences within Area 39 from traffic noise under Alternative 1. Of the 33 benefited outdoor use areas, 20 are first-row residences that are impacted and 13 are second-row residences that are not impacted but are receiving a 5-dB noise reduction due to the recommended sound wall. Furthermore, the cost per benefited receptor is $19,142, which is below the GDPW $35,000 cost per benefited receptor requirement for a sound wall to be considered reasonable. The results of the noise abatement analysis for this sound wall are shown in Table 8.2–18. Sheets 39 and 40 in Appendix G show the location of the sound wall for Area 39.
- Area 43: Two sound walls 12 ft (4 m) in height and 1,400 ft (427 m) in total length located along the shoulder of the southbound side of Route 1 would provide feasible noise abatement for 29 outdoor use areas for single-family residences within Area 43 from traffic noise under Alternative 1. Furthermore, the cost per benefited receptor is $23,123, which is below the GDPW $35,000 cost per benefited receptor requirement for a sound wall to be considered reasonable. Of the 29 benefited outdoor use areas, 18 are first-row residences that are impacted and 11 are second-row residences that are not impacted but are receiving a 5-dB noise reduction due to the recommended sound walls. The results of the noise abatement analysis for this sound wall are shown in Table 8.2–19. Sheets 41 and 42 in Appendix G show the location of the sound wall for Area 43.
- Area 45: Two sound walls 8 ft (2 m) in height and 2,915 ft (888 m) in total length located along the shoulder of the southbound side of Route 1 would provide feasible noise abatement for 28 impacted frontage outdoor use areas for a park within Area 45 from traffic noise under Alternative 1. Furthermore, the cost per benefited receptor is $33,291, which is below the GDPW $35,000 cost per benefited receptor requirement for a sound wall to be considered reasonable. The results of the noise abatement analysis for this sound wall are shown in Table 8.2–20. Sheets 42, 43, and 44 in Appendix G show the location of Area 45.
- Area 47: Outdoor use areas for 12 single-family residences within Area 47 would be impacted from traffic noise under Alternative 1. However, most of these residences have direct-access driveways to Route 1 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. In addition, building a sound wall for these scattered residences along the alignment would not be reasonable because the sound wall cost would exceed the cost per benefited receptor requirement. Sheet 46 in Appendix G shows the location of Area 47.
- Area 48: Outdoor use areas for nine single- and multi-family residences within Area 48 would be impacted from traffic noise under Alternative 1. However, most of these residences have direct-access driveways to Route 1 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheet 48 in Appendix G shows the location of Area 48.
- Area 49: Two sound walls 12 ft (4 m) in height and 1,060 ft (323 m) in total length located along the shoulder of the southbound side of Route 27 would provide feasible noise abatement for 15 outdoor use areas for single-family residences within Area 49 from traffic noise under Alternative 1. Of the 15 benefited outdoor use areas, 10 are first-row residences that are impacted and five are second-row residences that are not impacted but are receiving a

5-dB noise reduction due to the recommended sound walls. Furthermore, the cost per benefited receptor is $33,824, which is below the GDPW $35,000 cost per benefited receptor requirement for a sound wall to be considered reasonable. The results of the noise abatement analysis for this sound wall are shown in Table 8.2–21. Sheets 50 and 51 in Appendix G show the location of Area 49.

- Area 50: An outdoor sports complex within Area 50 would have nine frontage outdoor use areas that would be impacted from traffic noise under Alternative 1. However, most of these areas have parking lots between them and the alignment with direct access to Route 27 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheets 50 and 51 in Appendix G show the location of Area 50.
- Area 52: Outdoor use areas for eight multi-family residences and a motel within Area 52 would be impacted from traffic noise under Alternative 1. However, most of these residences and motel have direct-access driveways to Route 8 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheet 53 in Appendix G shows the location of Area 52.
- Area 53: A sound wall 8 ft (2 m) in height and 780 ft (238 m) long located along the shoulder of the northbound side of Route 8 would provide feasible noise abatement for 10 outdoor use areas for multi-family residences within Area 53 from traffic noise under Alternative 1. Furthermore, the cost per benefited receptor is $24,960, which is above the GDPW $35,000 cost per benefited receptor requirement for a sound wall to be considered reasonable. The results of the noise abatement analysis for this sound wall are shown in Table 8.2–22. Sheet 53 in Appendix G shows the location of Area 53.
- Area 55: Outdoor use area for one single-family residence within Area 55 would be impacted from traffic noise under Alternative 1. However, because there is only one impacted residence, a sound wall would have to be extended beyond the residence’s property to provide feasible abatement, which would exceed the cost per benefited receptor requirement. Sheet 56 in Appendix G shows the location of Area 55.
- Area 56: Outdoor use areas for 11 single- and multi-family residences within Area 56 would be impacted from traffic noise under Alternative 1. However, most of these residences have direct-access driveways to Route 8 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. In addition, building a sound wall for these scattered residences along the alignment would not be reasonable because the sound wall cost would exceed the cost per benefited receptor requirement. Sheets 57 and 58 in Appendix G show the location of Area 56.
- Area 57: Outdoor use areas for 11 single- and multi-family residences within Area 57 would be impacted from traffic noise under Alternative 1. However, most of these residences have direct-access driveways to Route 16 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. In addition, building a sound wall for these scattered residences along the alignment would not be reasonable because the sound wall cost would exceed the cost per benefited receptor requirement. Sheets 59 and 60 in Appendix G show the location of Area 57.
- Area 59: Outdoor use areas for six single-family residences within Area 59 would be impacted from traffic noise under Alternative 1. However, most of these residences have direct-access driveways to Route 16 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheet 62 in Appendix G shows the location of Area 59.

- Area 60: Outdoor use areas for three single-family residences within Area 60 would be impacted from traffic noise under Alternative 1. However, these residences have direct-access driveways to Route 8 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheet 63 in Appendix G show the location of Area 60.
- Area 61: A funeral home and the outdoor use areas for seven single- and multi-family residences within Area 61 would be impacted from traffic noise under Alternative 1. However, most of these residences, as well as the funeral home, have direct-access driveways to Route 16 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheets 63 and 64 in Appendix G show the location of Area 61.
- Area 63: Outdoor use areas for 23 single- and multi-family residences and a church within Area 63 would be impacted from traffic noise under Alternative 1. However, most of these residences, as well as the church, have direct-access driveways to Route 10 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. In addition, building a sound wall for these scattered residences along the alignment would not be reasonable because the sound wall cost would exceed the cost per benefited receptor requirement. Sheets 67, 68, and 69 in Appendix G show the location of Area 63.
- Area 64: Outdoor use areas for 18 single- and four multi-family residences within Area 64 would be impacted from traffic noise under Alternative 1. However, most of these residences have direct-access driveways to Route 10 that would prevent the construction of a continuous sound wall required to provide feasible noise abatement. Sheets 67, 68, and 69 in Appendix G show the location of Area 64.

Apra Harbor

Since there are no noise-sensitive receptors along the proposed roadway improvement projects within the Apra Harbor Region, no noise abatement modeling was performed for traffic noise under Alternative 1.

South

While there are noise-sensitive land uses along routes in the South Region, noise from traffic would not impact the noise-sensitive land uses under Alternative 1. Therefore, noise abatement modeling was not performed.

8.2.6.2 Alternative 2 (Preferred Alternative)

Year 2014 (Peak Construction and Peak Population)

Construction impacts and abatement measures of Alternative 2 are similar to those described under Alternative 1.

Year 2030

Results of the noise impact analysis indicate that under Alternative 2 noise impacts and abatement measures for each region is similar to those described under Alternative 1.

8.2.6.3 Alternative 3

Year 2014 (Peak Construction and Peak Population)

Construction impacts and abatement measures of Alternative 3 are similar to those described under Alternative 1.

Year 2030

North

Under Alternative 3, potential traffic noise impacts to noise-sensitive receptors would be the same as Alternative 1 for the North Region, even though there was a significant increase to the future traffic volume for GRN #8 and #9. There are 88 noise receptors that would experience sound levels approaching or exceeding the NAC of 67 dBA. The type and number of impacted noise-sensitive receptors are described in the North Region subsection of Alternative 1, except for the following noise sensitive sites that have updated sheets to show the change in the 66-dBA noise contour line due to the increased traffic volume for GRN #8 and #9:

- Area 1: Outdoor use areas for 16 single-family residences and one church within Area 1 would be impacted from traffic noise under Alternative 1. Sheets 1B and 2B in Appendix G show the location of Area 1.
- Area 2: None of the outdoor use areas for the multi-family residences within Area 2 would be impacted from traffic noise under Alternative 1. Sheet 4B in Appendix G shows the location of Area 2.
- Area 3: Outdoor use areas for two single-family residences within Area 3 would be impacted from traffic noise under Alternative 1. Sheets 3B and 4B in Appendix G show the location of Area 3.
- Area 4: Outdoor use areas for four single-family residences within Area 4 would be impacted from traffic noise under Alternative 1. Sheets 4B and 5B in Appendix G show the location of Area 4.

Central

Under Alternative 3, potential traffic noise impacts to noise-sensitive receptors for the Central Region would be the same as Alternative 1, even though there was a significant increase to the future traffic volume for GRN #18 and #19. There are 378 noise receptors that would experience sound levels approaching or exceeding the NAC of 67 dBA. The type and number of impacted noise sensitive receptors are described in the Central Region subsection of Alternative 1, except for the following noise-sensitive sites that have updated sheets to show the change in the 66-dBA noise contour line due to the increased traffic volume for GRN #18 and #19:

- Area 60: Outdoor use areas for three single-family residences within Area 60 would be impacted from traffic noise under Alternative 1. Sheet 63B in Appendix G shows the location of Area 60.
- Area 61: A funeral home and the outdoor use areas for seven single- and multi-family residences within Area 61 would be impacted from traffic noise under Alternative 1. Sheets 65B and 66B in Appendix G show the location of Area 61.
- Area 62: None of the multi-family residences outdoor use areas within Area 62 would be impacted from traffic noise under Alternative 1. Sheets 65B and 66B in Appendix G show the location of Area 62.

Apra Harbor

Since there are no noise-sensitive receptors along the proposed roadway improvement projects within the Apra Harbor Region, no impacts from traffic noise under Alternative 3 would occur.

South

While there are noise-sensitive land uses along routes in the South Region, noise from traffic would not impact the noise sensitive land uses under Alternative 3.

Abatement Measures

North

Noise abatement analysis results within the North Region for Alternative 3 are the same as Alternative 1.

Central

Noise abatement analysis results within the Central Region for Alternative 3 are the same as Alternative 1.

Apra Harbor

Since there are no noise-sensitive receptors along the proposed roadway improvement projects within the Apra Harbor Region, no noise abatement modeling was performed for traffic noise under Alternative 3.

South

While there are noise-sensitive land uses along routes in the South Region, noise from traffic would not impact the noise-sensitive land uses under Alternative 3; therefore, noise abatement modeling was not performed.

8.2.6.4 Alternative 8

Year 2014 (Peak Construction and Peak Population)

Construction impacts and abatement measures of Alternative 8 are similar to those described under Alternative 1.

Year 2030

Noise impacts and abatement measures under Alternative 8 for each region are similar to those described under Alternative 3.

8.2.6.5 No-Action Alternative

Year 2009

There would be no specific construction for this alternative besides regular scheduled roadway maintenance work. Traffic noise levels would be as measured and calculated for the existing conditions.

Year 2014

There would be no specific construction for this alternative besides regular scheduled roadway maintenance work. Traffic noise levels would be slightly higher than the measured and calculated for the existing conditions as a result of growth in traffic volumes.

Year 2030

North

Under the no-action alternative, potential traffic noise impacts to noise-sensitive receptors were assessed for 16 representative areas within the North Region, and the number of impacts per area is shown in Table 8.2–9. There are 49 noise-sensitive receptors that would experience sound levels approaching or exceeding the NAC of 67 dBA. The type and number of impacted noise sensitive receptors for each area are described in the following text:

- Area 1: Outdoor use areas for 16 single-family residences and one church within Area 1 would be impacted from traffic noise under the no-action alternative. Sheets 1 and 2 in Appendix G show the location of Area 1.
- Area 2: None of the outdoor use areas for the multi-family residences within Area 2 would be impacted from traffic noise under the no-action alternative. Sheet 4 in Appendix G shows the location of Area 2.
- Area 3: None of the outdoor use areas for the single-family residences within Area 3 would be impacted from traffic noise under the no-action alternative. Sheets 3 and 4 in Appendix G show the location of Area 3.
- Area 4: None of the outdoor use areas for the single-family residences within Area 4 would be impacted from traffic noise under the no-action alternative. Sheets 4 and 5 in Appendix G show the location of Area 4.
- Area 5: None of the outdoor use areas for the single- and multi-family residences within Area 5 would be impacted from traffic noise under the no-action alternative. Sheets 5, 6, and 7 in Appendix G show the location of Area 5.
- Area 6: This area represents a military outdoor physical training site and has four frontage outdoor use areas. None of the military outdoor physical training areas within Area 6 would be impacted from traffic noise under the no-action alternative. Sheet 6 in Appendix G shows the location of Area 6.
- Area 7: None of the outdoor use areas for the single-family residences within Area 7 would be impacted from traffic noise under the no-action alternative. Sheets 7 and 8 in Appendix G show the location of Area 7.
- Area 8: This area represents a military outdoor recreational site and has 12 frontage outdoor use areas. None of the military outdoor recreational areas within Area 8 would be impacted from traffic noise under the no-action alternative. Sheets 7 and 8 in Appendix G show the location of Area 8.
- Area 9: None of the outdoor use areas for the single-family residences and the golf course within Area 9 would be impacted from traffic noise under the no-action alternative. Sheets 9, 10, and 11 in Appendix G show the location of Area 9.
- Area 10: None of the outdoor use areas for the single-family residences within Area 10 would be impacted from traffic noise under the no-action alternative. Sheets 11 and 12 in Appendix G show the location of Area 10.
- Area 11: None of the outdoor use areas for the single- and multi-family residences or the school within Area 11 would be impacted from traffic noise under the no-action alternative. Furthermore, none of the schools indoor use areas would be impacted from noise under the no-action alternative. Sheets 12, 13, and 14 in Appendix G show the location of Area 11.
- Area 12: Outdoor use areas for seven single-family residences within Area 12 would be impacted from traffic noise under the no-action alternative. Sheets 15 and 16 in Appendix G show the location of Area 12.
- Area 13: Outdoor use areas for four single-family residences within Area 13 would be impacted from traffic noise under the no-action alternative. Sheets 15, 16, and 17 in Appendix G show the location of Area 13.

- Area 14: Outdoor use areas for seven single- and four multi-family residences within Area 14 would be impacted from traffic noise under the no-action alternative. Sheets 17, 18, and 19 in Appendix G show the location of Area 14.
- Area 15: This area represents a school and has three frontage outdoor use receptors. None of the school's outdoor recreational areas or its indoor use areas within Area 15 would be impacted from traffic noise under the no-action alternative. Sheet 18 in Appendix G shows the location of Area 15.
- Area 16: Outdoor use areas for nine single-family residences and one church within Area 16 would be impacted from traffic noise under the no-action alternative. Sheet 19 in Appendix G shows the location of Area 16.

Central

Under the no-action alternative, potential traffic noise impacts to noise-sensitive receptors were assessed for 48 representative areas within the Central Region, and the number of impacts per area is shown in Table 8.2–10. There are 342 noise-sensitive receptors that would experience sound levels approaching or exceeding the NAC of 67 dBA. The type and number of impacted noise-sensitive receptors for each area are described in the following text:

- Area 17: Outdoor use areas for 13 single- and two multi-family residences within Area 17 would be impacted from traffic noise under the no-action alternative. Sheets 20, 21, and 22 in Appendix G show the location of Area 17.
- Area 18: Outdoor use areas for seven single-family residences and 10 frontage outdoor use areas for a park within Area 18 would be impacted from traffic noise under the no-action alternative. Sheets 20, 21, and 22 in Appendix G show the location of Area 18.
- Area 19: None of the frontage outdoor use areas for a park within Area 19 would be impacted from traffic noise under the no-action alternative. Sheets 22 and 23 in Appendix G show the location of Area 19.
- Area 20: Outdoor use areas for two single- and two multi-family residences within Area 20 would be impacted from traffic noise under the no-action alternative. Sheets 22 and 23 in Appendix G show the location of Area 20.
- Area 21: Outdoor use areas for one single- and two multi-family residences within Area 21 would be impacted from traffic noise under the no-action alternative. Sheet 23 in Appendix G shows the location of Area 21.
- Area 22: Outdoor use areas for seven single- and two multi-family residences, as well as one frontage outdoor use area for a playground, within Area 22 would be impacted from traffic noise under the no-action alternative. Sheets 23 and 24 in Appendix G show the location of Area 22.
- Area 23: Outdoor use area for one single-family residence and three frontage outdoor use areas for a park within Area 23 would be impacted from traffic noise under the no-action alternative. Sheets 24 and 25 in Appendix G show the location of Area 23.
- Area 24: Outdoor use areas for three multi-family residences within Area 24 would be impacted from traffic noise under the no-action alternative. Sheet 25 in Appendix G shows the location of Area 24.
- Area 25: Outdoor use areas for two single-family residences within Area 25 would be impacted from traffic noise under the no-action alternative. Sheets 25 and 26 in Appendix G show the location of Area 25.

- Area 26: None of the six frontage outdoor use areas for a cemetery within Area 26 would be impacted from traffic noise under the no-action alternative. Sheet 25 in Appendix G shows the location the location of Area 26.
- Area 27: A park within Area 27 would have 11 frontage outdoor use areas that would be impacted from traffic noise under the no-action alternative. Sheets 27 and 28 in Appendix G show the location of Area 27.
- Area 28: A park within Area 28 would have two frontage outdoor use areas that would be impacted from traffic noise under the no-action alternative. Sheet 28 in Appendix G shows the location of Area 28.
- Area 29: A park within Area 29 would have four frontage outdoor use areas that would be impacted from traffic noise under the no-action alternative. Sheets 28 and 29 in Appendix G show the location of Area 29.
- Area 30: A park within Area 30 would have nine frontage outdoor use areas that would be impacted from traffic noise under the no-action alternative. Sheets 29, 30, and 31 in Appendix G show the location of Area 30.
- Area 31: A park within Area 31 would have four frontage outdoor use areas that would be impacted from traffic noise under the no-action alternative. Sheet 32 in Appendix G shows the location of Area 31.
- Area 32: Outdoor use areas for four multi-family residences within Area 32 would be impacted from traffic noise under the no-action alternative. Sheet 33 in Appendix G shows the location of Area 32.
- Area 33: None of the multi-family residences outdoor use areas within Area 33 would be impacted from traffic noise under the no-action alternative. Sheet 34 in Appendix G shows the location of Area 33.
- Area 34: A school within Area 34 would have eight frontage outdoor use areas that would be impacted from traffic noise under the no-action alternative; however, none of the school’s indoor use areas would be impacted from traffic noise under the no-action alternative. Sheets 34 and 35 in Appendix G show the location of Area 34.
- Area 35: Outdoor use areas for 11 multi-family residences and four frontage outdoor use areas for a park within Area 35 would be impacted from traffic noise under the no-action alternative. Sheets 35 and 36 in Appendix G show the location of Area 35.
- Area 36: A park with four frontage outdoor use areas and two churches within Area 36 would be impacted from traffic noise under the no-action alternative. Sheets 36 and 37 in Appendix G show the location of Area 36.
- Area 37: None of the multi-family residences outdoor use areas within Area 37 would be impacted from traffic noise under the no-action alternative. Sheets 37 and 38 in Appendix G show the location of Area 37.
- Area 38: None of the multi-family residences outdoor use areas and one frontage outdoor use areas for a church within Area 38 would be impacted from traffic noise under the no-action alternative. Sheet 38 in Appendix G shows the location of Area 38.
- Area 39: Outdoor use areas for 21 single-family residences within Area 39 would be impacted from traffic noise under the no-action alternative. Sheets 39 and 40 in Appendix G show the location of Area 39.

- Area 40: None of the multi-family residences outdoor use areas within Area 40 would be impacted from traffic noise under the no-action alternative. Sheet 41 in Appendix G shows the location of Area 40.
- Area 41: None of the single-family residences outdoor use areas within Area 41 would be impacted from traffic noise under the no-action alternative. Sheet 41 in Appendix G shows the location of Area 41.
- Area 42: None of the single-family residences outdoor use areas within Area 42 would be impacted from traffic noise under the no-action alternative. Sheets 41 and 42 in Appendix G show the location of Area 42.
- Area 43: Outdoor use areas for 18 single-family residences within Area 43 would be impacted from traffic noise under the no-action alternative. Sheet 42 in Appendix G shows the location of Area 43.
- Area 44: None of the single-family residences outdoor use areas within Area 44 would be impacted from traffic noise under the no-action alternative. Sheet 42 in Appendix G shows the location of Area 44.
- Area 45: A park within Area 45 would have 30 frontage outdoor use areas that would be impacted from traffic noise under the no-action alternative. Sheets 42, 43, and 44 in Appendix G show the location of Area 45.
- Area 46: None of the single-family residences outdoor use areas within Area 46 would be impacted from traffic noise under the no-action alternative. Sheet 44 in Appendix G shows the location of Area 46.
- Area 47: Outdoor use areas for 12 single-family residences within Area 47 would be impacted from traffic noise under the no-action alternative. Sheet 46 in Appendix G shows the location of Area 47.
- Area 48: Outdoor use areas for seven single within Area 48 would be impacted from traffic noise under the no-action alternative. Sheet 48 in Appendix G shows the location of Area 48.
- Area 49: Outdoor use areas for 17 single- and four multi-family residences within Area 49 would be impacted from traffic noise under the no-action alternative. Sheets 50 and 51 in Appendix G show the location of Area 49.
- Area 50: An outdoor sports complex within Area 50 would have nine frontage outdoor use areas that would be impacted from traffic noise under the no-action alternative. Sheets 50 and 51 in Appendix G show the location of Area 50.
- Area 51: None of the recreational outdoor use areas or indoor use areas for a school within Area 51 would be impacted from traffic noise under the no-action alternative. Sheet 51 in Appendix G shows the location of Area 51.
- Area 52: Outdoor use areas for eight multi-family residences within Area 52 would be impacted from traffic noise under the no-action alternative. Sheet 53 in Appendix G shows the location of Area 52.
- Area 53: Outdoor use areas for 10 multi-family residences within Area 53 would be impacted from traffic noise under the no-action alternative. Sheet 53 in Appendix G shows the location of Area 53.
- Area 54: None of the multi-family residences outdoor use areas within Area 54 would be impacted from traffic noise under the no-action alternative. Sheet 54 in Appendix G shows the location of Area 54.

- Area 55: Outdoor use area for one single-family residence within Area 55 would be impacted from traffic noise under the no-action alternative. Sheet 56 in Appendix G shows the location of Area 55.
- Area 56: Outdoor use areas for nine single- and two multi-family residences within Area 56 would be impacted from traffic noise under the no-action alternative. Sheets 57 and 58 in Appendix G show the location of Area 56.
- Area 57: Outdoor use areas for 10 single- and one multi-family residence within Area 57 would be impacted from traffic noise under the no-action alternative. Sheets 59 and 60 in Appendix G show the location of Area 57.
- Area 58: None of the 28 frontage outdoor use areas for a military outdoor recreational area within Area 58 would be impacted from traffic noise under the no-action alternative. Sheets 59 and 60 in Appendix G show the location of Area 58.
- Area 59: Outdoor use areas for six single-family residences within Area 59 would be impacted from traffic noise under the no-action alternative. Sheet 62 in Appendix G shows the location of Area 59.
- Area 60: Outdoor use areas for three single-family residences within Area 60 would be impacted from traffic noise under the no-action alternative. Sheet 63 in Appendix G shows the location of Area 60.
- Area 61: Outdoor use areas for five single- and two multi-family residences within Area 61 would be impacted from traffic noise under the no-action alternative. Sheets 63 and 64 in Appendix G show the location of Area 61.
- Area 62: None of the multi-family residences outdoor use areas within Area 62 would be impacted from traffic noise under the no-action alternative. Sheets 65 and 66 in Appendix G show the location of Area 62.
- Area 63: Outdoor use areas for 21 single- and two multi-family residences within Area 63 would be impacted from traffic noise under the no-action alternative. Sheets 67, 68, and 69 in Appendix G show the location of Area 63.
- Area 64: Outdoor use areas for 18 single- and four multi-family residences within Area 64 would be impacted from traffic noise under the no-action alternative. Sheets 67, 68, and 69 in Appendix G show the location of Area 64.

Apra Harbor

Since there are no noise-sensitive receptors along the proposed roadway improvement projects within the Apra Harbor Region, no impacts from traffic noise under the no-action alternative would occur.

South

While there are noise-sensitive land uses along routes in the South Region, noise from traffic would not impact the noise sensitive land uses under the no-action alternative.

8.2.6.6 Summary of Impacts

During the construction period, some of the noise sensitive receptors that are close to the roadways may be exposed to noise levels greater than 80 dBA. A combination of noise mitigation techniques with equipment noise control and administrative measures may be selected to provide the most effective means to minimize effects of the construction activity noise as discussed below.

Table 8.2–23 summarizes the potential impacts of each action alternative and the no-action alternative.

Table 8.2–23. Summary of Potential Noise Impacts – Roadway Project

Potentially Impacted Resource	*Alternative 1*	*Alternative 2**	*Alternative 3*	*Alternative 8*	*No Action*
Construction Noise Impacts to Sensitive Receptors	LSI	LSI	LSI	LSI	NA
Traffic Noise Impact on North Region Sensitive Receptors	SI-M	SI-M	SI-M	SI-M	SI-M
Traffic Noise Impact on Central Region Sensitive Receptors	SI-M	SI-M	SI-M	SI-M	SI-M
Traffic Noise Impact on Apra Harbor Region Sensitive Receptors	NI	NI	NI	NI	NI
Traffic Noise Impact on South Region Sensitive Receptors	NI	NI	NI	NI	NI

Legend: LSI = Less than significant impact; NA = not applicable; NI = No impact; SI-M = Significant impact mitigable to less than significant. *Preferred Alternative.

A summary of noise-sensitive receptors that would be impacted is provided in Table 8.2–24 for the North Region and Table 8.2–25 for the Central Region, respectively.

Table 8.2–24. Summary of Potential Roadway Project Noise Impacts for the North Region

	Number of Predicted Impact Receptors				
Type of Noise Sensitive Receptors	*Alternative 1*	*Alternative 2*	*Alternative 3*	*Alternative 8*	*No Action*
Area 1: Single Family Residences and a Church	17	17	17	17	17
Area 2: Multi-Family Residences	0	0	0	0	0
Area 3: Single Family Residences	2	2	2	2	0
Area 4: Single Family Residences	4	4	4	4	0
Area 5: Single and Multi-Family Residences	0	0	0	0	0
Area 6: Military Outdoor Physical Training Area	4	4	4	4	0
Area 7: Single Family Residences	0	0	0	0	0
Area 8: Military Outdoor Recreation Area	12	12	12	12	0
Area 9: Single Family Residences and a Golf Course	0	0	0	0	0
Area 10: Single Family Residences	1	1	1	1	0
Area 11: Single Family Residences, Multi-Family Residences, and a school	10	10	10	10	0
Area 12: Single Family Residences	7	7	7	7	7
Area 13: Single Family Residences	8	8	8	8	4
Area 14: Single and Multi-Family Residences	13	13	13	13	11
Area 15:School	0	0	0	0	0
Area 16: Single Family Residences and a Church	10	10	10	10	10
Total	**88**	**88**	**88**	**88**	**49**

Table 8.2–25. Summary of Potential Roadway Project Noise Impacts for the Central Region

Type of Noise Sensitive Receptors	*Number of Predicted Impact Receptors*				
	Alternative 1	*Alternative 2*	*Alternative 3*	*Alternative 8*	*No Action*
Area 17: Single Family Residences and a Multi-Family Residence	15	15	15	15	15
Area 18: Single Family Residences and a Park	17	17	17	17	17
Area 19: Park	8	8	8	8	0
Area 20: Single Family Residences and a Multi-Family Residence	4	4	4	4	4
Area 21: Park, a Single Family Residence, and a Multi-Family Residence	6	6	6	6	3
Area 22: Playground, a Single Family Residence, and a Multi-Family Residence	10	10	10	10	10
Area 23: Park and a Single Family Residence	7	7	7	7	4
Area 24: Multi-Family Residences	3	3	3	3	3
Area 25: Park and Single Family Residences	6	6	6	6	2
Area 26: Cemetery	6	6	6	6	0
Area 27: Park	20	20	20	20	11
Area 28: Park	2	2	2	2	2
Area 29: Park	4	4	4	4	4
Area 30: Park	9	9	9	9	9
Area 31: Park	4	4	4	4	4
Area 32: Multi-Family Residences	4	4	4	4	4
Area 33: Multi-Family Residences	0	0	0	0	0
Area 34: School	8	8	8	8	8
Area 35: Park, a Single Family Residence, and Multi-Family Residences	15	15	15	15	15
Area 36: One School and Two Churches	6	6	6	6	6
Area 37: Multi-Family Residences	0	0	0	0	0
Area 38: Multi-Family Residences and a Church	1	1	1	1	1
Area 39: Single Family Residences	21	21	21	21	21
Area 40: Multi-Family Residences	0	0	0	0	0
Area 41: Single Family Residences	0	0	0	0	0
Area 42: Single Family Residences	0	0	0	0	0
Area 43: Single Family Residences	18	18	18	18	18
Area 44: Single Family Residences	0	0	0	0	0
Area 45: Park, Single Family Residences, and Multi-Family Residences	30	30	30	30	30
Area 46: Single Family Residences	0	0	0	0	0
Area 47: Single Family Residences	12	12	12	12	12
Area 48: Single Family Residences, and Multi-Family Residences	9	9	9	9	7
Area 49: Single Family Residences and Multi-Family Residences	21	21	21	21	21

Type of Noise Sensitive Receptors	*Number of Predicted Impact Receptors*				
	Alternative 1	*Alternative 2*	*Alternative 3*	*Alternative 8*	*No Action*
Area 50: Outdoor Sports Complex	9	9	9	9	9
Area 51: School	0	0	0	0	0
Area 52: Multi-Family Residences and a Motel	9	9	9	9	8
Area 53: Multi-Family Residences	10	10	10	10	10
Area 54: Multi-Family Residences	0	0	0	0	0
Area 55: Single Family Residences and a Motel	1	1	1	1	1
Area 56: Single Family Residences and Multi-Family Residences	11	11	11	11	11
Area 57: Single Family Residences and Multi-Family Residences	11	11	11	11	11
Area 58: Military Outdoor Recreational Area	0	0	0	0	0
Area 59: Single Family Residences	6	6	6	6	6
Area 60: Single Family Residences	3	3	3	3	3
Area 61: Single Family Residences, Multi-Family Residences, and a Funeral Home	7	7	7	7	7
Area 62: Multi-Family Residences	0	0	0	0	0
Area 63: Single Family Residences, Multi-Family Residences, and a Church	23	23	23	23	23
Area 64: Single Family Residences, Multi-Family Residences, and a School	22	22	22	22	22
Total	**378**	**378**	**378**	**378**	**342**

Future noise impacts for each of the alternatives were predicted by projecting a 66-dBA traffic noise contour line modeled using Traffic Noise Model 2.5 onto aerial photographs of the project alignment. No impacts were predicted for the Apra Harbor Region or South Region. In addition, there are no beneficial impacts from any of the alignments.

8.2.6.7 Summary of Proposed Mitigation Measures

The sound walls discussed in Section 8.2.6.1, Alternative 1, Abatement Measures were designed to reduce traffic noise levels by at least the minimum requirement of 5 dB.

Fifteen sound walls were analyzed for 12 areas throughout the alignment in the North Region where sound walls were determined to be feasible. Twelve of these sound walls were determined to be both feasible and reasonable. In the Central Region, a total of 123 sound walls were analyzed. The location and dimension of sound walls as presented are preliminary. Views of the impacted residents or recreational areas would be a major consideration in reaching a final decision on the abatement measures to be provided. If pertinent parameters change substantially during the final project design, reanalysis of the traffic noise impact may become necessary, and the noise abatements may be changed. A final decision of the construction of the noise abatements would be made upon completion of the project design. These sound walls would reduce the number of predicted impacted receptors from 466 to 316 for Alternatives 1, 2, 3, and 8. Noise impacts for the North and Central Regions are shown in Table 8.2–26 and Table 8.2-27, respectively.

Table 8.2–26. Summary of Potential Roadway Project Noise Impacts with Proposed Abatement for the North Region

Type of Noise Sensitive Receptors	*Number of Predicted Impact Receptors*				
	Alternative 1	*Alternative 2*	*Alternative 3*	*Alternative 8*	*No Action*
Area 1: Single Family Residences and a Church	6	6	6	6	17
Area 2: Multi-Family Residences	0	0	0	0	0
Area 3: Single Family Residences	2	2	2	2	0
Area 4: Single Family Residences	4	4	4	4	0
Area 5: Single and Multi-Family Residences	0	0	0	0	0
Area 6: Military Outdoor Physical Training Area	0	0	0	0	0
Area 7: Single Family Residences	0	0	0	0	0
Area 8: Military Outdoor Recreation Area	0	0	0	0	0
Area 9: Single Family Residences and a Golf Course	0	0	0	0	0
Area 10: Single Family Residences	1	1	1	1	0
Area 11: Single Family Residences, Multi-Family Residences, and a school	10	10	10	10	0
Area 12: Single Family Residences	7	7	7	7	7
Area 13: Single Family Residences	8	8	8	8	4
Area 14: Single and Multi-Family Residences	13	13	13	13	11
Area 15:School	0	0	0	0	0
Area 16: Single Family Residences and a Church	10	10	10	10	10
Total with Abatement	**61**	**61**	**61**	**61**	**-**
Total without Abatement (Table 8.2–9**)**	**88**	**88**	**88**	**88**	49

Not all of the impacted receptors could be abated. As stated in the abatement section, many of the receptors have direct access to the roadway that prevents the construction of a continuous sound wall required to provide feasible abatement. Furthermore, many of the impacted receptors are also scattered along different routes, preventing feasible abatement from being cost effective and, thus, not reasonable. Also of the 316 impacted receptors that could not be abated, 271 of them are impacted under the no-action alternative.

Table 8.2-27. Summary of Potential Roadway Project Noise Impacts with Proposed Abatement for the Central Region

Type of Noise Sensitive Receptors	*Number of Predicted Impact Receptors*				
	Alternative 1	*Alternative 2*	*Alternative 3*	*Alternative 8*	*No Action*
Area 17: Single Family Residences and a Multi-Family Residence	15	15	15	15	15
Area 18: Single Family Residences and a Park	7	7	7	7	17
Area 19: Park	8	8	8	8	0
Area 20: Single Family Residences and a Multi-Family Residence	4	4	4	4	4
Area 21: Park, a Single Family Residence, and a Multi-Family Residence	6	6	6	6	3
Area 22: Playground, a Single Family Residence, and a Multi-Family Residence	10	10	10	10	10
Area 23: Park and a Single Family Residence	0	0	0	0	4
Area 24: Multi-Family Residences	3	3	3	3	3
Area 25: Park and Single Family Residences	6	6	6	6	2
Area 26: Cemetery	6	6	6	6	0
Area 27: Park	8	8	8	8	11
Area 28: Park	2	2	2	2	2
Area 29: Park	4	4	4	4	4
Area 30: Park	9	9	9	9	9
Area 31: Park	4	4	4	4	4
Area 32: Multi-Family Residences	4	4	4	4	4
Area 33: Multi-Family Residences	0	0	0	0	0
Area 34: School	0	0	0	0	8
Area 35: Park, a Single Family Residence, and Multi-Family Residences	15	15	15	15	15
Area 36: One School and Two Churches	6	6	6	6	6
Area 37: Multi-Family Residences	0	0	0	0	0
Area 38: Multi-Family Residences and a Church	1	1	1	1	1
Area 39: Single Family Residences	1	1	1	1	21
Area 40: Multi-Family Residences	0	0	0	0	0
Area 41: Single Family Residences	0	0	0	0	0
Area 42: Single Family Residences	0	0	0	0	0
Area 43: Single Family Residences	0	0	0	0	18
Area 44: Single Family Residences	0	0	0	0	0
Area 45: Park, Single Family Residences, and Multi-Family Residences	2	2	2	2	30
Area 46: Single Family Residences	0	0	0	0	0
Area 47: Single Family Residences	12	12	12	12	12
Area 48: Single Family Residences, and Multi-Family Residences	9	9	9	9	7
Area 49: Single Family Residences and Multi-Family Residences	11	11	11	11	21

Type of Noise Sensitive Receptors	*Number of Predicted Impact Receptors*				
	Alternative 1	*Alternative 2*	*Alternative 3*	*Alternative 8*	*No Action*
Area 50: Outdoor Sports Complex	9	9	9	9	9
Area 51: School	0	0	0	0	0
Area 52: Multi-Family Residences and a Motel	9	9	9	9	8
Area 53: Multi-Family Residences	0	0	0	0	10
Area 54: Multi-Family Residences	0	0	0	0	0
Area 55: Single Family Residences and a Motel	1	1	1	1	1
Area 56: Single Family Residences and Multi-Family Residences	11	11	11	11	11
Area 57: Single Family Residences and Multi-Family Residences	11	11	11	11	11
Area 58: Military Outdoor Recreational Area	0	0	0	0	0
Area 59: Single Family Residences	6	6	6	6	6
Area 60: Single Family Residences	3	3	3	3	3
Area 61: Single Family Residences, Multi-Family Residences, and a Funeral Home	7	7	7	7	7
Area 62: Multi-Family Residences	0	0	0	0	0
Area 63: Single Family Residences, Multi-Family Residences, and a Church	23	23	23	23	23
Area 64: Single Family Residences, Multi-Family Residences, and a School	22	22	22	22	22
Total with abatement	**255**	**255**	**255**	**255**	**-**
Total without abatement (Table 8.2–10)	**378**	**378**	**378**	**378**	**342**

8.3 NO-ACTION ALTERNATIVE

Under the no-action alternative, no utility or roadway upgrades or improvements associated with the proposed actions would occur and existing operations at the proposed project areas would continue. There would be limited localized noise impacts related to non-military individual project construction. There would not be a significant increase in military population. Anticipated beneficial effects and improved roadway capacity would not be realized.

8.4 SUMMARY OF IMPACTS

This section summarizes the potential noise impacts associated with the proposed action alternatives for each major component – power, potable water, wastewater, solid waste, and off base roadways.

Table 8.4–1 summarizes the potential noise impacts of utility and off base roadways. No difference was identified among alternatives. Construction impacts were associated with the noise generated by construction equipment at the project site. These impacts would be localized and short term.

Table 8.4–1. Summary of Impacts

	Power Alternatives	*Potable Water Alternatives*	*Wastewater Alternatives*	*Solid Waste Alternatives*	*Off Base Roadway Alternatives*
Construction	LSI	LSI	LSI	NI	LSI
Operations	NI	NI	NI	LSI	SI-M

Legend: LSI= Less than significant impact; NI= No impact; SI-M = Significant impact mitigable to less than significant.

8.5 SUMMARY OF PROPOSED MITIGATION MEASURES

Table 8.5–1 summarizes the proposed mitigation measures.

Table 8.5–1. Summary of Proposed Mitigation Measures

	Power Alternatives	*Potable Water Alternatives*	*Wastewater Alternatives*	*Solid Waste Alternatives*	*Off Base Roadway Alternatives*
Construction	None	None	None	None	None
Operations	None	None	None	None	Sound walls

During construction, the impacts are less than significant but equipment noise control Best Management Practices would be implemented, as follows:

- Ensure that all equipment items have the manufacturers’ recommended noise abatement measures, such as mufflers, engine enclosures, and engine vibration isolators, intact and operational.
- Inspect all construction equipment at periodic intervals to ensure proper maintenance and presence of noise control devices (e.g., mufflers and shrouding).
- Turn off idling equipment.

Other administrative mitigation/abatement measures could be applied, as follows:

- Implement a construction noise monitoring program to limit the impacts.
- Plan noisier operations during times least sensitive to receptors.
- Avoid scheduling construction during nighttime hours (10:00 p.m. to 7:00 a.m.) and on weekends.
- Keep noise levels relatively uniform and avoid impulsive noises.
- Maintain good public relations with the community to minimize objections to the unavoidable construction impacts. Provide frequent activity updates of all construction activities.

During operations, noise impacts due to roadway traffic noise could be abated through noise barriers where they are feasible and reasonable.

CHAPTER 9.
AIRSPACE

9.1 INTRODUCTION

This chapter contains a discussion of the potential environmental consequences associated with implementing the alternatives within the region of influence for this resource. For a description of the affected environment for all resources, refer to Volume 2, Chapters 3–19. The locations described in Volume 2 include the region of influence for the utilities and roadway projects, and the chapters are presented in the same order as the resource areas contained in Volume 6.

9.2 ENVIRONMENTAL CONSEQUENCES

Airspace management is defined as directing, controlling, and handling aircraft flight operations in the volume of air that overlies the land and sea. For the related actions no new tall structures would be modified or constructed, such as power plant smokestacks, that would affect airspace use. In addition, no proposed utilities and roadway projects exist that would interfere with airfield operations. Aircraft operating out of Andersen Air Force Base would continue to follow existing procedures that restrict overflight of federally listed endangered Mariana crow and Mariana fruit bat habitat. Therefore, no impacts on airspace associated with the proposed utilities and roadway projects would occur.

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CHAPTER 10.
LAND AND SUBMERGED LAND USE

10.1 INTRODUCTION

This section relies on the Volume 2 affected environment description of land and submerged land ownership and management for both civilian and Department of Defense (DoD) land. Submerged lands refer to areas in coastal waters extending from the Guam coastline into the ocean 3 nautical miles (5.6 kilometers), which is the limit of territorial jurisdiction. The focus of Volume 6, Chapter 10 is to address the land ownership and land use impacts associated with the related actions including large-scale utility projects and roadways. The methodology for impact analysis is as described in Volume 2.

Many of the related actions occur on non-DoD land in conjunction with existing Government of Guam (GovGuam) utilities and roadways. Collocation provides opportunities for maximum land use efficiency. Associated linear facilities, such as transmission or distribution lines would be required. The potential impacts are described by alternatives and components, and the chapter concludes by identifying and discussing mitigation measures that apply to significant impacts.

The region of influence for land use is land on the proposed development area and adjacent properties, and the ocean within 3 nautical miles (5.6 kilometers) offshore.

10.2 ENVIRONMENTAL CONSEQUENCES

10.2.1 Approach to Analysis

There are two components to the land use analysis: (1) land/submerged lands ownership and management, and (2) land/submerged land use. There are different criteria for assessing potential impacts under these two categories.

Short-term impacts would be related to facility construction activities that would be located within the project footprint or on previously disturbed lands. No construction staging area has been designated away from the project site. No construction impacts are described. All impacts related to land ownership and use are assumed to occur during the long-term operational phase of the proposed action as the changed conditions would alter the development and use of the current site and its vicinity. The potential indirect impacts that would be due to changes in land ownership and use are addressed under other specific resource categories, such as traffic, noise, natural resources, and recreation. Incompatibility with adjacent land uses to the extent that public health and safety is impacted is addressed under public health and safety and noise resource sections. Federal lands are not subject to local zoning regulations and permitting; however, consistency with surrounding non-federal land uses is an important consideration for land use planning. Coastal Zone Management Act consistency determination assessments would be prepared for each construction phase. The coastal zone consistency determination for construction projects occurring in fiscal years 2010 and 2011 is being prepared and would be submitted to the Bureau of Statistics and Plans for review.

Off Base Roadways

Methods for assessing impacts on land use differ slightly for the utilities and the roadways. The roadway analysis is subject to Federal Highway Administration (FHWA) regulations. Impacts on land ownership, social, economic, right-of-way (ROW) acquisition, and relocation as a result of the proposed roadway improvement projects are addressed in Volume 6, Chapter 17.

10.2.1.1 Land Ownership/Management

Utilities

The impact assessment methodology for land/submerged land ownership and management is not dictated by regulatory authority or permit requirements. There is flexibility in the methodology and assumptions that are made. The basic premise is that a release of federal lands/submerged lands to the GovGuam or individuals has beneficial impacts on the new landowners. Conversely, the acquisition of land by the federal government may be considered a beneficial or an adverse impact depending on the perspective of the individual landowner. Owners who are interested in selling land to the federal government would presumably perceive the federal acquisition as a beneficial impact, whereas owners who are not interested in selling their land would presumably perceive the federal acquisition as an adverse impact. Owners who do not want to sell their property (or relocate) are likely to consider an involuntary acquisition or relocation as an adverse impact even though they are properly compensated. Until the land acquisition negotiations are concluded, the impact analysis assumes a significant adverse impact on an individual landowner. There are exceptions to this rule, such as in the case of acquisition of non-possessory affirmative easements for utilities or other ROWs. A more detailed discussion of the land acquisition process is described in Volume 9, Appendix F, Section 5.2.6.

The comments received during the scoping period and Draft Environmental Impact Statement (EIS) comment period did not support an increase in federal land on island and the increase is considered an adverse impact. The impacts of the proposed islandwide increase in federal land are being addressed in Volume 6, Chapter 17.

No indirect impacts are associated with changes in land ownership, except for those that would be discussed under other resource categories. For example, changes in land ownership may have an impact on potential tax revenue to the GovGuam and this would be addressed under socioeconomics.

The test for significance of the potential land ownership/management for utilities is based on the type of land acquisition. New land for industrial plants is considered a significant adverse impact because of the quantity of land required. Land ownership impacts due to proposed linear facilities is dependent on site-specific conditions, such as the availability of existing easements and utility corridors, location, land use, and quantity of land affected. Expansion of an existing utility corridor requiring modification of existing easements would be a less than significant impact. A new corridor through undeveloped land may be considered a mitigable, significant impact because it may not be consistent with future development plans.

Off Base Roadways

Methods for assessing impacts on land use differ slightly for the utilities and the roadways. The roadway analysis is subject to FHWA regulations. Impacts on land ownership, social, economic, ROW acquisition, and relocation as a result of the proposed roadway improvement projects are addressed in Volume 6, Chapter 17.

10.2.1.2 Land Use

Utilities

There are two criteria used to assess impacts on land and submerged land use:

- Consistency with current or documented planned land and submerged land use. Land use consistency includes impacts on access policies and loss of open space.
- Restrictions on access.

Land Use Criterion 1: Consistency with Current or Documented Planned Land Use

Land use plans are intended to guide future development. Potential adverse land use impacts would result from a proposed land use that is incompatible with the existing land use or planned land use or if vacant (i.e., no modern manmade structures) land and open space is developed. It is possible for land uses to be inconsistent, but not necessarily incompatible. For example, residential development next to a park is inconsistent, but compatible, while an industrial facility proposed within a residential area would likely be incompatible and inconsistent. Potential adverse impacts would also result if there are incompatible changes in use within submerged lands. Changes in access policies may result from changes in land use and adverse impacts would result if the access became more restrictive to the public.

The test for impact significance is less rigorous for existing DoD land and submerged land, where limited land availability may result in less than ideal land use changes. Federal actions on federal lands/submerged lands are subject to Base Command approval, but are not required to conform to state/territory land use plans or policies. The proposed action alternatives of this EIS have been developed in consultation with Base Command planners. As a result, there would be no anticipated significant impact to land use within DoD parcel boundaries. Land use changes on existing DoD land could be the basis for significant impacts on other resources (such as visual resources, noise, traffic, recreation, cultural and biological resources) within and beyond DoD land boundaries. Impacts on these resources and others are addressed in other resource chapters of this EIS.

Proposed land uses on newly acquired lands may have an adverse impact if they are not consistent with the existing or proposed land use at that site. Similarly, a change in use within non-DoD submerged land could have an adverse impact. The test for significance is the degree of incompatibility and is qualitative. For example, proposed military housing would be consistent with existing or planned civilian residential communities and there would be no adverse impact to land use. A proposed industrial facility in an area that is designated for a public park would be a significant adverse impact, while the same facility in an area designated for heavy commercial land use would have no significant adverse impact.

While a proposed land use under the action alternatives may be consistent with existing land use, there is potential for adverse impacts due to changes in land use intensity. For example, a training range that is used once per month would likely have no adverse impact, while daily use may result in an adverse impact. Potential adverse impacts associated with changes in land use intensity such as increases in marine traffic (Volume 6, Chapter 13), noise (Volume 6, Chapter 8), and unexploded ordnance (Volume 6, Chapter 18) are addressed under other resource area discussions of this EIS. No significance criterion is established for land use intensity impacts. Noise from airfields or training may be a land use constraint and is discussed.

Land Use Criterion 2: Restrictions on Access

Additional restrictions on public access due to changes in land use on federally-controlled lands/submerged lands would be a potential adverse impact. For example an increase in the setback distance from Navy ships for security purposes may restrict access to a Self-Contained Underwater Breathing Apparatus site. The test for significance is subjective and based on geographic area affected, the schedule or timing of the access restrictions (permanent or occasional), and the population affected.

Physical access restrictions can also result if land acquisition by the federal government results in a pocket or island of non-federal land. This would be an adverse impact on the landowners to which access has been restricted. The significance of the impact is based on the extent to which access to the non-federal land is restricted. Significant adverse impacts result when the private property is surrounded by federal property because there would be access restrictions and other potential land use limitations to the private property. Similarly, such pockets of non-DoD land within DoD land is an adverse impact on military land use.

The Farmland Protection Policy Act (FPPA) (Public Law 97-98, 7 United States Code 4201, and 7 Code of Federal Regulations 658) is intended for federal agencies to (1) identify and take into account the potential adverse effects of federal programs on the preservation of farmland; (2) consider alternative actions, as appropriate, that could lessen such adverse effects; and (3) assure that such federal programs, to the extent practicable, are compatible with state, unit of local government, and private programs and policies to protect farmland. The FPPA addresses Prime and Important Farmlands. Consistency with FPPA was a land use significance criterion in the Draft EIS, but was removed for the Final EIS. In the interval between the two EISs, the Navy determined that the Guam and Commonwealth of the Northern Mariana Islands (CNMI) military relocation is exempt from FPPA regulations because the action is undertaken by a federal agency for national defense purposes (Section (§) 1547(b) of the Act, 7 United States Code 4208(b)). Although consistency with FPPA is not a criterion for analysis, impacts on agricultural use are assessed in this EIS in conjunction with impacts on other land uses, such as residential or urban land uses.

Roadways

Land use impacts as a result of the proposed roadway improvement projects are assessed following FHWA Guidance for Preparing and Processing Environmental and § 4(f) Documents (FHWA 1987). Land use impacts would involve project effects that would be inconsistent with the comprehensive development plans adopted for the area and other plans used in the development of the transportation plan.

Impacts on land use as a result of roadway improvements could be classified into short-term impacts and long-term impacts. Short-term impacts would occur during the peak construction period (2014) and would include disruption of current use activities such as access road blockage, temporary closure of public or private facilities, and business disruption. This type of impact would cease at the completion of construction activities. Long-term impacts (post-construction up to future year 2030) would involve changes in land use patterns, population density, and growth rate. Proposed projects that are inconsistent with applicable plans and policies are considered to cause an adverse long-term impact to land use as well.

10.2.1.3 Issues Identified During Public Scoping Process

Many scoping issues regarding land use overlap with other resource areas, such as noise and recreation, and are discussed under those sections. As part of the analysis, concerns related to land use that were mentioned by the public, including regulatory stakeholders, during the public scoping meetings were addressed. None of the land use issues were specific to utilities or roadways. The following are public, including regulatory agency, preferences:

- No increases of federal land ownership (although some landowners were interested to sell).
- No re-acquisition of lands that have been or are in the process of being released by the federal government.
- Retention of current public ROWs.

10.2.2 Power

10.2.2.1 Basic Alternative 1: Recondition up to Five Existing Guam Power Authority–Permitted Facilities to Provide Peaking Power/Reserve Capacity

Basic Alternative 1 would recondition existing Combustion Turbines (CTs) and upgrade Transmission and Distribution (T&D) systems and would not require new construction or enlargement of the existing footprint of the facility. This work would be undertaken by the Guam Power Authority on its existing permitted facilities. Reconditioning would be made to existing permitted facilities at the Marbo, Yigo, Dededo (2 units), and Macheche CTs. The five CTs are currently being used very little, if at all. Upon reconditioning, these CTs would be available for peaking and reserve power to ensure system reliability. T&D system upgrades would be on existing above ground and underground transmission lines. This alternative supports Main Cantonment Alternatives 1 and 2 and Main Cantonment Alternatives 3 and 8 would require additional upgrades to the T&D system.

Construction

All impacts related to land ownership and use are assumed to occur during the long-term operational phase of the proposed action as the changed conditions would alter the development and use of the current site and its vicinity.

Operation

Under Basic Alternative 1, the land use footprint of generation and substation facilities would not extend beyond existing property boundaries. No new uses in submerged lands are proposed. No acquisition of land by the federal government is proposed, and no additional restrictions would be placed on public access. No construction would occur at these generation facilities; existing facilities would only be upgraded. Some of the overhead transmission lines would require upgrading, with some remaining overhead and others being changed from overhead to underground. All of the transmission lines would follow current routings and would not negatively impact land ownership or use. The lines being converted from overhead to underground would potentially impact land use in a beneficial manner by eliminating overhead lines impact to surface land use. Some substations would require upgrades, which would occur on the current facilities without requiring expansion of their footprints. Therefore, there would be no adverse impacts and a potentially beneficial impact to land use.

The population growth that is not a direct result of the proposed action would increase the on-island demand for electricity. Projections suggest there is sufficient power capacity to meet the total demand (Volume 6, Chapter 2, Table 2.1-2) if Basic Alternative 1 is implemented. The indirect impacts on land use would be as described for Basic Alternative 1.

Basic Alternative 1 would result in no impacts on land/submerged land ownership or use.

Proposed Mitigation Measures

Because no significant impacts on land/submerged land ownership, management, or use were identified under Basic Alternative 1, no mitigation is necessary or proposed.

10.2.2.2 Summary of Impacts

Table 10.2-1 summarizes the potential impacts of the alternative. A text summary is provided below.

Table 10.2-1. Summary of Potential Land and Submerged Land Use Impacts – Power

Potential Impact	*Basic Alternative 1**
Land Ownership	
Land	NI
Submerged land	NI
Land Use	
1. Consistency with existing or proposed land use	
DoD land	NI
DoD submerged lands	NI
Non-DoD land	NI
Non-DoD submerged lands	NI
1. Public Access	NI

Legend: DoD = Department of Defense; NI = No impact.
*Preferred Alternative.

The Basic Power Alternative 1 would have no impact on land or submerged land ownership or use during operation. As described under the approach to analysis, the land ownership and use impacts occur during operation and construction impacts are described as not applicable.

10.2.3 Potable Water

10.2.3.1 Basic Alternative 1 (Preferred Alternative)

Basic Alternative 1 would provide additional water capacity of 11.3 MGd (42.8 MLd), which is anticipated to be met by an estimated 22 new wells at Andersen Air Force Base (AFB), rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 2.5 MG (9.5 ML) water storage tanks would be constructed at ground level at NCTS Finegayan. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

Basic Alternative 1 combines a number of water resource development options staged over 5 years, from 2010 to 2015. These options include installing new water supply wells, rehabilitating existing wells, and interconnecting with GWA. Basic Alternative 1 would affect the north (water supply wells) and central (rehabilitation of Navy Regional Medical Center well) areas of Guam.

<u>Construction</u>

All impacts related to land ownership and use are assumed to occur during the long-term operational phase of the proposed action as the changed conditions would alter the development and use of the current site and its vicinity.

<u>Operation</u>

Under Basic Alternative 1, no acquisition of non-DoD land and no submerged land uses are proposed. No impact on land and submerged lands ownership would occur. Additional public access restrictions would not be imposed. No land use impacts on farmlands were identified.

At Andersen AFB, an estimated 22 new water wells including one contingency well would be installed. The wells are planned in clusters and are consistent with adjacent land uses. A 1,000-foot (305-meter) wellhead protection arc is generated at each well that constrains land use within the arc. This constraint would not result in an adverse land use impact because the areas are vacant with no other planned land uses at or adjacent to the sites. The existing wells that are proposed for use or rehabilitation are also on DoD land, and no impact to land ownership or use was identified.

Water storage tanks would be sited in conjunction with the large scale development proposals of the proposed actions described in Volumes 2 and 5. They would be sited to be consistent with the proposed land uses. No adverse impacts on land use are anticipated. Potential visual impacts are described in Volume 6, Chapter 15. Storage tanks and distribution lines and pumps would be sited on DoD land or within existing ROWs along roads. This does not represent a change in land ownership or use.

The population growth that is not a direct result of the proposed action would increase the on-island demand for potable water. The GWA had pre-existing plans to install 16 new potable wells by 2014. These wells would not require additional land or submerged land acquisitions by the federal government; therefore, no impact on land ownership is anticipated. There are 1,000-foot (305-meter) wellhead protection arcs associated with the new wells that could constrain future community land use plans. However, these wells are planned land uses by the GovGuam and development plans would be updated to minimize land use impacts. There would be adverse impacts on land use.

In conclusion, Basic Alternative 1 and the GWA proposed wells would result in no impacts on land ownership or use.

Proposed Mitigation Measures

As no significant impacts on land/submerged land ownership, management, or use were identified under Basic Alternative 1, no mitigation is necessary or proposed.

10.2.3.2 Basic Alternative 2

Basic Alternative 2 would provide additional water capacity of 11.7 MGd (44.3 MLd), which is anticipated to be met by an estimated 20 new wells at Andersen Air Force Base (AFB) and 11 new wells at Air Force Base Barrigada, rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 1.8 MG (6.8 ML) water storage tanks would be constructed at ground level at NCTS Finegayan and one 1 MG (3.8 ML) water storage tank would be construction at Air Force Base Barrigada. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

Construction

All impacts related to land ownership and use are assumed to occur during the long-term operational phase of the proposed action as the changed conditions would alter the development and use of the current site and its vicinity.

Operation

The impacts on land ownership and use are as described under Basic Alternative 1. Basic Alternative 1 and the GWA proposed wells would result in no impacts on land ownership or use.

Proposed Mitigation Measures

No impacts on land/submerged land ownership or use were identified for Basic Alternative 2; therefore, no mitigation is proposed.

10.2.3.3 Summary of Impacts

Table 10.2-2 summarizes the potential impacts of each basic alternative. A text summary is provided below.

Table 10.2-2. Summary of Potential Land and Submerged Land Use Impacts – Potable Water

Potentially Impact	*Basic Alternative 1**	*Basic Alternative 2*
Land Ownership		
Land	NI	NI
Submerged land	NI	NI
Land Use		
Consistency with existing or proposed land use		
DoD land	NI	NI
DoD submerged lands	NI	NI
Non-DoD land	NI	NI
Non-DoD submerged lands	NI	NI
1. Public Access	NI	NI

Legend: DoD = Department of Defense; NI = No impact. *Preferred Alternative.

The action alternatives are all on DoD land in vacant areas with no conflicting land uses identified at or adjacent to the project components. No land or submerged land ownership or use impacts during operation were identified. As described under the approach to analysis, the land ownership and use impacts that occur during operation and construction impacts are described as not applicable.

10.2.4 Wastewater

10.2.4.1 Basic Alternative 1a (Preferred Alternative) and 1b

Basic Alternative 1 (Basic Alternative 1a supports Main Cantonment Alternatives 1 and 2; and Basic Alternative 1b supports Main Cantonment Alternatives 3 and 8) combines upgrades to the existing primary treatment facilities and expansion to secondary treatment at the Northern District Wastewater Treatment Plant (NDWWTP). The difference between Basic Alternatives 1a and 1b is a requirement for a new sewer line from Barrigada housing to NDWWTP for Basic Alternative 1b.

Construction

All impacts related to land ownership and use are assumed to occur during the long-term operational phase of the proposed action as the changed conditions would alter the development and use of the current site and its vicinity.

Operation

Under Basic Alternative 1a and 1b, the land use footprint of the NDWWTP would not extend beyond the existing property boundary. Basic Alternative 1a requires a new gravity sewer from Finegayan to the NDWWTP; however, the alignments are in existing easements or aligned along existing roads' ROWs. A short segment is between the southwest corner of South Finegayan and the intersection with the existing GWA trunk sewer (Volume 6, Chapter 2, Figure 2.3-2) where a new utility easement is likely required. This requirement would result in a less than significant impact on land ownership and no impact on land use because the alignment follows an existing minor roadway.

New Interim Alternative 1b requires an additional new sewer line with two pump stations, from Barrigada housing to the NDWWTP, aligned along an existing Route 16 GWA ROW. The segment between the NDWWTP and Route 3 may require new easements along an existing minor roadway resulting in a less than significant impact on land ownership. No impact on land use would occur.

The population growth that is not a direct result of the proposed action would increase the on-island demand for wastewater management. The impacts on wastewater treatment plants other than NDWWTP would be GWA's responsibility to manage. Some existing plants may require expansion and improvements to collections systems. These improvements would likely be within existing sewer alignments and not require land acquisition. The land use would remain unchanged.

Proposed Mitigation Measures

No mitigation measures are required.

10.2.4.2 Summary of Impacts

Table 10.2-3 summarizes the potential impacts of each interim alternative. A text summary is provided below.

Table 10.2-3. Summary of Potential Land and Submerged Land Use Impacts – Wastewater

Potentially Impact	*Basic Alternative 1a*	*Basic Alternative 1b*
Land Ownership		
Land	LSI	LSI
Submerged land	NI	NI
Land Use		
1. Consistency with existing or proposed land use:		
DoD land	NI	NI
DoD submerged lands	NI	NI
Non-DoD land	NI	NI
Non-DoD submerged lands	NI	NI
2. Public Access	NI	NI

Legend: DoD = Department of Defense; LSI = Less than significant impact; NI = No impact.
*Preferred Alternative.

There would be less than significant impacts on land ownership from acquisition of short easements along existing roads' ROW for underground lines under both alternatives. No impact on submerged land ownership is anticipated. No impacts on land use or existing public access policies are anticipated from the proposed actions or GWA potential improvements to existing collection systems. As described under the approach to analysis, the land ownership and use impacts occur during operation and construction impacts are described as not applicable.

10.2.5 Solid Waste

10.2.5.1 Basic Alternative 1 (Preferred Alternative)

The Preferred Alternative would be to continue to use the Navy Landfill at Apra Harbor for municipal solid waste (MSW) until the new GovGuam Layon Landfill at Dandan is available for use. Disposal of other waste streams excluded from Layon Landfill would continue at the Navy Landfill. Construction and demolition (C&D) debris would continue to be disposed at the Navy hardfill.

Construction

Under Basic Alternative 1, no construction would occur; therefore, there would be no construction impacts on land use.

Operation

Under Basic Alternative 1, no land acquisition would occur. No new uses in submerged lands are proposed. No land acquisition is proposed, and no additional public access restrictions would be imposed. Therefore, Interim Alternative 1 would result in no impacts on land ownership or use.

Proposed Mitigation Measures

No significant impacts on land/submerged land ownership, management, or use were identified under Basic Alternative 1; therefore, no mitigation is necessary or proposed.

10.2.5.2 Summary of Impacts

Table 10.2-4 summarizes the potential impact of the Preferred Alternative. A text summary is provided below.

Table 10.2-4. Summary of Potential Solid Waste Impacts

Potentially Impact	*Basic Alternative 1**
Land Ownership	
Land	NI
Submerged land	NI
Land Use	
1. Consistency with existing or proposed land use:	
DoD land	NI
DoD submerged lands	NI
Non-DoD land	NI
Non-DoD submerged lands	NI
2. Public access	NI

Legend: DoD = Department of Defense; NI = No impact. *Preferred Alternative.

Since there is no construction involved in the alternative for solid waste, there are no impacts on land use or submerged lands.

10.2.6 Off Base Roadways

The North and Central Guam Land Use Plan (Bureau of Statistics and Plans [BSP] 2009) has accounted for the DoD facility expansion and organic (natural) growth within the island of Guam over the next 20 years. Growth in the military sector would impact private-sector economic and residential growth and development. As part of the North and Central Guam Land Use Plan development, the public has been involved in identifying potential policies and changes needed to address future growth. The draft vision statement from the first round of public meetings states that “Guam is a sustainable tropical paradise that is safe, walkable, family- and community-oriented, and protective of natural resources.”

The 2030 Guam Transportation Plan (GTP) (Guam Department of Public Works [GDPW] 2008) presents a comprehensive, long-term strategy to improve transportation infrastructure and operations throughout Guam. The GovGuam, through its GDPW and Department of Administration, Division of Public Transportation Services, and FHWA, as well as the Federal Transit Administration have partnered to prepare this plan. The plan addresses Guam’s anticipated multimodal transportation needs, including roadway, bicycle, pedestrian, and transit facilities. The GTP includes forecasts for population, employment, and traffic growth through the year 2030; including impacts associated with the relocation of potential DoD multiple services. Sustainable financing and project implementation recommendations are also included in the plan.

Different types of roadway improvements are being proposed under the Guam Road Network (GRN) improvement projects, including pavement strengthening, intersection improvement, road widening, road rehabilitation, bridge replacement, road relocation, and Military Access Point (MAP) improvements. Temporary impacts on current uses of land along the vicinity of the construction sites would normally occur as a result of construction equipment blockage and traffic lane closures that are typical of any public works project. A Traffic Management Plan (TMP) would minimize these temporary impacts.

Long-term impacts would involve changes in land use patterns, population density, and growth rate that have not been approved or planned by the Guam BSP. Adverse impacts are determined by the magnitude and types of conversion that are not consistent with the approved land use patterns. When possible, engineering design would be performed to avoid the acquisition of public facilities, such as parkland.

Of the six different types of roadway improvements being proposed, pavement strengthening (including some pavement strengthening projects where widening would occur) and bridge replacement would normally occur within the existing ROW; therefore, the improvements would not result in any impacts on land use. Road widening, intersection improvements, new road, and road relocation would potentially result in impacts on land use if ROW acquisition is required. MAP improvements are consistent with respective installation general plans or regional shore infrastructure plans would occur within DoD lands; therefore, impacts on land use are not anticipated with these improvements.

10.2.6.1 Alternative 1

The roadway projects that would be implemented for Alternative 1 are listed in Volume 6, Chapter 2, Table 2.5-3, with the exception of the following GRN projects: #38 (which is an intersection improvement at a MAP), #39 (MAP), #41 (MAP), #47 (MAP), #48 (MAP), #49 (MAP), #49A (MAP), #63 (pavement strengthening and widening), and #74 (pavement strengthening and widening). As stated above, the proposed GRN projects are consistent with the North and Central Guam Land Use Plan and the GTP. The following subsections describe the impacts of the proposed roadway construction on land use during the peak construction period and the future year 2030.

Year 2014 (Peak Construction and Force Flow)

North

Improvements within the North Region consist of intersection improvements, pavement strengthening, road widening, intersection improvements to MAPs and a new road. Land uses in this region along the proposed GRN project locations are comprised mostly of DoD land and low-density residential. Implementation of Alternative 1 would require the acquisition of approximately 82 acres (ac) (33 hectares [ha]) of land area. Approximately 22 ac (9 ha) of residential property would be acquired resulting in approximately 20 residential units subject to relocation. Approximately 13 ac (5 ha) of non-residential property would be acquired with the relocation of approximately four non-residential or business units. In addition, approximately 47 ac (19 ha) of military-owned land within the North Region would be acquired. Businesses identified for possible acquisition in the North Region include one fast-food restaurant, one convenience/outdoor supply store, and two storage facilities. More detailed information about ROW acquisition and relocation is presented in Volume 6, Chapter 17. This change in land use is consistent with the North and Central Guam Land Use Plan (BSP 2009). The impact from the required commercial and residential land conversion is considered significant, but could be mitigated to a less than significant level with careful planning and, if unavoidable, with compensation measures.

The new two-lane Finegayan Connection that would run parallel to Routes 1 and 3 between the Route 1/16 intersection and South Finegayan is proposed to alleviate traffic on Routes 1 and 3 and on the

Route 1/3 intersection. Construction of this parallel road would require additional ROW north of Route 1 and west of Route 3. These areas are generally undeveloped. According to the North and Central Guam Land Use Plan, the area north of Route 1 and west of Route 3 has been designated as part of the Dos Amantes Planning Area, where hotel/resort and an urban center would be the major land uses in the future. The proposed road would support future land uses planned under the Dos Amantes Planning Area; therefore, the proposed Finegayan Connection construction would be consistent with future land use.

Impacts on current uses of land from construction activities would be typical of a public works project. A TMP would be developed and implemented during construction. The impacts are not considered significant with implementation of the TMP.

Central

Three intersection improvement and three road widening projects are proposed within the Central Region. Improvements are located along the major arterial running along the coastline and inland where major commercial and tourist activities are situated. To accommodate the construction, approximately 74 ac (30 ha) of land area would need to be acquired. Approximately 42 ac (17 ha) of residential property would be acquired, with approximately 51 residential units subject to relocation in the Central Region. Approximately 10 ac (4 ha) of non-residential property would be acquired, with approximately seven non-residential or business units subject to relocation. Businesses identified for possible acquisition include three fast-food restaurants, one office space, and a gas station and rental car office. In addition, approximately 22 ac (9 ha) of military-owned land within the Central Region would be acquired. The impact from the required commercial and residential land conversion is considered significant, but could be mitigated to a less than significant level with careful planning and, if unavoidable, with compensation measures.

Two existing parks along Route 1 would be affected by minor ROW acquisition to accommodate the proposed intersection improvements; however, no permanent closure of any public park or recreational facility would occur. In addition, the use of public parks for transportation projects would be considered a use of § 4(f) resources. Impacts on parklands are addressed in Volume 6, Chapter 11, and impacts on § 4(f) resources are addressed in Volume 6, Chapter 21.

Although impacts on current uses of land from construction activities would be typical of a public works maintenance project, occasional disruption to business/commercial and tourist facilities could be expected. A TMP would be developed for implementation during construction activities. To further minimize the impacts on business/commercial and tourist activities, close coordination with business owners and area residents would be conducted to keep them informed of the roadway improvement schedule. Construction of the various proposed projects would be scheduled to the extent practicable to avoid multiple projects under construction at the same time.

Apra Harbor

One intersection improvement project is proposed within the Apra Harbor Region. No residential units are subject to relocation in this region. Implementation of this alternative would not require acquisition of non-residential or military-owned property. No substantial impacts on commercial and residential land use conversion from the proposed improvement would occur. Impacts during the peak construction period within this region would be similar to those described for the Central Region.

South

One intersection improvement project is proposed within the South Region. The improvement would occur within the existing ROW. No residential or non-residential units would be relocated, and no lands would be acquired. No substantial impacts on commercial and residential land use conversion from the proposed improvement would occur. Impacts during the peak construction period within this region would be similar to those described under the North Region.

Proposed Mitigation Measures

The GDPW would develop a TMP for implementation during construction activities. The TMP would identify and provide alternate traffic detour routes, construction materials haul routes, bus stops, transit routes and operation hours, pedestrian routes, and residential and commercial access routes to be used during the construction period.

The GDPW would develop an outreach program to keep residents, businesses, and any service providers within the area informed, and to inform surrounding communities about the project construction schedule, relocation plans and assistance programs, areas affected by traffic and the TMP, and other relevant project information.

Year 2030

North

The North and Central Guam Land Use Plan (BSP 2009) has addressed the changes in future land use as a result of the proposed Guam and CNMI military relocation project, as well as other military facility expansions over the next 20 years. The proposed GRN improvement projects are intended to meet the projected traffic demand both under the proposed military expansion action and the no-action alternative (natural growth). The proposed GRN improvement projects are consistent with the North and Central Guam Land Use Plan (BSP 2009) that addresses the projected growth from the proposed military relocation on the island, and the GTP that addresses the long-term strategy to improve transportation infrastructure and operations throughout Guam.

All construction activities associated with proposed improvements in the North Region would have been completed by the year 2030. Since no farmland and parkland conversion to roadway use or the use of parkland are expected within this region, no adverse impacts on land use or on farmland and parkland are anticipated.

Because no ocean use is in the North Region within the vicinity of the proposed GRN projects, no impacts on submerged land via ocean use would occur.

Central

The proposed GRN improvement projects are consistent with the North and Central Guam Land Use Plan (BSP 2009) that addresses the projected growth from the proposed military facility expansion on the island, and the GTP that addresses the long-term strategy to improve transportation infrastructure and operations throughout Guam.

All construction activities associated with proposed improvements in the Central Region would have been completed by the year 2030. Since there would be no permanent closure of any parkland, no impacts on parkland use over the long term would occur. The roadway improvement would help enhance access to park and recreational facilities within the Central Region. The long-term impact pertaining to parkland use is beneficial.

No farmland conversion to roadway use would occur; therefore, no adverse impacts on farmland are anticipated.

The proposed roadway improvement projects would be confined within the existing roadway corridor; therefore, no permanent impacts on submerged land use would occur.

Apra Harbor

The proposed GRN improvement projects are consistent with the North and Central Guam Land Use Plan (BSP 2009) that addresses the projected growth from the proposed military facility expansion on the island, and the GTP that addresses the long-term strategy to improve transportation infrastructure and operations throughout Guam.

The construction activities associated with proposed improvements within the Apra Harbor Region would have been completed by the year 2030.

No farmland conversion to roadway use or the use of parkland are expected within this region; therefore, no adverse impacts on farmland and parkland are anticipated.

The proposed roadway improvement projects would be confined within the existing roadway corridor; therefore, no permanent impacts on submerged land use would occur.

South

The proposed GRN improvement projects are consistent with the North and Central Guam Land Use Plan (BSP 2009) that addresses the projected growth from the proposed military facility expansion on the island, and the GTP that addresses the long-term strategy to improve transportation infrastructure and operations throughout Guam.

The construction activities associated with proposed improvements within the South Region would have been completed by the year 2030.

No farmland conversion to roadway use or the use of parkland are expected within this region; therefore, no adverse impacts on farmland and parkland are anticipated.

Because no ocean use is within the vicinity of the proposed GRN projects, no impacts on submerged land use would occur.

Proposed Mitigation Measures

Because the proposed GRN improvement projects are consistent with the North and Central Guam Land Use Plan (BSP 2009) and the GTP, no mitigation measures would be required.

Most roadway improvements would be undertaken within the existing ROW, with some ROW acquisition that would result in conversion of residential, commercial, and open space uses to public (transportation) use. The proposed roadway improvements are intended to meet the projected traffic demand based on the local land use plans. Land use conversion from the required ROW acquisition would be addressed through the relevant planning agencies of the GovGuam. Compensation as a result of land use disruption or acquisition is addressed in the Socioeconomic and General Services sections of this document.

10.2.6.2 Alternative 2 (Preferred Alternative)

The roadway projects that would be implemented for Alternative 2 are listed in Volume 6, Chapter 2, Table 2.5-3, with the exception of the following GRN projects: #38A (MAP), #39A (MAP), #41A (MAP), #47 through #49A (MAP), #63 (pavement strengthening), and #74 (pavement strengthening).

Peak construction and permanent impacts on land uses under Alternative 2 would be similar to those described under Alternative 1 because the same projects are proposed under this alternative with the only difference being gate locations for MAP projects, which have no impact on existing commercial or residential uses.

Proposed Mitigation Measures

Proposed mitigation measures for Alternative 2 would be the same as those proposed for Alternative 1.

10.2.6.3 Alternative 3

The roadway projects that would be constructed under Alternative 3 are listed in Volume 6, Chapter 2, Table 2.5-3, with the exception of the following GRN projects: #20 (pavement strengthening), #31 (pavement strengthening), #38A (MAP), #39A (MAP), #41 (MAP), #41A (MAP), and #124 (new roadway). In general, the MAP and pavement strengthening projects would not cause significant impacts on existing commercial or residential uses. Impacts on land use disruption from construction activities under Alternative 3 in 2014 during peak construction would be slightly less than Alternatives 1 and 2 because no new roadway (GRN# 124) would be constructed under this alternative. However, there would be no new roadway to support the planned land-use development within the Dos Amantes Planning Area in the long term.

To accommodate the roadway construction in the North Region, Alternative 3 would require the acquisition of approximately 71 ac (29 ha) of land area. Approximately 22 ac (9 ha) of residential property would be acquired with approximately 47 residential units subject to relocation. Approximately 2.0 ac (0.8 ha) of non-residential property would be acquired with the potential relocation of approximately four non-residential or business units, including one fast-food restaurant, one convenience/outdoor supply store, and two storage facilities. In addition, approximately 47 ac (19 ha) of military-owned land within the North Region would be acquired.

Within the Central Region, Alternative 3 would require the acquisition of approximately 84 ac (34 ha) of land area. Approximately 42 ac (17 ha) of residential property would be acquired, with approximately 51 residential units subject to relocation. Approximately 20 ac (8 ha) of non-residential property would be acquired with the potential relocation of approximately seven non-residential or business units, including three fast-food restaurants, one office space, one gas station, and one rental car office. In addition, approximately 22 ac (9 ha) of military-owned land within the Central Region would be acquired.

Similar to Alternatives 1 and 2, no residential and non-residential property acquisition would be required under Alternative 3 in the Apra Harbor and South Regions.

Proposed Mitigation Measures

Proposed mitigation measures for Alternative 3 would be the same as those proposed for Alternative 1.

10.2.6.4 Alternative 8

The roadway projects that would be constructed under Alternative 8 are listed in Volume 6, Chapter 2, Table 2.5-3, with the exception of the following GRN projects: #38 (MAP), #39 (MAP), #41 (MAP), #47 (MAP), #48 (MAP), #49 (MAP), #63 (pavement strengthening), and #74 (pavement strengthening). In general, the MAP and pavement strengthening projects would not cause significant impacts on existing commercial or residential uses. Therefore, impacts on land use disruption under Alternative 8 in 2014 during peak construction would be similar to those described under Alternative 1. The impacts are similar because the same projects are proposed under this alternative, with the only difference being the gate locations for military access (GRN #s 38A and 49A). Land use impacts over the long term (year 2030) of Alternative 8 would be similar to Alternative 1.

To accommodate the roadway construction in the North Region, Alternative 8 would require the acquisition of approximately 82 ac (33 ha) of land. Approximately 22 ac (9 ha) of residential property would be acquired, with approximately 20 residential units subject to relocation. Approximately 13 ac (5 ha) of non-residential property would be acquired with the potential relocation of approximately four non-residential or business units, including one fast-food restaurant, one convenience/outdoor supply store, and two storage facilities. In addition, approximately 47 ac (19 ha) of military-owned land within the North Region would be acquired.

Within the Central Region, Alternative 8 would require the acquisition of approximately 75 ac (30 ha) of land. Approximately 42 ac (17 ha) of residential property would be acquired, with approximately 51 residential units subject to relocation. Approximately 10 ac (4 ha) of non-residential property would be acquired with the potential relocation of approximately seven non-residential or business units, including three fast-food restaurants, one office building, one gas station, and one rental car office. In addition, approximately 23 ac (9 ha) of military-owned land within the Central Region would be acquired.

Similar to Alternatives 1 and 2, no residential and non-residential property acquisition would be required for Alternative 8 in the Apra Harbor Region and South Region.

Proposed Mitigation Measures

Proposed mitigation measures for Alternative 8 would be the same as those proposed for Alternative 1.

10.2.6.5 No-Action Alternative

2009

Under the no-action alternative, only some roadway improvements would be constructed to support normal growth on Guam. Based on the GTP, without the military relocation project, it is anticipated that committed improvements that are currently programmed for funding in the Territorial Transportation Improvement Plan would be constructed. The types of projects currently funded include safety improvements, bridge replacements, roadway rehabilitation, and traffic improvements; therefore, the no-action alterative is consistent with the Territorial Transportation Improvement Plan and GTP.

Construction activities for the improvement projects would be typical of public works projects, as described under Alternatives 1, 2, 3, and 8. Because the no-action alternative does not include proposed roadway improvement projects in year 2009 (baseline year), there would be no construction impacts on land use under the no-action alternative.

2014

Construction activities for the improvement projects would be typical of public works maintenance projects. Because the no-action alternative would include only limited roadway improvement projects (compared to the GRN roadway improvements that would occur for Alternatives 1, 2, 3 and 8) to be constructed by the year 2014, construction impacts on land use under this alternative would be less than each of the build alternatives described above. Under the no-action alternative, no parkland and farmland conversion would be required; the impacts on parkland and farmland uses would be less than significant.

2030

As discussed previously, roadway improvements have been proposed and documented in the GTP. The no-action alternative, in the long-term, is consistent with the Territorial Transportation Improvement Plan and GTP.

Under the no-action alternative, the proposed 20 roadway improvements would be phased for construction over the period between 2014 and 2030. Construction activities of the improvement projects would be typical of public works projects as described under the proposed Alternatives 1, 2, 3, and 8. A TMP would be developed for implementation during construction activities. The TMP would identify and provide alternate traffic detour routes, construction materials hauling routes, bus stops, transit routes and operation hours, pedestrian routes, and residential and commercial access routes to be used during the construction period.

Because the number of roadway improvements projects under the no-action alternative (20) is substantially fewer than for Alternatives 1, 2, 3, and 8, and because the improvements would occur over a longer period of time, impacts on the use of land from this ongoing road improvement program would be less than significant.

Proposed Mitigation Measures

Because the proposed GRN improvement projects under the no-action alternative are consistent with the GTP, and because the impacts are considered to be less than significant, no mitigation measures are proposed.

10.2.6.6 Summary of Impacts

Table 10.2-5 summarizes the potential impacts of each action alternative. A text summary is provided below.

Table 10.2-5. Summary of Potential Land and Submerged Land Use Impacts – Roadway Project

Potentially Impacted Resource	*Alternative 1*	*Alternative 2**	*Alternative 3*	*Alternative 8*
Consistency with approved plans and policies	NI	NI	NI	NI
Disruption to current use of land	SI-M	SI-M	SI-M	SI-M
Commercial and residential land conversion	SI-M	SI-M	SI-M	SI-M
Ocean use	NI	NI	NI	NI
Farmland conversion	NI	NI	NI	NI
Parkland conversion	LSI	LSI	LSI	LSI

Legend: LSI = Less than significant impact; NI = No impact; SI-M = Significant impact mitigable to less than significant.
*Preferred Alternative.

The North and Central Guam Land Use Plan (BSP 2009) has addressed the changes in future land use as a result of the proposed Guam and CNMI military relocation project, as well as other military facility expansions over the next 20 years. The proposed GRN improvement projects are intended to meet the projected traffic demand both under the proposed military relocation and the no-action alternative (natural growth). The proposed GRN improvement projects are consistent with the North and Central Guam Land Use Plan (BSP 2009) that addresses projected growth from the proposed military relocation on the island, and the GTP that addresses the long-term strategy to improve transportation infrastructure and operations throughout Guam.

Implementation of the proposed roadway improvements project under each alternative would require some residential, non-residential, and military land acquisition for ROW use. Some residential and business properties would be subject to relocation.

10.2.6.7 Summary of Potential Mitigation Measures

Table 10.2-6 summarizes the potential mitigation measures for roadway projects impacts on land and submerged land use.

Table 10.2-6. Summary of Potential Mitigation Measures for Roadway Projects Impacts on Land Use

Phase	*Mitigation Measure*
Construction	Traffic Management Plan to identify/provide alternate: • Traffic detour routes • Construction material haul routes • Bus stops • Transit routes and operating hours • Pedestrian routes • Residential/commercial access routes • Outreach Program to inform residents, businesses, service providers and communities of: • Project construction schedules • Relocation plans • Assistance programs • Areas affected by traffic • Other relevant information
Operation	None

Implementation of the adaptive program management and force flow mitigation measures could further reduce roadway projects impacts on land use by lowering peak population levels during construction. See Volume 7 for a full description of these two mitigation measures.

CHAPTER 11.
RECREATIONAL RESOURCES

11.1 INTRODUCTION

This chapter discusses potential environmental consequences associated with implementing the alternatives within the region of influence for each resource. A description of the affected environment for each resource is provided in Volume 2. The locations described in Volume 2 include the region of influence for the utilities and roadway projects with the chapters presented in the same order as in Volume 6.

11.2 ENVIRONMENTAL CONSEQUENCES

11.2.1 Approach to Analysis

11.2.1.1 Methodology

Utilities

Information on recreational resources on Guam and public access was collected through stakeholder meetings in April 2007, Geographic Information System data compiled and reviewed for this Environmental Impact Statement (EIS) literature review, personal communications, and limited visitor data that are available for a few specific locations on the island. A comprehensive recreational carrying capacity analysis—assessing the number of individuals who can be supported in a given area within natural resource limits without degrading the natural social, cultural, and economic environment (Global Development Research Center 2008)—was not conducted as part of this EIS, but is suggested as a mitigation measure to better quantify potential impacts on recreational resources. Existing baseline data for conducting recreational resource impact analyses are somewhat limited because the Guam Department of Parks and Recreation (GDPR) does not collect visitor data (e.g., user counts, visitor satisfaction, user conflicts, visitor demands, and etc.) for its recreational facilities (GDPR 2009). Consequently, the analysis in this chapter relied considerably on information obtained through site reconnaissance and communications with natural resource planners at Andersen Air Force Base (AFB). The analysis of potential impacts on recreational resources is based on the long-term (operational) effects (i.e., after construction has occurred and all buildings, facilities, and structures are in place as well as the temporary impacts resulting from the influx of off-island workers). Construction-related activities would be relatively minimal in their impacts (i.e., earth-moving equipment clearing vegetation and constructing facilities and other structures).

Roadway Projects

The methodology used in assessing recreational resource impacts as a result of the proposed roadway improvements is generally the same as that described in the preceding “Utilities” section. However, the analysis focuses on direct (e.g., land acquisitions, elimination of access, degradation of facilities) and indirect (e.g., degradation of use due to traffic delays), temporary (i.e., construction), and permanent (i.e., operation) effects that could result by implementing the proposed Guam Road Network (GRN) under each alternative.

11.2.1.2 Determination of Significance

For the purpose of this EIS, the proposed action and alternatives would cause a significant impact on recreational resources if they:

- Would impede access to recreational resources
- Would substantially reduce recreational opportunities
- Would cause substantial conflicts between recreational users
- Would cause substantial physical deterioration of recreational resources

Recreational impacts as a result of the proposed roadway improvement projects are assessed following Federal Highway Administration Guidance for Preparing and Processing Environmental and Section 4(f) Documents (Federal Highway Administration 1987), which are similar to those listed above.

11.2.1.3 Issues Identified During Public Scoping Process

As part of the analysis, concerns related to recreational resources that were mentioned by the public, including regulatory stakeholders, during the public scoping meetings were addressed. These included the potential impact of the proposed action on civilian access to Department of Defense (DoD) facilities, recreation areas, Apra Harbor, and other locations, both in terms of construction and operations impacts.

11.2.2 Power

11.2.2.1 Basic Alternative 1: Recondition up to Five Existing Guam Power Authority–Permitted Facilities to Provide Peaking Power/Reserve Capacity

Basic Alternative 1 would recondition five existing Combustion Turbines (CTs) and upgrade and provide some new Transmission and Distribution (T&D) systems within existing utility corridors and would not require enlargement of the existing footprint of the generating facilities or new construction. Reconditioning would be made to existing permitted facilities at the Marbo, Yigo, Dededo (2 units), and Macheche CTs. T&D system upgrades would be on existing above ground and underground transmission lines. This alternative supports Main Cantonment Alternatives 1 and 2 and Main Cantonment Alternatives 3 and 8 would require additional upgrades to the T&D system.

Construction

The proposed reconditioning of the existing GPA facilities would be confined to the existing locations, wherein general overhaul, capabilities testing, and controlled startups would be performed. Also T&D systems would be upgraded. This upgrade would include installing larger wires on existing overhead distribution lines, moving some of the overhead lines to underground, and upgrading to existing substations within their current footprints. The proposed construction activities may impede roadway access to recreational areas by way of coning off construction area and/or diverting traffic to other routes. Increased time traveling on affected roads may occur; however, direct impacts on recreational resources are not expected.

For information on impacts caused by population growth from the influx of off-island workers, see Volume 2, Chapter 9, Section 9.2.2.2.

Operation

The proposed reconditioning of the existing CTs and T&D improvements would be confined to the existing locations and routes. At present, there are no recreational resources sited near the proposed (preexisting) location of the reconditioning and T&D upgrades. Therefore, Basic Alternative 1 would result in no impacts on recreational resources.

Proposed Mitigation Measures

No proposed mitigation measures would be needed.

11.2.2.2 Summary of Impacts

Table 11.2-1 summarizes the potential impacts of the Basic Alternative 1.

Table 11.2-1. Summary of Potential Impacts on Recreational Resources – Power

*Basic Alternative 1**
NI Recreational Resources (trails, historic and cultural attractions, dive sites, game hunting, fishing/crabbing, scenic points, golf course, day use resorts, spelunking, parks, beaches)

Legend: NI = No impact. *Preferred Alternative.

The Basic Alternative 1 would recondition the existing CTs and upgrade T&D systems. The upgraded distribution lines would be routed within the existing utility corridors and distribution system upgrades would occur within the footprint of existing substations. In as much as there are no identified recreational resources in proximity of the locations considered, the components of the proposed activities would be consistent with existing environment and adverse impacts on recreational resources are not anticipated.

11.2.3 Potable Water

11.2.3.1 Basic Alternative 1 (Preferred Alternative)

Basic Alternative 1 would provide additional water capacity of 11.3 MGd (42.8 MLd), which is anticipated to be met by an estimated 22 new wells at Andersen Air Force Base (AFB), rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 2.5 MG (9.5 ML) water storage tanks would be constructed at ground level at NCTS Finegayan. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

Construction

Development of the proposed wells at Andersen AFB and the two new 2.5 MG (9.5 ML) ground-level water storage tanks and two new 1 MG (3.8 ML) elevated storage tanks at Naval Computer Telecommunications Station Finegayan may impede roadway access to recreational areas (e.g., coning off construction area, diverting traffic). Increased time traveling on affected roads would likely result; however, direct impacts on recreational resources is not anticipated.

For information on impacts caused by population growth from the influx of off-island workers, see Volume 2, Chapter 9, Section 9.2.2.2.

Operation

The proposed development is not situated on or near the existing recreational resources. Inhibited access or the loss of use of recreational resources are not anticipated. Therefore, Alternative 1 would result in no impacts on recreational resources.

Proposed Mitigation Measures

No mitigation measures are needed.

11.2.3.2 Basic Alternative 2

Basic Alternative 2 would provide additional water capacity of 11.7 MGd (44.3 MLd), which is anticipated to be met by an estimated 20 new wells at Andersen Air Force Base (AFB) and 11 new wells at Air Force Base Barrigada, rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 1.8 MG (6.8 ML) water storage tanks would be constructed at ground level at NCTS Finegayan and one 1 MG (3.8 ML) water storage tank would be construction at Air Force Base Barrigada. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

Construction

The effects of the proposed actions under Basic Alternative 2 would be similar to those described under Alternative 1.

For information on impacts caused by population growth from the influx of off-island workers, see Volume 2, Chapter 9, Section 9.2.2.2.

Operation

The implementation of Basic Alternative 2 is limited to DoD lands where access is restricted to installation personnel and guests. Operation of the existing water supply wells and water storage tanks at Finegayan and Air Force Barrigada would not affect the function of the existing recreational resources that are near the project. Therefore, Alternative 2 would result in no impacts on recreational resources.

Proposed Mitigation Measures

No mitigation measures are needed.

11.2.3.3 Summary of Impacts

Table 11.2-2 summarizes the potential impacts of each interim alternative.

Table 11.2-2. Summary of Potential Impacts on Recreational Resources – Potable Water

*Basic Alternative 1**	*Basic Alternative 2*
NI Recreational Resources (trails, historic and cultural attractions, dive sites, game hunting, fishing/crabbing, scenic points, golf course, day use resorts, spelunking, parks, beaches)	NI Recreational Resources (trails, historic and cultural attractions, dive sites, game hunting, fishing/crabbing, scenic points, golf course, day use resorts, spelunking, parks, beaches)

Legend: NI = No *i*mpact. *Preferred Alternative.

The proposed alternatives for potable water, wherein new water supply wells would be developed at Andersen AFB and at Barrigada, and the construction of ground-level water storage tanks at Finegayan and Barrigada, would be confined to areas not within proximity to recreational resources. During the construction period, there may be slight delays on public right-of-ways (ROWs) due to the presence of construction-related vehicles; however, no direct impacts on the existing recreational resources in the proximity of the project locations are anticipated. The operation of the proposed features under either alternative would have no effect on the existing recreational resources.

11.2.4 Wastewater

11.2.4.1 Basic Alternative 1a (Preferred Alternative) and 1b

Basic Alternative 1 (Alternative 1a supports Main Cantonment Alternatives 1 and 2; and Alternative 1b supports Main Cantonment Alternatives 3 and 8) combines upgrade to the existing primary treatment facilities and expansion to secondary treatment at the Northern District Wastewater Treatment Plant (NDWWTP). The difference between Alternatives 1a and 1b is a requirement for a new sewer line from Barrigada housing to NDWWTP for Alternative 1b.

Construction

The proposed upgrade of the existing primary treatment facilities and expansion of the secondary treatment at the NDWWTP would be confined to the existing location. Although the Tanguisson Beach and Hilaan coastline are near the NDWWTP site, loss of access and use to these resources during the construction period is not expected. The proposed construction of wastewater facilities are not anticipated to have a direct impact on the existing recreational resources.

For information on impacts caused by population growth from the influx of off-island workers, see Volume 2, Chapter 9, Section 9.2.2.2.

Operation

The operation of the NDWWTP and Hagatna Wastewater Treatment Plant (WWTP) would not directly affect the access and use of nearby recreational resources because of the considerable distance from the point of wastewater outfall discharge to the near-shoreline area where recreational uses occur—particularly near Tanguisson Beach and the Hilaan coastlines (e.g., snorkeling, swimming, beachcombing) where NDWWTP is situated in proximity. Therefore, Basic Alternative 1a would result in less than significant impacts on recreational resources.

The construction workforce housing, in addition to the existing population serviced by the Hagatna WWTP, which is not proposed to be upgraded and/or expanded, would likely experience frequent sewer system overflows. Sewage spilling into marine and terrestrial recreational resources would likely result in temporary to permanent loss of access and use of recreational resources. Therefore, the operation of the existing indirect impact on recreational resources would be potentially significant.

11.2.4.2 Basic Alternative 1b

Construction

In addition to a sewer line proposed under Basic Alternative 1a, a new sewer line would be installed to convey wastewater generated from Barrigada housing to the NDWWTP. During the construction period, there may be slight delays on public ROWs in or near the Barrigada site caused by the presence of construction-related vehicles. Travel on affected roads may be delayed; however, direct impacts on recreational resources are not expected.

For information on impacts caused by population growth from the influx of off-island workers, see Volume 2, Chapter 9, Section 9.2.2.2.

Operation

The effects during the operational phase would be similar to those described under Basic Alternative 1a.

Proposed Mitigation Measures

No mitigation measures are needed.

11.2.4.3 Summary of Impacts

Table 11.2-3 summarizes the potential impacts of each interim alternative. An analysis of long-term alternatives was not developed because the alternatives are not ready for project-specific analysis.

Table 11.2-3. Summary of Potential Impacts on Recreational Resources – Wastewater

*Basic Alternative 1a**	*Basic Alternative 1b*
Construction Impacts (direct and indirect are the same)	
NI No loss of access and use of recreational resources during construction.	NI No loss of access and use of recreational resources during construction.
Operation Impacts (direct with indirect in parentheses)	
LSI (SI) The operation of the existing facilities, upgraded or not, is not expected to inhibit the access and use of existing recreational resources. (Overflow of the sewer system, particularly into marine and/or terrestrial recreational resources, could result in temporary to permanent loss of access and use).	LSI (SI) The operation of the existing facilities, upgraded or not, is not expected to inhibit the access and use of existing recreational resources. (Overflow of the sewer system, particularly into marine and/or terrestrial recreational resources, could result in temporary to permanent loss of access and use).

Legend: LSI = Less than significant impact; NI = No impact; SI = Significant impact. *Preferred Alternative.

The upgrade of the existing primary treatment facilities and the expansion of the secondary treatment facilities at the NDWWTP site involve site-specific work that would not impede the existing access to and the use of the recreational resources, which can be found at the nearby Tanguisson beach and the Hilaan coastline. Therefore, a direct impact on the existing recreational resources during construction period is not expected. The proposed installation of the new sewer line from Barrigada housing to NDWWTP would have similar effect on the ROWs and persons traveling by car to the recreational resource in the Barrigada area—during the construction phase only. No impacts on the recreational resources near the Barrigada area is anticipated during the operational phase. Under either alternative, the operation of the Hagatna WWTP, which would service the indirect permanent population in addition to the existing visitor and resident population, would likely experience overflows. In the event sewage overflows to marine or terrestrial recreational resources, access and use of these features would likely cease temporarily or permanently. These prospects would signal potentially significant indirect impacts on the existing recreational resources.

11.2.5 Solid Waste

11.2.5.1 Basic Alternative 1 (Preferred Alternative)

The Preferred Alternative would be to continue to use the Navy Landfill at Apra Harbor for municipal solid waste (MSW) until the new GovGuam Layon Landfill at Dandan is available for use. Disposal of other waste streams excluded from Layon Landfill would continue at the Navy Landfill. Construction and demolition (C&D) debris would continue to be disposed at the Navy hardfill.

Construction

The proposed construction efforts for the planned Layon Landfill would likely be completed before the relocation of the Marines and their dependents to Guam. No impacts on the recreational resources are anticipated.

For information on impacts caused by population growth from the influx of off-island workers, see Volume 2, Chapter 9, Section 9.2.2.2.

Operation

This alternative proposes the use of the existing Navy Landfill until the completion of the new Layon Landfill in July 2011. Continued use of the existing Navy Landfill is not expected to cause adverse impacts on the recreational resources as they are not situated within proximity. There are no recreational resources at the proposed Layon Landfill.

Proposed Mitigation Measures

No mitigation measures are needed.

11.2.5.2 Summary of Impacts

Table 11.2-4 summarizes the potential impact of the Preferred Alternative. A text summary is provided below.

Table 11.2-4. Summary of Potential Impacts of the Preferred Alternative – Solid Waste

Basic Alternative 1
NI Recreational Resources (trails, historic and cultural attractions, dive sites, game hunting, fishing/crabbing, scenic points, golf course, day use resorts, spelunking, parks, beaches)

Legend: NI = No impact.

The existing Navy landfill near Apra Harbor is not situated in close proximity to the recreational resources in the area. Adverse impacts on the access to and the use of these resources as the result of continued operation of the landfill is not anticipated. Similar to the Navy Landfill, there are no recreational resources at or near the proposed Layon Landfill site. There are no impacts on the recreational resources anticipated with the implementation of the proposed actions.

11.2.6 Off Base Roadways

This section addresses effects to non-public and public recreational facilities during the peak construction and post-construction periods (2014 to 2030). The analysis focuses on direct (e.g., land acquisitions, elimination of access, degradation of facilities) and indirect (e.g., degradation of use due to increased noise, traffic delays) temporary (i.e., construction) and permanent (i.e., operation) effects that could result with implementation of the proposed GRN under each alternative. Because the GRN projects are public works-type improvements, such as pavement strengthening (including some projects that could include widening), intersection improvement, road widening, road rehabilitation, bridge replacement, road relocation, and Military Access Point (MAP) construction, they generally include small to medium work crews and machinery. Most of the proposed improvements would be constructed within the public ROW or within existing DoD lands. Only a small number of projects that involve intersection improvement, road widening, and road relocation would require some ROW acquisition. Construction activities would include identifying and locating staging areas (e.g., machinery and material storage, equipment, trailers, employee parking); construction material and equipment transportation; site clearing and demolition, utility relocation, roadway/bridge construction, and finish work (e.g., landscaping, signage). Most of the environmental consequences associated with implementation of the proposed action would occur during construction. Once the construction is completed, its operation would be tested, including traffic signal system, communications systems, and associated equipment (if any) prior to actual usage of the roadways.

11.2.6.1 Alternative 1

The roadway projects that would be implemented for Alternative 1 are listed in Volume 6, Chapter 2, Table 2.5-3, with the exception of the following GRN projects: #38 (MAP), #39 (MAP), #41 (MAP), #47 (MAP), #48 (MAP), #49 (MAP), #49A (MAP), #63 (pavement strengthening), and #74 (pavement strengthening). The following subsections described impacts on recreation resources during the peak construction period and the future year 2030 due to the proposed roadway construction.

Year 2014 (Peak Construction and Population)

North

The proposed roadway improvement projects within the North Region are located along Routes 1, 3, 9, 15, and 28. There are no GRN projects that would result in either direct or indirect effects to recreational facilities located at Andersen AFB, including the Northwest Field area. These recreational facilities are located on base property north of the proposed GRN projects. In addition, access to these facilities is limited to installation personnel and their guests.

Route 3 provides the principal access to recreational opportunities in the western segment of the North Region (i.e., Dededo and Finegayan areas). Proposed improvements along Route 3 would include pavement strengthening, intersection improvements, road widening, and intersection improvements to MAPs. Recreational opportunities within this area are almost exclusively focused along the coast approximately 1.5 miles (mi) (2.4 kilometers [km]) from Route 3. One of the most popular tourist attractions within the North Region is Two Lovers Point. This tourist attraction can be accessed from Routes 1 or 3.

Routes 1 and 15 provide the principal access to recreational opportunities in the eastern segment of the North Region (i.e., Spring Hill Subdivision, Perez Acres, Gayinero, and Lupog). Proposed improvements along Routes 1 and 15 are limited to pavement strengthening and intersection improvements. Along Route 1, recreational activities are limited to a conservation reserve, golf course, and memorial park. Route 15 includes scenic vistas, historic/cultural attractions, and trails.

Temporary easements would be required along Routes 1, 3, 9, and 15 during the construction period. Temporary indirect impacts would result due to construction activities and may include traffic delays, lane closures, and rerouting of traffic. A Traffic Management Plan (TMP) would be developed for implementation during construction activities. The Guam Department of Public Works (GDPW) would closely coordinate with business and recreational facility owners to continuously provide them with information regarding construction schedules, anticipated traffic lane closures, and detour routes. The impacts are not considered adverse with incorporation of the TMP and coordination plan. Once the construction is completed, the availability of improved roadway conditions would help enhance these recreational opportunities in the North Region.

In addition to traffic delays and access obstruction, it is anticipated that indirect impacts on recreational resources could be derived from the increase in number of construction workers and indirect workers (such as workers in retailed employment, hotel employment, and other service industries), which are anticipated to be over 35,000 during the peak construction period of the military facility expansion construction in 2013 (GDPW 2008). Most of these workers would come from off-island locations. The 2013 Construction Peak and 2015 Military relocation travel demand study prepared as part of the 2030 Guam Transportation Plan (GTP) traffic analysis (Appendix C of the GTP) assumed that off-island workers for construction-related jobs would live together at the area near the construction sites and would make trips only to the construction sites. These workers would be transported to the construction sites by a fleet of passenger vans, shuttles, or buses. The travel demand study further assumed that off-island workers for indirect jobs (such as retailed employment, hotel employment, and others) would not bring additional members of their families, but that they would actually live together forming households of various sizes to economize money. The analysis assumed that these workers would be responsible for their own transportation to and from their work locations and that they would make home-based other and non-home-based trips at the same rates as other Guam residents.

Construction of the proposed GRN projects would result in an increase in number of construction workers on a temporary basis, but would not result in the increase in the number of indirect workers. Using the same assumption as the GTP traffic analysis, the increase in number of construction workers during the peak construction year of the GRN project would not substantially affect the recreational and park facilities on Guam. Because these workers would return to their home base after the construction is completed, the indirect impact on recreational resources from construction workers is considered temporary and less than significant.

Central

Road improvements within the Central Region would occur along Routes 1, 7, 8, 8A, 10, 15, 16, 25, 26, 27, and Chalan Lujuna Road. Most of the proposed improvements are pavement strengthening, with a few intersection improvements, road widening and road realignment.

There are no GRN projects that would result in either direct or indirect effects to recreational facilities on Navy Barrigada or Air Force Barrigada. These recreational facilities are located outside the area of the proposed GRN projects. In addition, access to these facilities is limited to installation personnel and their guests.

Route 1 provides the principal access to recreational opportunities in the western segment of the Central Region (i.e., Piti, Asan, Hagatna, Mongmong, and Tamuning). Proposed improvements along Route 1 include pavement strengthening, intersection improvements, bridge replacement, and intersection improvements to MAPs. Recreational opportunities along the western segment of the Central Region are largely comprised of beaches, trails, public parks, and scenic vistas. Portions of Route 1 are located immediately adjacent to or within close proximity to these recreational areas. Traffic congestion and travel delays could be expected during the peak construction year. A TMP would be developed for implementation during construction activities. The GDPW would closely coordinate with business and recreational facility owners to continuously provide them with information regarding construction schedules, anticipated traffic lane closures, and detour routes. The impacts are not considered adverse with incorporation of the TMP and coordination plan. Once the construction is completed, the availability of improved roadway conditions would help enhance the recreational opportunities in the Central Region.

Based on preliminary engineering design information, some minor parkland acquisition would be taken from three parks located along Route 1 to accommodate roadway construction, as summarized below.

- **Guam Seal Park** would be affected by GRN #3 (Agana Bridge Replacement) (see Figure 11.2-1). The bridge replacement limits are conceptual at this stage, and the affected land cannot be accurately estimated; however, based on the preliminary drawing, approximately 4,800 square feet (ft^2) (1,463 square meters [m^2]) or 0.10 acre (ac) (0.004 hectare [ha]) of land may be required.
- **Buffer Strip Park** would be affected by GRN #7 and GRN #6 intersection widening at Routes 1 and 27, and Routes 1 and 26 (see Figure 11.2-2). While the widening currently depicted can likely be adjusted to avoid most of the linear impact, the existing roadway at the

intersection with Route 27 appears to encroach on the park ROW by approximately 500 ft^2 (152 m^2)or 0.010 ac (0.004 ha).

- **Chinese Park** would be affected by GRN #33 intersection widening at Routes 1 and 14 (see Figure 11.2-3). The existing ROW parcel line appears to indicate that the existing roadway is built partially inside the park ROW. Approximately 15,900 ft^2 (4,846 m^2) or 0.36-ac (0.15-ha) of land would need to be acquired to correct this situation and to allow the intersection improvements.

The estimated acreage to be acquired at each of the above parks is subject to change during the detailed engineering design phase. Some design adjustment could also avoid impacts on the existing parkland. Any parkland acquisition would be coordinated between GDPW and GDPR. Because construction of the proposed improvement projects would be centered on the roadway intersection and corridor, no park closure is anticipated during the peak construction year. The impacts are not considered adverse with incorporation of the TMP and coordination plan described above. The use of public parks for transportation projects would be considered a use of Section 4(f) resources. Impacts on Section 4(f) resources are addressed in Volume 6, Chapter 21.

Routes 10 and 15 provide principal access to recreational opportunities in the eastern segment of the Central Region (i.e., Barrigada, Asbeco, and Adacao). Proposed improvements along Routes 10 and 15 include pavement strengthening, intersection improvements, roadway realignment, and intersection improvements at MAPs. As previously noted, recreational opportunities within this area are almost exclusively focused along the coast approximately 0.5 mi (0.8 km) to 1.5 mi (2.4 km) from Route 15.

Effects during construction in the Central Region would be similar to those described for the North Region. Once the construction is completed, the availability of improved roadway conditions would help enhance recreational opportunities in the Central Region.

Apra Harbor

Road improvements within the Apra Harbor Region would occur along Routes 1, 2A, and 11. These improvements are limited to pavement strengthening, intersection improvements, and intersection improvements at one MAP.

There are no GRN projects that would result in either direct or indirect effects to recreational facilities within Naval Base Guam. These recreational facilities are located outside of the proposed GRN projects. In addition, access to these facilities is limited to installation personnel and their guests.

Routes 1 and 11 provide the principal access to recreational opportunities in the Apra Harbor Region (i.e., Piti). Proposed improvements along Route 1 include pavement strengthening, intersection improvements, rehabilitation, and a MAP at Naval Base Guam. Recreational opportunities in the Apra Harbor Region are largely limited to the Sasa Bay area and immediately northwest of Piti, which contains marine reserves and fishing areas. Portions of Routes 1 and 11 are located immediately adjacent to or within close proximity to these areas.

Effects during the construction period within the Apra Harbor Region would be similar to those described for the North Region. The impacts are not considered adverse with incorporation of the TMP and coordination plan described above. Once construction is completed, the availability of improved roadway conditions would help enhance the recreational opportunities in the Apra Harbor Region.

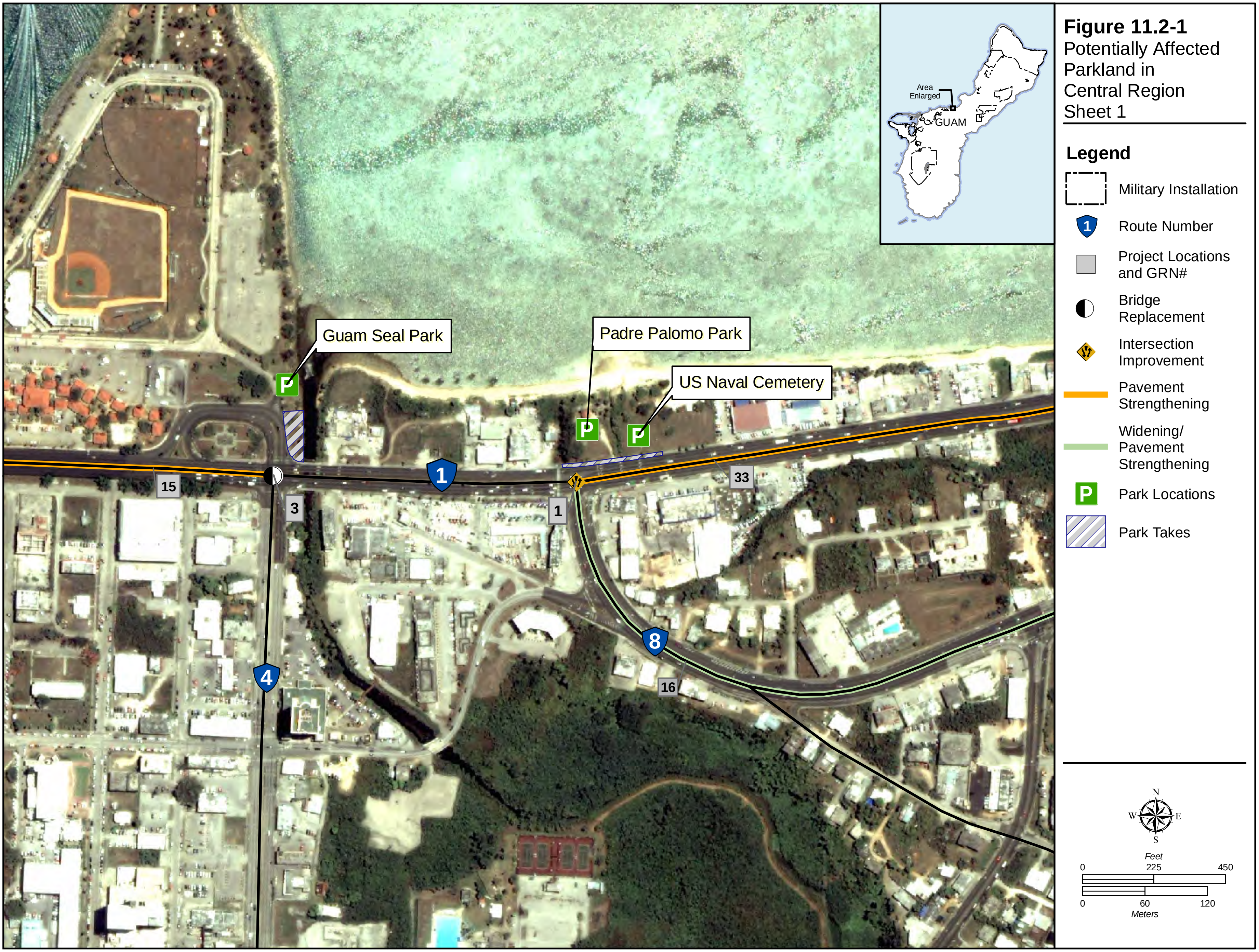

Figure 11.2-1
Potentially Affected Parkland in Central Region
Sheet 1

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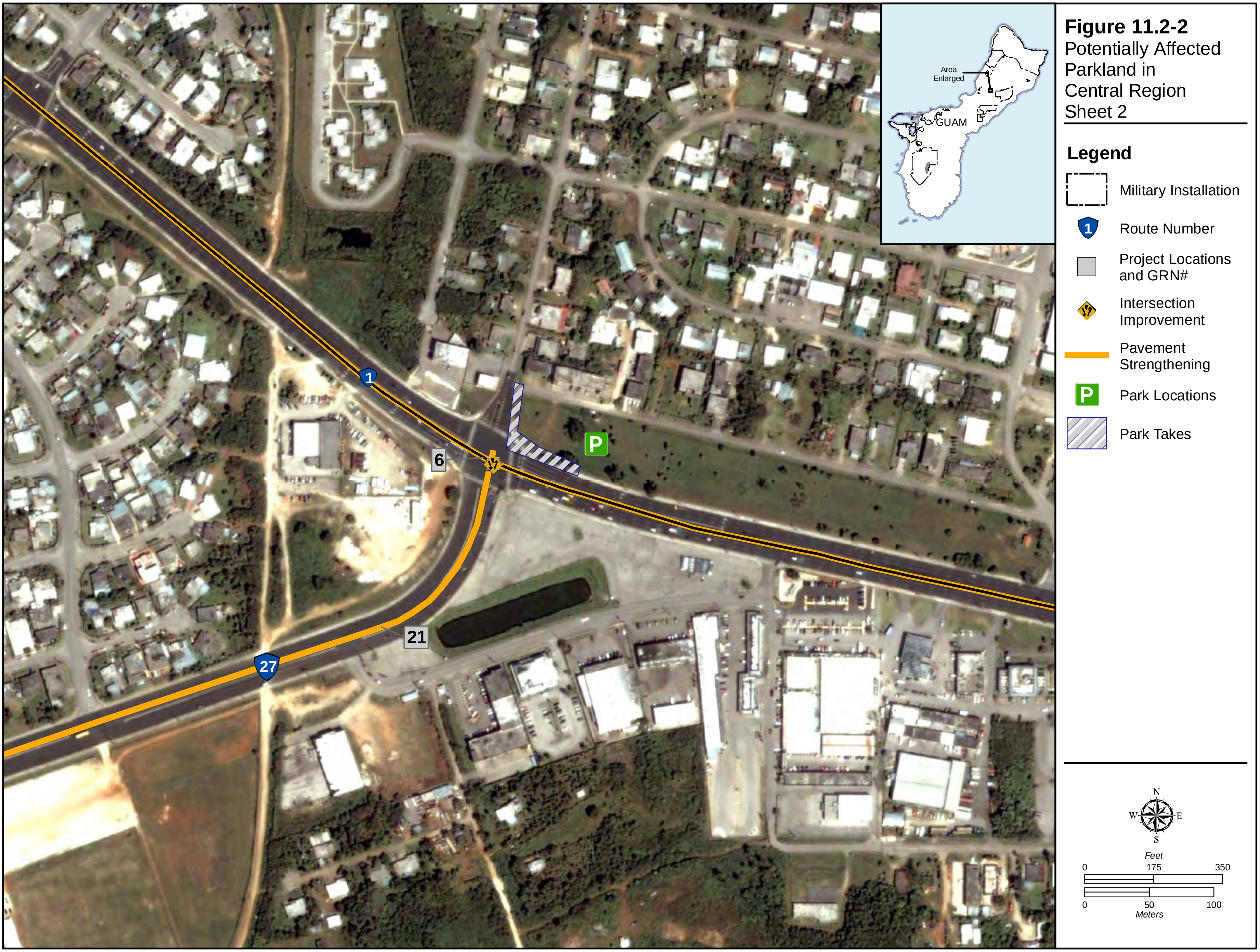
Figure 11.2-2
Potentially Affected Parkland in Central Region Sheet 2

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Figure 11.2-3
Potentially Affected Parkland in Central Region
Sheet 3

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South

Road improvements within the South Region include two pavement strengthening projects on Route 5, an intersection improvement on Route 2, and a MAP project at the Naval Munitions Site on Route 12 in the village of Santa Rita.

There are no GRN projects that would result in either direct or indirect effects to recreational facilities contained on the Naval Munitions Site. These recreational facilities are located outside the area of the proposed GRN projects. In addition, access to these facilities is limited to installation personnel and their guests.

Routes 2 and 17 provide the principal access to recreational opportunities in the South Region (i.e., Santa Rita, Agat, and Merizo). Proposed improvements along Route 2 are limited to intersection improvements. There are no improvements proposed for Route 17. Recreational opportunities in the South Region are largely limited to hiking trails, scenic vistas, and beaches/parks. Portions of Route 2 are located immediately adjacent to or within close proximity to these areas.

Effects during the construction period within the South Region would be similar to those described for the North Region. The impacts are not considered adverse with incorporation of the TMP and coordination plan described above. Once the construction is completed the availability of improved roadway conditions would help enhance the recreational opportunities in the South Region.

Proposed Mitigation Measures

- The GDPW would develop a TMP for implementation during construction activities. The TMP would identify and provide alternate traffic detour routes, construction materials hauling routes, bus stops, transit routes and operation hours, pedestrian routes, and residential and commercial access routes to be used during the construction period.
- The GDPW would develop an outreach program to keep residents, businesses, and any service providers within the area updated, and to inform surrounding communities about the project construction schedule, relocation plans and assistance programs, traffic-impacted areas and the TMP, and other relevant project information.
- To the extent applicable, engineering design would take into consideration avoidance of acquisition of public recreational facilities, such as parkland.

Year 2030

North

As described previously, the proposed GRN improvements are largely public works-type projects that are designed to enhance and improve the roadway system of Guam. No land acquisitions or permanent access closures for either public or non-public facilities are proposed that would result in permanent adverse effects to recreational opportunities contained within the North Region. In certain instances, some roadway improvements may result in long-term beneficial effects where access may previously be limited or in poor condition.

Central

As mentioned in the impact section under Year 2014, three public parks located along Route 1 would be affected by minor ROW acquisitions to accommodate the proposed intersection improvements and road widening; however, no permanent closure of these parks is anticipated. Land acquisition would be required that would affect the existing three parks, however, the land to be acquired is less than 0.5 ac and would not affect the long-term use of the facilities.

Apra Harbor

Effects during the operation period within the Apra Harbor Region would be similar to those described for the North Region.

South

Effects during the operation period within the South Region would be similar to those described for the North Region.

Proposed Mitigation Measures

No mitigation measures would be required.

11.2.6.2 Alternative 2 (Preferred Alternative)

The roadway projects that would be implemented for Alternative 2 are listed in Volume 6, Chapter 2, Table 2.5-3 with the exception of the following GRN projects: #38A (MAP), #39A (MAP), #41A (MAP), #47 (MAP), #48 (MAP), #49 (MAP), #49A (MAP), #63 (pavement strengthening), and #74 (pavement strengthening). Peak construction and long-term impacts on recreation resources under Alternative 2 would be similar to those described under Alternative 1 because the same projects are proposed under this alternative with the only difference being gate location for the MAP projects which have no impact on existing recreational resources. Best Management Practices as listed in Alternative 1 would be implemented.

Proposed Mitigation Measures

Mitigation measures would be similar to Alternative 1.

11.2.6.3 Alternative 3

The roadway projects that would be constructed under Alternative 3 are listed in Volume 6, Chapter 2, Table 2.5-1with the exception of the following GRN projects: #38A (MAP), #39A (MAP), #41 (MAP), #41A (MAP), #20 (pavement strengthening), #31 (pavement strengthening), and #124 (new roadway). Impacts on recreation from construction activities under Alternative 3 in 2014 during peak construction would be slightly less than Alternatives 1 and 2 because no new roadway (GRN #124) would be constructed under this alternative. However, beneficial impacts on recreational enhancement would be slightly less than Alternatives 1 and 2 due to unavailability of roadway to support the planned land-use development within the Dos Amantes Planning Area.

Proposed Mitigation Measures

Mitigation measures would be similar to Alternative 1.

11.2.6.4 Alternative 8

The roadway projects that would be constructed under Alternative 8 are listed in Volume 6, Chapter 2, Table 2.5-1 with the exception of the following GRN projects: #38 (MAP), #39 (MAP), #41 (MAP), #47 (MAP), #48 (MAP), #49 (MAP), #63 (pavement strengthening), and #74 (pavement strengthening). In general, the MAP and pavement strengthening projects would not cause significant impact to recreational facilities. Therefore, impacts on recreation under Alternative 8 in 2014 during peak construction would be similar to those described under Alternative 1 because the same projects are proposed under this alternative with the exception of GRN# 49A, which is a MAP project. In the long-term beneficial impacts on recreation facilities under Alternative 8 would be similar to Alternatives 1 and 2.

Proposed Mitigation Measures

Mitigation measures would be similar to Alternative 1.

11.2.6.5 No-Action Alternative

2009

Under the no-action alternative, only some roadway improvements would be constructed by the Government of Guam to support normal growth within the island. Because the no-action alternative would include no roadway improvement project in year 2009 (baseline year), construction impacts on recreational facilities under this alternative would be less than significant compared with each of the build alternatives described above.

2014

Construction activities for improvement projects to be completed by the Government of Guam would be typical of public works maintenance projects, as listed in Volume 6, Chapter 2, Table 2.5-10. Because the no-action alternative would include only seven roadway improvement projects (compared to the number of GRN projects) to be constructed by the year 2014, construction impacts on recreation facilities under this alternative would be less than the level to be incurred under each of the build alternatives described above. Under the no-action alternative, minor parkland acquisition could be required for some roadway improvement projects, but the acquisition is not anticipated to be a greater impact than the proposed GRN project. Therefore, the impacts on recreational facilities under the no-action alternative would be less than significant.

2030

Under the no-action alternative, an additional 20 roadway improvements would be phased for construction over the period between 2014 and 2030 (Volume 6, Chapter 2, Table 2.5-10). Construction activities of the improvement projects would be typical of public works projects. Under the no-action alternative, minor parkland acquisition could be required for some roadway improvement projects, but the acquisition is not anticipated to be a greater impact than the proposed GRN project. Therefore, impacts on recreation facilities under the no-action alternative would be less than significant.

Proposed Mitigation Measures

Mitigation measures would be similar to Alternative 1 for each roadway improvement project proposed to be constructed.

11.2.6.6 Summary of Impacts

Table 11.2-5 summarizes the potential impacts of each alternative.

Implementation of the proposed roadway improvement projects would result in disruption of recreational opportunities situated along the roadway corridors during the construction period. This impact would be temporary and would cease after the construction activity is complete. To accommodate the proposed improvements, some parkland along certain roadway corridors would be subject to acquisition, but none of the improvements would result in severe disruption of recreational opportunities or permanent closure of any parkland. Roadway improvements around the island would essentially enhance long-term recreational opportunities on Guam.

Table 11.2-5. Summary of Potential Impacts on Recreational Resources – Roadway Project

Potentially Impacted Resource	*Alternative 1*	*Alternative 2**	*Alternative 3*	*Alternative 8*
Disruption of recreational opportunities during peak construction	SI-M	SI-M	SI-M	SI-M
Disruption of long-term recreational opportunities	LSI	LSI	LSI	LSI
Enhancement of long-term recreational opportunities	BI	BI	BI	BI

Legend: BI = Beneficial impact; LSI = Less than significant impact; SI-M = Significant impact mitigable to less than Significant. *Preferred Alternative.

11.2.6.7 Summary of Proposed Mitigation Measures

Table 11.2-6 summarizes the proposed mitigation measures for roadway projects impacts on recreation.

Table 11.2-6. Summary of Proposed Mitigation Measures for Roadway Projects Impacts on Recreation

Phase	*Mitigation Measure*
Construction	Engineering design to consider avoidance of acquisition of public recreational facilities. Traffic Management Plan to identify/provide alternate: • Traffic detour routes • Construction material haul routes • Bus stops • Transit routes and operating hours • Pedestrian routes • Residential/commercial access routes • Outreach Program to inform residents, businesses, service providers, and communities of: • Project construction schedules • Relocation plans • Assistance programs • Areas affected by traffic • Other relevant information
Operation	None

Implementation of the adaptive program management and force flow mitigation measures could further reduce roadway projects impacts on recreation by lowering peak population levels during construction. See Volume 7 for a full description of these two mitigation measures.

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CHAPTER 12.
TERRESTRIAL BIOLOGICAL RESOURCES

12.1 INTRODUCTION

This chapter contains a discussion of the potential environmental consequences associated with implementing the alternatives within the region of influence for this resource. For a description of the affected environment for all resources, refer to the respective chapter of Volume 2. The locations described in Volume 2 include the region of influence for the utilities and roadway projects, and the chapters are presented in the same order as the resource areas contained in Volume 6.

Species mentioned in this section are described using the common name when there is an English common name that is in relatively common use on Guam (all wildlife and some plants). Common names are cross-referenced to scientific names in Appendix G. Where there is no commonly used English name for plants, the scientific name is used with the Chamorro name in parentheses when first used.

12.2 ENVIRONMENTAL CONSEQUENCES

12.2.1 Approach to Analysis

12.2.1.1 Methodology

The affected environment for terrestrial biological resources for the proposed roadway improvement projects is described in Volume 2 of this Environmental Impact Statement (EIS).

Biological resource issues and concerns include the potential direct, indirect, and cumulative impacts of the proposed actions and alternatives during the construction and operation phases. Impacts may be either temporary (reversible) or permanent (irreversible). Direct and indirect impacts are distinguished as follows.

Direct impacts are associated with proposed construction activities (e.g., ground-disturbing activities) and operations (e.g., noise and lighting). Potential types of direct impacts include, but are not limited to:

- Loss of habitat due to vegetation removal during construction.
- Temporary loss of habitat during construction from noise, lighting, and human activity.
- Potential loss of habitat due to disturbance of species in areas surrounding operations from noise, lighting, and human activity.
- Injury or mortality to wildlife or special-status species caused by the action that occur at the same time and place as the action.

Indirect impacts are caused by or result from project-related activities, are usually later in time, and are reasonably foreseeable (e.g., increased likelihood of non-native species moving into the area after disturbance). Potential indirect impacts include, but are not limited to:

- All disturbances from human activity, noise, and lighting that would potentially impact unoccupied suitable habitat for special-status species.
- Introduction of new non-native invasive species or increased dispersal of existing non-native invasive species on Guam.
- Dispersal of existing non-native invasive species from Guam to the Commonwealth of the Northern Mariana Islands (CNMI), Hawaii, or other destinations.
- Adverse effects from pollutants that are released from construction or military operations.

General principles used to evaluate impacts are:

- The extent, if any, that the action would permanently lessen ecological habitat qualities that Endangered Species Act (ESA)-listed species depend upon, and which partly determines the species' prospects for conservation and recovery.
- The extent, if any, that the action would diminish population sizes, distribution, or habitat of regionally important native plant or animal species.
- The extent, if any, that the action would be likely to jeopardize the continued existence of any ESA-listed species.
- The extent, if any, that the action would be inconsistent with the goals of United States (U.S.) Fish and Wildlife Service (USFWS) recovery plans, Navy and Air Force Integrated Natural Resources Management Plans, or the Guam Comprehensive Wildlife Conservation Strategy.

Many of the proposed roadway improvement projects were excluded from further analysis of direct impacts if such projects would not require road widening, where all proposed improvements would occur within the existing impervious cover footprint because these projects would not directly or indirectly affect terrestrial biological resources (i.e., vegetation communities, wildlife resources, or special-status species). In addition, roadway projects were excluded from further direct impact analysis if they would occur in developed areas with no appreciable effect to terrestrial biological resources (i.e., vegetation communities, wildlife resources, or special-status species). These types of projects would require clearing of vegetation, but the area required for clearing has been so heavily degraded, modified, or characterized by urban vegetation that the loss of the area would not appreciably affect terrestrial biological resources (i.e., vegetation communities, wildlife resources, or special-status species). The analysis of indirect impacts for roadways considers the potential for noise impacts and impacts from runoff, sedimentation, and non-point source pollution inputs into freshwater (non-marine) aquatic environments and surrounding vegetation communities.

12.2.1.2 Determination of Significance

Significance of impacts on vegetation, wildlife, and special-status species were determined using guidelines in the previous section. Special-status species are defined as ESA- and Guam-listed species and species that are designated candidates for ESA listing. Specific significance criteria are discussed below. If significant impacts are determined, then mitigation may be proposed to offset the impacts.

Vegetation

Impacts would be determined significant if any primary limestone forest (mature forest dominated by native species) would be cleared, unless determined to be very minor in the context of the surrounding forest areas. Any loss of this forest vegetation community would be considered significant because of the large historical and continuing losses of this forest type on Guam. Loss of wetland or mangrove vegetation would also be considered potentially significant. Note that impacts on vegetation types other than primary limestone forest could also be determined significant if these areas are habitat for protected wildlife or special-status species (as evaluated below).

Wildlife

Impacts would be determined significant if native wildlife species are present and the proposed project would result in more than minimal changes in population sizes or distributions of regionally important native animal species. These wildlife species include those designated as Species of Greatest Conservation Need in the Guam Comprehensive Wildlife Conservation Strategy (Guam Division of Aquatic and Wildlife Resources [GDAWR] 2006; excluding special-status species which are addressed separately below). Non-native invasive species impacts that exceed the criteria specified above are evaluated. Historical impacts from non-native invasive species have been severe, particularly from the brown tree snake (BTS) (see discussion in Volume 2). Although the proposed action would not result in additional impacts from BTS on Guam, the concern is that the BTS would be inadvertently introduced to other islands throughout the Pacific. This concern is addressed comprehensively for all actions proposed in this EIS with mitigation measures described in Volume 2, Chapter 10.

Migratory Birds

The Migratory Bird Treaty Act prohibits the taking, killing, or possessing migratory birds, with an exemption for military readiness activities (as defined in federal regulations) provided they do not result in a significant adverse effect on a population of a migratory bird species. Congress defined military readiness activities as all training and operations of the Armed forces that relate to combat and the adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use. Military readiness activities do not include: (A) routine operation of installation support functions such as administrative offices, military exchanges, water treatment facilities, schools, housing, storage facilities, and morale, welfare, and recreation activities; (B) the operation of industrial activities; and (C) the construction or demolition of facilities used for a purpose described in A or B (50 Code of Federal Regulations Part 21).

The Department of Defense (DoD) must consult with the USFWS if it is determined that a military readiness activity would have a significant adverse effect on a population of a migratory bird species. An activity has a significant adverse effect if, over a reasonable period of time, it diminishes the capacity of a population of a migratory bird species to maintain genetic diversity, to reproduce, and to function effectively in its native ecosystem.

Migratory bird conservation relative to non-military readiness activities is addressed separately in a Memorandum of Understanding developed in accordance with Executive Order 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*. The Memorandum of Understanding between the DoD and USFWS was signed in July 2006 and DoD responsibilities included, but are not limited to (1) incorporating conservation measures addressed in regional or state bird conservation plans and Integrated Natural Resources Management Plans; (2) managing military lands and activities other than military readiness in a manner that supports migratory bird conservation; and (3) avoiding or minimizing impacts on migratory birds, including incidental take and the pollution or detrimental alteration of the environments used by migratory birds.

The following species that occur on Guam are considered non-migratory birds and are not covered under the Migratory Bird Treaty Act: black francolin, black drongo, Eurasian tree sparrow, island-collard dove (previously known as Philippine turtle dove), common pigeon, and king quail.

Special-Status Species

The presence of special-status species in the project areas was described in Volume 2. Background information is presented in the species profiles in Appendix G. Impacts would be determined significant if special-status species are present in the project area and any project action is likely to result in harassment or harm of an individual, population or species. Impacts on ESA-listed species would include vegetation clearing of designated undeveloped Overlay Refuge lands, or identified recovery habitat, unless it is determined that the removal of habitat or other affect is minor when considering all the remaining habitat and quality of habitat available to that species and considering USFWS recovery plan goals. Significant indirect impacts would also include disturbing ESA- and Guam-listed species due to noise, lighting, or human activity. If unoccupied but recovery habitat is affected by operational noise, lighting, or human activity, impacts would be considered indirect and would be determined significant unless the area affected is considered minor when considering all the remaining habitat and quality of habitat available to that species.

The baseline area for Overlay Refuge on Guam is 21,690 acres (ac) (8,778 hectares [ha]) (USFWS 2008) with slight modifications made to correspond to the present Naval Computer and Telecommunications Station (NCTS)-Former Federal Aviation Administration (FAA) boundary (see Figure 10.1-2). The area of identified recovery habitat on Guam is 28,655 ac (11,596 ha) for the Mariana fruit bat and Guam Micronesian kingfisher, 27,124 ac (10,977 ha) for the Mariana crow, 49,564 ac (20,058 ha) for the Guam rail, and 11,668 ac (4,722 ha) for the *Serianthes* tree (USFWS 2010).

For ESA-listed species, federal agencies are required to ensure that their actions do not jeopardize the continued existence of an endangered or threatened species or its critical habitat. Analyses of potential impacts are based on review of plans for the proposed action and the available current and historical distributional data for each species. In accordance with Section 7 of the ESA, a Biological Assessment (BA) was prepared by the Navy to analyze the potential impacts on ESA-listed and critical habitat under the jurisdiction of the USFWS.

The BA and the subsequent Biological Opinion (BO) issued by the USFWS after their review of the BA, would be the final determination of impacts on ESA-listed species that are being evaluated in this EIS. The BO may provide an Incidental Take Statement that would list the amount or extent of take anticipated. Based on that take it would specify Terms and Conditions that the action proponent must comply with to be exempt from the prohibitions of Section 9 of the ESA. These are non-discretionary requirements. The BO may also specify Conservation Recommendations that are discretionary proponent activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

12.2.1.3 Issues Identified during Public Scoping Process

Terrestrial biological resource issues identified by the public, including regulatory stakeholders, during the public scoping process that are applicable to the proposed action include the following:

- Activities associated with the military expansion (i.e., construction, expansion, renovation projects, and military training activities) may result in habitat loss and physical disturbance of federally listed endangered species and other federal trust species.
- Potential for harm to fragile ecosystems on Guam and in the CNMI from introducing non-native species due to increased traffic among the islands from the movement of personnel and materials. Such species include the BTS, flatworms, various insects, and some plants. The EIS should outline inspection and sanitary procedures to prevent this movement.
- Existing control and containment activities at air and sea ports for the BTS are insufficient to deal with the risk associated with the increased cargo and personnel movement from Guam to other vulnerable destinations. The issue “of utmost concern” is BTS interdiction and an effective, enforceable procedure for inspecting all military cargo, personnel, and equipment entering the CNMI must be instituted. The Navy must ensure funding to sustain a 100 percent (%) inspection rate of all cargo, vehicles, munitions, and household goods associated with the relocation of Marines. Guam regulation protocols 505 and 506 should be incorporated into a BTS control plan to be included as part of the EIS.

12.2.2 Power

12.2.2.1 Basic Alternative 1 (Preferred Alternative)

Basic Alternative 1 would recondition existing Combustion Turbines (CTs) and upgrade Transmission and Distribution (T&D) systems and would not require new construction or enlargement of the existing footprint of the facility. This work would be undertaken by the Guam Power Authority on its existing permitted facilities. Reconditioning would be made to existing permitted facilities at the Marbo, Yigo, Dededo (two units), and Macheche CTs. These CTs are currently being used very little if at all, and after reconditioning would be used as peaking and reliability reserve power. T&D system upgrades would be on existing above ground and underground transmission lines. This alternative supports proposed Main Cantonment Alternatives 1 and 2; proposed Main Cantonment Alternatives 3 and 8 would require additional upgrades to the T&D system.

All power line installations or upgrades would occur along existing disturbed utility or roadway corridors and would result in a less than significant impact to terrestrial biological resources.

Proposed Mitigation Measures

No mitigation would be needed.

12.2.2.2 Summary of Impacts

Table 12.2-1 summarizes the potential impacts of the Basic Alternative 1. There would be less than significant impacts on terrestrial biological resources because the proposed alternative involves only upgrades to existing facilities and construction and installation of power lines in existing utility corridors in developed areas.

Table 12.2-1. Summary of Potential Impacts on Terrestrial Biological Resources – Power (Basic Alternative 1)

Basic Alternative 1
Construction (direct and indirect impacts same)
NI • No impacts on vegetation, wildlife, and special-status species.
Operation
NI • No impacts on vegetation, wildlife, and special-status species.

Legend: NI = No impact.

12.2.3 Potable Water

As discussed in Volume 6, Chapter 2, Section 2.2.2, potable water alternatives are not distinguished as interim or long-term. Impacts from proposed potable water waterlines that run along public roadways are not evaluated since roadway improvements that would disturb these same areas are being evaluated for impacts in Volume 6, Chapter 4 and no additional impact beyond construction is anticipated.

12.2.3.1 Basic Alternative 1 (Preferred Alternative)

Basic Alternative 1 would provide additional water capacity of 11.3 MGd (42.8 MLd), which is anticipated to be met by an estimated 22 new wells at Andersen Air Force Base (AFB), rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 2.5 MG (9.5 ML) water storage tanks would be constructed at ground level at NCTS Finegayan. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint. The placement of new underground waterlines and wells would be constructed along existing rights-of-way and areas of disturbed vegetation to the maximum extent possible.

In addition to the Basic Alternative 1 for the DoD water system, the GWA water system would need to be expanded to provide water to the construction workforce, induced civilian growth, and regularly expected civilian growth. The details of what GWA would specifically do to expand their water system are not known, but it would be roughly similar in magnitude to the DoD water system expansions. Not having details on this GWA water system expansion makes it impossible to accurately assess these potential indirect impacts on terrestrial biological resources. If the expansion of the GWA water systems does not occur, the civilian water customers would experience increased occurrences of low water pressure and irregular water service. This would not have an impact on terrestrial biological resources.

Construction

Vegetation

The vegetation associated with the various components under Basic Alternative 1 that would be removed is shown in Figure 12.2-1 and listed in Table 12.2-2. Disturbed limestone vegetation community types on Andersen AFB that would be affected are primarily mixed limestone forest (plateau/secondary and vitex) closed canopy forest. As mentioned above, the location for the placement of potable water components has not yet been determined. Uncommon tree species, such as *Tabernaemontana rotensis* would be avoided when placing these structures to the extent possible. At NCTS Finegayan, all water system components would be placed in areas already included in the proposed main cantonment area so that there would be no additional impacts on vegetation. Impacts on vegetation at Andersen AFB and Andersen South would be less than significant because minimal primary limestone forest would be removed. Vegetation removed does provide habitat for wildlife and special-status species. These impacts are evaluated in subsequent sections.

Table 12.2-2. Potential Direct Impacts on Vegetation Communities with Implementation of Potable Water Basic Alternative 1 (ac [ha])

Parcel and Activity	*Limestone Forest, Disturbed*	*Tangantangan, Casuarina*	*Shrub/ Grasslands, Savanna*	*Developed*
Andersen AFB				
Water Wells	2.9 (1.2)	0.2 (0.1)	0	1.9 (0.8)
Waterlines	11 (4.5)	0.4 (0.2)	0	16 (6.5)
Andersen South				
Waterlines	2.3 (0.9)		0.1 (0.04)	0.1 (0.04)
Total area removed	**16 (6.5)**	**0.6 (0.2)**	**0.1 (0.04)**	**18 (7.3)**

Legend: ac = acre; AFB = Air Force Base; ha = hectare.

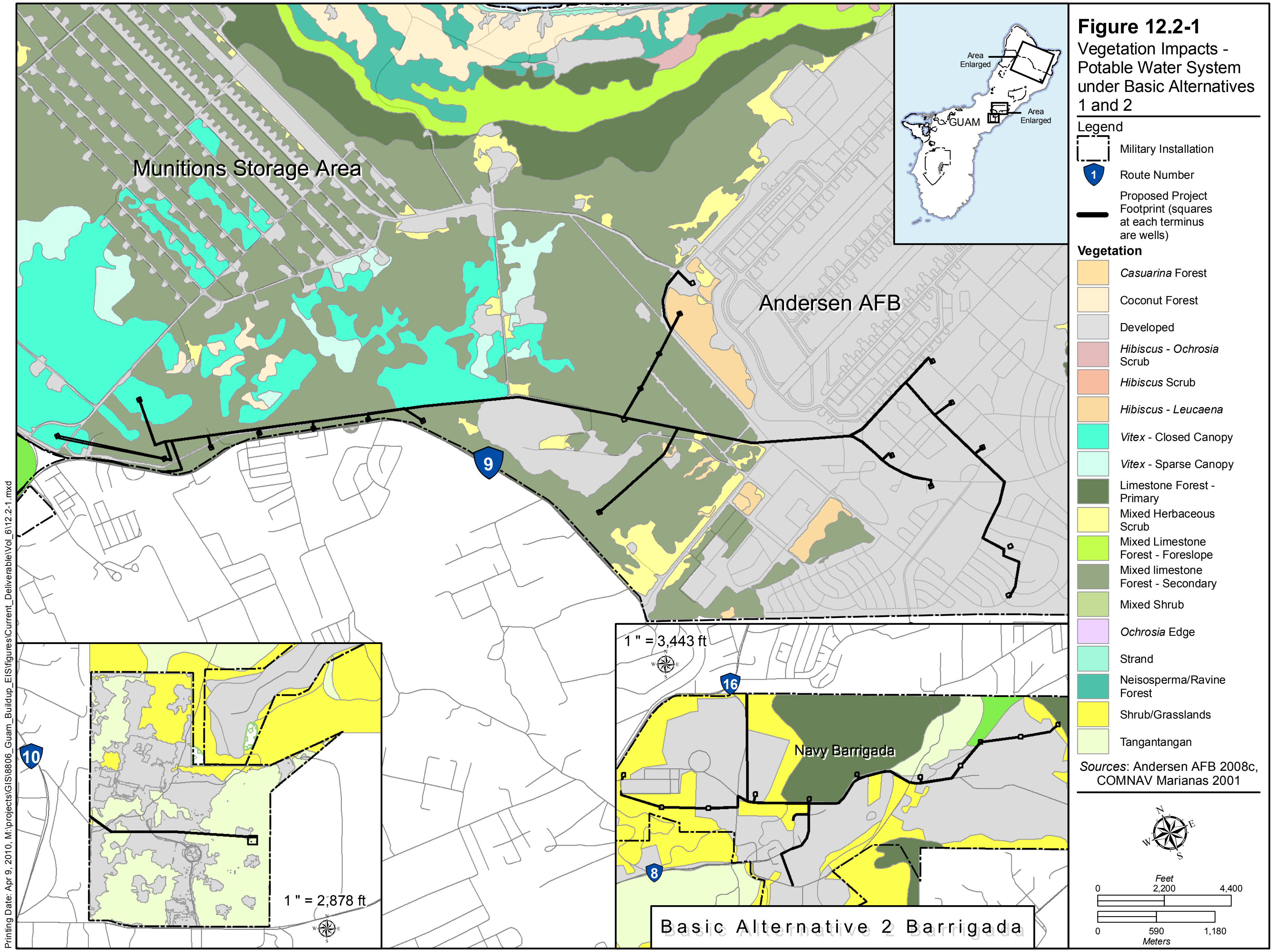

Figure 12.2-1
Vegetation Impacts - Potable Water System under Basic Alternatives 1 and 2

Wildlife

Based on studies by others and observations in other similar areas on Andersen AFB, NCTS Finegayan, and Andersen South (discussed in Volume 2, Chapter 10, Section 10.1), the only native bird species likely to be present in the project areas are the yellow bittern and possibly the Pacific golden plover in open areas; both species are common throughout Guam. Native species of skinks and geckos have not been reported in the project areas in any recent studies (within the past 10 years) and were not observed in surveys conducted in project areas for this EIS.

Proposed construction activities would displace the species and other wildlife from suitable habitat in the proposed project areas. Smaller, less-mobile species and those seeking refuge in burrows could inadvertently be killed during construction activities; however, long-term, permanent impacts on populations of such species would be less than significant because the species is abundant in surrounding areas. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Therefore, impacts on wildlife due to proposed construction activities at Andersen AFB would be less than significant under Alternative 1.

Special-Status Species

Specific identified habitat areas would be removed under Basic Alternative 1 for potable water, including Overlay Refuge and recovery habitat for the federal- and Guam-listed Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher (Figure 12.2-2 and Table 12.2-3). At NCTS Finegayan and the Former FAA parcel, all water system components would be in areas already included in the proposed main cantonment area so that there would be no additional impacts on habitat areas. Based on the removal of these habitat areas at Andersen AFB, there would be significant impacts on the three species. Several wells and connecting waterlines in the eastern cluster would be constructed in habitat of the Micronesian starling, a Guam-listed species (Figure 12.2-2) but loss if this small amount of habitat would result in less than significant impacts on this species.

Mariana fruit bat. Specific habitat areas would be removed under Basic Alternative 1 for potable water, including Overlay Refuge and recovery habitat for the fruit bat (Figure 12.2-2, Table 12.2-3). Based on the removal of 10 ac (4.0 ha) of recovery habitat that is also Overlay Refuge, there would be significant impacts on fruit bat. Removal of these areas due to construction would have a significant impact on recovery habitat available for the species. The magnitude of the impacts would be reduced with a suite of actions described in Volume 2, Chapter 10, Section 10.2.2.6. Monitoring prior to construction would be conducted to determine if the fruit bat was present in the project area. If present, construction would be halted until the species left the area. With this mitigation, temporary indirect impacts on roosting and foraging activities of the Mariana fruit bat from noise and activity during construction would be less than significant.

Mariana crow. Specific habitat areas would be removed under Basic Alternative 1, including Overlay Refuge and recovery habitat for the crow (Figure 12.2-2a and Table 12.2-3). The Mariana crow is not currently present in areas where these projects would occur so there would be no impacts from construction. Based on the removal of 10 ac (4.0 ha) of recovery habitat that is also Overlay Refuge, there would be significant impacts on recovery habitat available for the species. The magnitude of the impacts would be reduced with a suite of actions described in Volume 2, Chapter 10, Section 10.2.2.6.

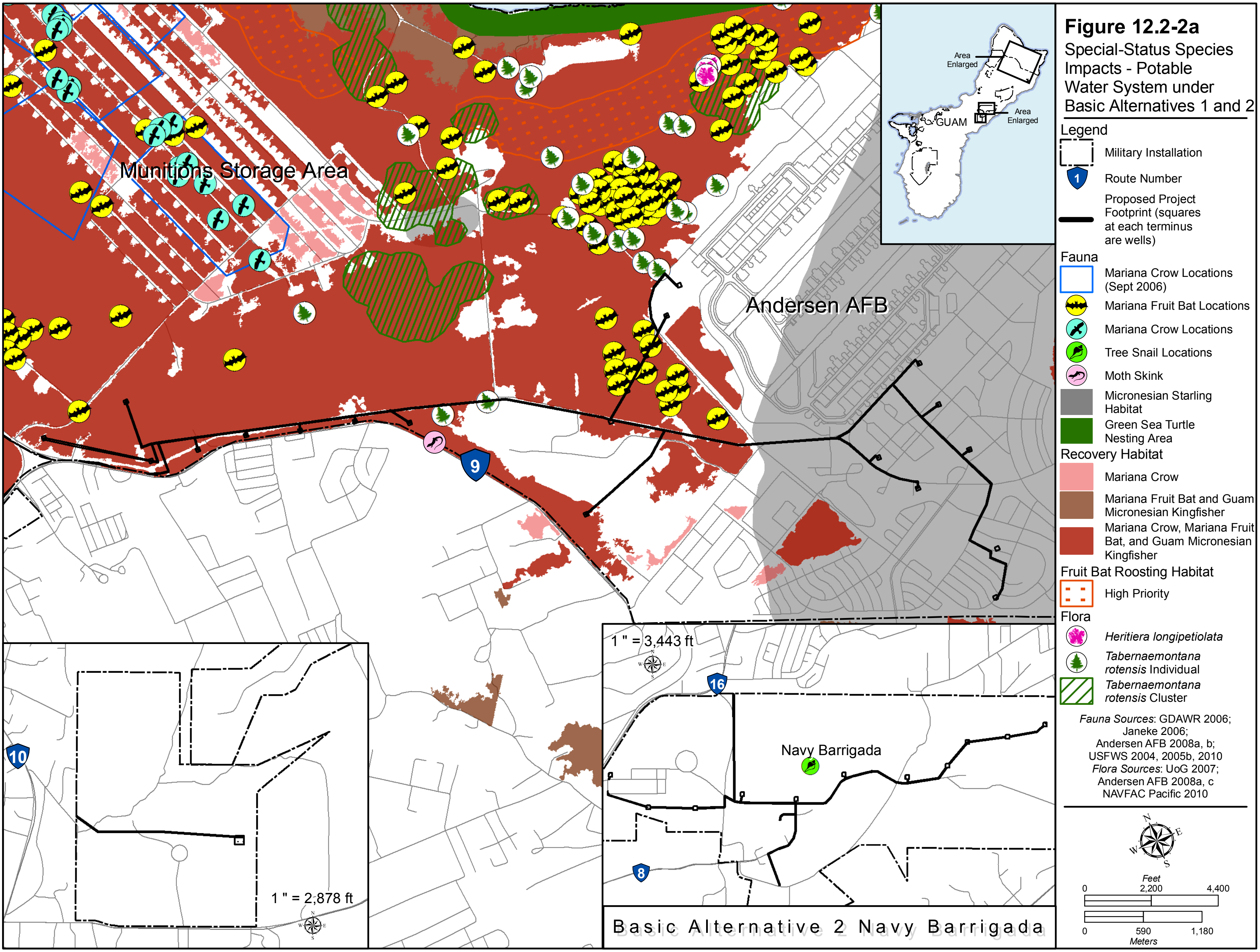

Figure 12.2-2a

Special-Status Species Impacts - Potable Water System under Basic Alternatives 1 and 2

Fauna Sources: GDAWR 2006; Janeke 2006; Andersen AFB 2008a, b; USFWS 2004, 2005b, 2010
Flora Sources: UoG 2007; Andersen AFB 2008a, c NAVFAC Pacific 2010

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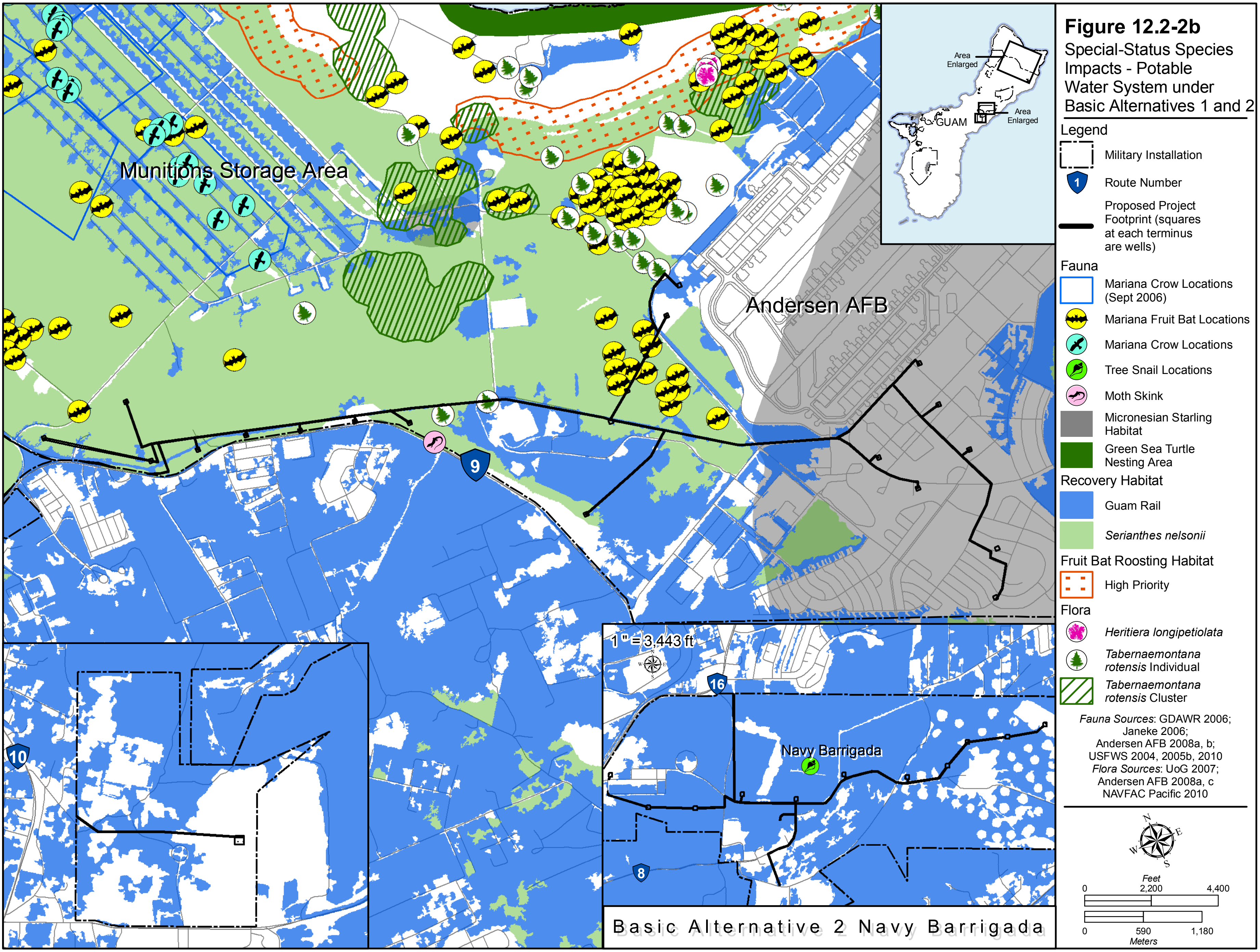

Figure 12.2-2b

Special-Status Species Impacts - Potable Water System under Basic Alternatives 1 and 2

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Table 12.2-3. Potential Impacts on Special-Status Species Habitat with Implementation of Potable Water – Basic Alternative 1 (ac [ha])

Parcel and Activity	*Overlay Refuge*	*Recovery Habitat – Bat and Kingfisher*	*Recovery Habitat – Crow*	*Recovery Habitat – Rail*	*Recovery Habitat – Serianthes*
Direct Impacts from Construction – Habitat Removed					
Andersen AFB					
Water Wells and Waterlines	11 (4.5)	10 (4.0)	10 (4.0)	8.8 (3.6)	11 (4.5)
Total area removed	**11 (4.5)**	10 (4.0)	10 (4.0)	8.8 (3.6)	11 (4.5)
Total Habitat Area of DoD Lands	21, 690 (8,778)	16,105 (6,517)	16,087 (6,510)	8,976 (3,632)	9,082 (3,654)
Total Habitat Area of Non-DoD Lands	0	12,550 (5,079)	11,037 (4,467)	40,588 (16,425)	2,640 (1,068)
Percentage of Habitat Area on Guam that is Removed (DoD and Non-DoD Lands)	0.05%	0.03%	0.04%	0.02%	0.09%

Note: Each habitat category is considered independently of others and is not an additive.
Legend: ac = acre; AFB = Air Force Base; DoD = Department of Defense; ha = hectare.

Guam Micronesian kingfisher. The kingfisher survives only in captivity at this time. Specific habitat areas would be removed under Basic Alternative 1, including Overlay Refuge and recovery habitat for the kingfisher (Figure 12.2-2a, Table 12.2-3). Based on the removal of 10 ac (4.0 ha) of recovery habitat that is also Overlay Refuge, there would be significant impacts to the kingfisher. Removal of these areas due to construction would have a significant impact on recovery habitat available for the species. The magnitude of the impacts would be reduced with a suite of actions described in Volume 6, Chapter 10, Section 10.2.2.6.

Guam rail. The rail survives only in captivity at this time. Proposed construction activities would include the loss of shrub/grassland habitat that is potential foraging and nesting habitat for the Guam rail. A total of 8.8 ac (3.6 ha) of recovery habitat would be removed. (Volume 6, Chapter 10, Figure 10.2-13b). Numerous mitigation measures, described in Volume 2, Chapter 10, Section 10.2.2.6, would be implemented to improve the likelihood that this species could eventually be reintroduced successfully to suitable habitat on Guam. Based on these measures and the presence of large areas of recovery habitat for the species throughout much of Guam, the proposed construction at the Andersen South and non-DoD lands would result in a less than significant impact to the species.

Micronesian starling. Several wells and connecting waterlines in the eastern cluster would be constructed in habitat of the Micronesian starling, a Guam-listed species (Figure 12.2-2b). The loss of small areas of habitat would result in less than significant impacts on this species.

Serianthes Tree. Although no individual trees would be affected, a total of 11 ac (4.5 ha) of recovery habitat for this tree species would be removed for construction of the various project components on Andersen AFB (Table 12.2-3). This removal action represents about 0.09% of the recovery habitat identified by USFWS for the species. Based on no impact to existing individual *Serianthes* and the low amount of habitat affected compared to the total habitat remaining for the species, impacts would be less than significant.

Mariana eight spot butterfly. The two host plant species for this butterfly were not observed in field work conducted in project areas in September 2009. Furthermore, these host plants are generally associated with primary limestone forest in areas of pinnacle karst (karren), which is not present in the project areas.

Therefore, it is unlikely the eight spot butterfly is present in the project area so removal of vegetation within these areas due to construction would have no impact on the species.

All special-status species. Other indirect effects on all species would occur as a result of the proposed construction. Movement of construction personnel, equipment, and supplies could result in the movement and spread of non-native plant and animal species to Guam, within Guam, and to other locations from Guam. Non-native species would affect special-status species or degrade habitat, thus are potential indirect impacts resulting from actions proposed in Basic Alternative 1. Special status species impacts may be significant but numerous mitigation measures, such as Hazard Analysis and Critical Control Point planning would be implemented to reduce impacts to less than significant.

Operation

Terrestrial biological resources would not be affected under this alternative because, once installed, the potable water lines and wells would require minimal maintenance.

Proposed Mitigation Measures

Impacts on special-status species recovery habitat resulting from proposed potable water projects would be mitigated with a suite of protection and conservation measures for all impacts on Guam described in Volume 2, Chapter 10, Section 10.2.2 for a description of these measures. Mitigation measures directly applicable to potential impacts from proposed potable water projects are summarized in Section 12.2.3.4 of this chapter. Best Management Practices (BMPs) that would be employed during all project construction and operations are described in Volume 7.

12.2.3.2 Basic Alternative 2

Basic Alternative 2 would provide additional water capacity of 11.7 MGd (44.3 MLd), which is anticipated to be met by an estimated 20 new wells at Andersen Air Force Base (AFB) and 11 new wells at Air Force Base Barrigada, rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 1.8 MG (6.8 ML) water storage tanks would be constructed at ground level at NCTS Finegayan and one 1 MG (3.8 ML) water storage tank would be construction at Air Force Base Barrigada. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

Indirect impacts on the GWA water system would be the same as described in Basic Alternative 1.

Andersen AFB and Andersen South

Construction

Vegetation. Impacts would be the same as those under Basic Alternative 1 except that two water wells and associated piping would not be installed. Acreages affected are listed in Table 12.2-4. Impacts would be less than significant because no primary limestone forest would be removed.

Special-Status Species. Impacts would be the same as those under Basic Alternative 1 except that two water wells and associated piping would not be installed so fewer habitats would be affected. Acreages affected are shown in Table 12.2-5.

Table 12.2-4. Potential Direct Impacts on Vegetation Communities with Implementation of Potable Water – Basic Alternative 2 (ac [ha])

Parcel and Activity	*Limestone Forest, Primary*	*Limestone Forest, Disturbed*	*Tangantangan or Casuarina*	*Shrub/ Grasslands, Savanna*	*Developed*
Andersen AFB					
Water Wells	0	2.1 (0.8)	0.2 (0.1)	0	1.4 (0.6)
Waterlines	0	11 (4.5)	0.4 (0.2)	0	16 (6.5)
Andersen South					
Waterlines	0	2.3 (0.9)	0	0.1 (0.04)	0.1 (0.04)
Navy Barrigada					
Water Wells and Waterlines	0.5 (0.2)*	0	0	2.8 (1.1)	9.8 (4.0)
Air Force Barrigada					
Water Storage Tank	0	0	0.8 (0.3)	0	0.1 (0.04)
Waterlines	0	0	1.0 (0.04)	0	1.1 (0.4)
Total area removed	**0.5 (0.2)**	**15 (6.1)**	**2.4 (1.0)**	**2.9 (1.2)**	**29 (12)**

Note: *This primary limestone forest removal is already accounted for in the development of the Army Cantonment in Volume 5, Alternative 2.

Legend: ac = acre; AFB = Air Force Base; ha = hectare.

Operation

Terrestrial biological resources would not be affected under this alternative because, once installed, the potable water lines, tanks, and wells would require minimal maintenance.

Table 12.2-5. Potential Impacts on Special-Status Species Habitat with Implementation of Potable Water – Basic Alternative 2 (ac [ha])

Parcel and Activity	*Overlay Refuge*	*Recovery Habitat – Bat and Kingfisher*	*Recovery Habitat – Crow*	*Recovery Habitat – Rail*	*Recovery Habitat – Serianthes*
Direct Impacts from Construction – Habitat Removed					
Andersen AFB					
Water Wells and Waterlines	11 (4.5)	0	0	4.7 (1.9)	0
Total area removed	**11 (4.5)**	0	0	4.7 (1.9)	0
Total Habitat Area - DoD Lands	21, 690 (8,778)	16,105 (6,517)	16,087 (6,510)	8,976 (3,632)	9,082 (3,654)
Total Habitat Area - Non-DoD Lands	0	12,550 (5,079)	11,037 (4,467)	40,588 (16,425)	2,640 (1,068)
% of Habitat Area on Guam that is Removed (DoD and Non-DoD Lands)	0.05%	0%	0%	0.01%	0%

Note: Each habitat category is considered independently of others and is not additive.

Legend: ac = acre; AFB = Air Force Base; DoD = Department of Defense; ha = hectare.

Barrigada

Construction

Vegetation. The vegetation associated with Navy and Air Force Barrigada components under Basic Alternative 2 that would be removed are listed in Table 12.2-4. Two water wells would be constructed within the limestone forest but they would be at the edge of the forest, near the road. Habitats near the roads are typically partially invaded by non-native species so the forest is of lower quality. Because of the size and location of the forest that would be removed, impacts on the primary limestone forest would be less than significant.

Wildlife. Wildlife species that currently occur at Barrigada are native and non-native species that are common elsewhere on Guam, such as Pacific golden plover, yellow bittern, island collared dove, western cattle egret, black francolin, Eurasian tree sparrow, blue-tailed skink, mutilating gecko, and mourning gecko. All these species are common on Guam. Proposed construction activities would displace wildlife from suitable habitat in the proposed project areas. Smaller, less mobile species, and those seeking refuge in burrows, could inadvertently be killed during construction activities; however, long-term, permanent impacts on populations of such species would be less than significant because these species are abundant in surrounding areas and would rapidly repopulate suitable portions of the affected area. Therefore, the impacts on wildlife would be less than significant.

Construction activities for the operation buildings would generate noise. Only a few, widespread migratory bird species are present that would be affected. They would move away from the construction areas but there are other areas of suitable habitat nearby. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Therefore, impacts on wildlife due to proposed construction activities would be less than significant under Basic Alternative 1.

Special-Status Species. Proposed construction activities at Navy and Air Force Barrigada would not impact any designated habitat areas. There would be no indirect impacts on special-status species. Species that would be directly affected are described below.

Guam tree snail. The Guam tree snail, an ESA candidate species, was documented in the primary limestone forest on one transect during site-specific surveys in 2008 in support of this EIS (see Figure 12.2-2a). The distribution and numbers of tree snails at the site is unknown. Proposed construction activities would remove 0.5 ac (0.2 ha) of primary limestone forest habitat. This area would be surveyed prior to removing vegetation and if present, tree snails would be relocated. With this mitigation, impacts would be less than significant.

Operation

Terrestrial biological resources would not be affected under this alternative because, once installed, the potable water lines, wells, and tanks would require minimal maintenance.

Proposed Mitigation Measures

Proposed mitigation measures for Andersen AFB, and Finegayan components would be the same as for Basic Alternative 1. Proposed mitigation for Navy Barrigada would be part of overall conservation measures that are described in Volume 2, Chapter 10 for Navy Barrigada. Mitigation measures directly applicable to potential impacts from proposed potable water projects are summarized in Section 12.2.3.4 of this chapter.

12.2.3.3 Summary of Impacts

Table 12.2-6 provides a summary of the potential impacts of each alternative.

Impacts would be less than significant to vegetation because no limestone forest would be removed. Impacts on wildlife would be less than significant because there would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Significant impacts would result from construction of water wells and waterlines at Andersen AFB because some of the areas where they would be placed is Overlay Refuge and identified recovery habitat for the Mariana fruit bat, Guam Micronesian kingfisher, and Mariana crow. These impacts would be mitigated to less than significant with measures described in this section and in Volume 2, Chapter 10.

Table 12.2-6. Summary of Potential Impacts on Terrestrial Biological Resources - Potable Water

*Basic Alternative 1**	*Basic Alternative 2*
Construction Impacts (direct with indirect impacts in parentheses if different)	
LSI • Less than significant impact to vegetation; no primary limestone forest would be removed. LSI • Less than significant impacts on wildlife. SI (SI-M) • Significant direct impacts due to removal of recovery habitat for several special-status species at Andersen AFB; habitat is also NWR Overlay; potential significant indirect impacts from noise and activity disturbance, mitigated to less than significant.	LSI • A minimal amount of primary limestone forest (0.5 ac [0.2 ha]) would be removed along the forest edge. LSI • Less than significant impacts on wildlife. SI (SI-M) • Significant direct impacts due to removal of recovery habitat for several special-status species at Andersen AFB; habitat is also NWR Overlay; potential significant indirect impacts from noise and activity disturbance, mitigated to less than significant. • Significant impacts at Navy Barrigada due to possible presence of the Guam tree snail in the area, mitigated to less than significant.
Operation	
NI • No impact to vegetation, wildlife, and special-status species.	NI • No impact to vegetation, wildlife, and special-status species.

Legend: ac = acre; AFB = Air Force Base; ha = hectare; LSI = Less than significant impact; NI = No impact; NWR = National Wildlife Refuge; SI = Significant impact; SI-M = Significant impact mitigable to less than significant. *Preferred Alternative.

12.2.3.4 Summary of Proposed Mitigation Measures

Table 12.2-7 provides a summary of the proposed mitigation measures of each alternative.

12.2.4 Wastewater

12.2.4.1 Basic Alternative 1a (Preferred Alternative)

Basic Alternative 1a supports the proposed Main Cantonment Alternatives 1 and 2 and combines upgrade to the existing primary treatment facilities and expansion to secondary treatment at the Northern District Wastewater Treatment Plant (NDWWTP). The difference between Alternatives 1a and 1b is a requirement for a new sewer line from Barrigada housing to NDWWTP for Alternative 1b.

Table 12.2-7. Summary of Proposed Terrestrial Biological Mitigation – Potable Water

Alternatives 1 and 2	*Alternative 2 Additional*	*No-Action Alternative*
Vegetation		
None specifically for vegetation.	None	None Necessary
Wildlife and Special-Status Species		
Develop the Micronesia Biosecurity Plan (see Volume 2, Chapter 10, Section 10.2.2.6)	Conduct pre-construction surveys in limestone forest within proposed water well footprint at Navy Barrigada and, if found, translocate Guam tree snails.	None Necessary
Use HACCP planning for construction projects (see Volume 2, Chapter 10, Section 10.2.2.6)		
Biological survey would be conducted for crows and bats before clearing (see Volume 2, Chapter 10, Section 10.2.2.6)		
Natural resource awareness briefings would be conducted for construction personnel (see Volume 2, Chapter 10, Section 10.2.2.6)		
The existing Navy Ungulate Management Plans would be updated to include the new lands to be used for training and cantonment areas and additional project-specific actions that would be necessary to ensure sensitive ecological resources are protected (see Volume 2, Chapter 10, Section 10.2.2.6)		
Establish or expand ecological reserves and conservation areas (see Volume 2, Chapter 10, Section 10.2.2.6)		

Legend: HACCP = Hazard Analysis and Critical Control Points.

Basic Alternatives 1a and 1b handle the increased demand from the direct DoD population increase. However, indirect impacts on the rest of the GWA sewage treatment systems would result from civilian population growth from the construction workforce, induced civilian growth, and regularly expected civilian growth. GWA would need to upgrade their sewer collection and treatment systems to properly meet this additional demand. The exact location of these upgrades would be up to GWA to specify. They do not have this need in their current resource management plan. Thus, the impact is currently impossible to assess. However, it appears that GWA would not be able to manage these improvements within the timeframe available. Thus, the wastewater system, except for the NDWWTP, would continue to not meet its National Pollutant Discharge Elimination System requirements and the collection systems would experience continued and additional overflow events. These affects would be at ocean outfalls.

Construction

Vegetation

Construction of a new sewer line from the Former FAA parcel to the NDWWTP would require a 24 feet (ft) (7.3 meter [m]) corridor approximately 8,300 ft (2,530 m) in length for a total of 4.6 ac (1.9 ha). The sewer line would follow trails that are evident on aerial photographs and traverse primarily through shrub/grassland and tangantangan habitat. Based on vegetation mapping by the U.S. Forest Service (2006), at most 1,000 ft (305 m) would traverse through disturbed limestone habitat; although, there are also open trails in through these areas that would be used for some of the pipeline corridor. Assuming the entire 1,000 ft (305 m) would need to be cleared, 0.6 ac (0.2 ha) disturbed limestone forest would be cleared, in addition to areas of shrub/grassland and tangantangan. Impacts from this removal would be less than significant because no primary limestone forest would be removed. Other sewer line installations or upgrades would occur along existing disturbed utility or roadway corridors and would result in a less than significant impact.

Wildlife

Based on studies by others and observations in other similar areas on the Former FAA parcel and South Finegayan, (discussed in Volume 2, Chapter 10, Section 10.1), the only native bird species likely to be present in the project areas are the yellow bittern and possibly the Pacific golden plover in open areas; both species are ubiquitous throughout Guam. The GDAWR has noted in comments on the Draft EIS that the area serves as a refuge for breeding yellow bitterns. Native species of skinks and geckos have not been reported in nearby project areas and were not observed in surveys conducted in project areas for this EIS (Naval Facilities Engineering Command [NAVFAC] Pacific 2010).

Proposed construction activities would displace the yellow bittern and other wildlife from suitable habitat in the proposed project areas. Smaller, less-mobile species and those seeking refuge in burrows could inadvertently be killed during construction activities; however, long-term, permanent impacts on populations of such species would be less than significant because the species are abundant in surrounding areas. DoD would minimize impacts on all migratory birds during the project. Due to the ubiquitous nature of the yellow bittern, per numerous reports and our field observations during project field studies, the proposed removal of habitat is not expected to adversely affect the population of yellow bitterns on Guam. Overall, there would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Therefore, impacts on wildlife due to proposed construction activities would be less than significant under Alternative 1a.

Special-Status Species

No special-status species have been identified in the area of proposed new gravity sewer in recent studies or in recent project-specific surveys in similar nearby areas at South Finegayan and Former FAA parcel (NAVFAC Pacific 2010). However, recovery habitat for the Guam rail has recently been mapped by the USFWS in the area. Proposed construction would primarily be along existing cleared corridors and would not reduce the amount of shrubby edge habitat that is preferred habitat of the Guam rail. Impacts on the Guam rail would be less than significant. Other sewer line installations or upgrades would occur along existing disturbed utility or roadway corridors and would result in a less than significant impact. There would be no impacts on other special-status species.

Operation

Terrestrial biological resources would not be affected under this alternative as proposed activities involve only upgrades to existing facilities and infrastructure and sewer pipelines would be placed underground.

12.2.4.2 Basic Alternative 1b

Basic Alternative 1b supports proposed Main Cantonment Alternatives 3 and 8 combines upgrade to the existing primary treatment facilities and expansion to secondary treatment at the NDWWTP. Under Basic Alternative 1b, the existing primary treatement system at NDWWTP would be refurbished and upgraded to accept additional wastewater flow and load from both central and northern Guam, and new sewer lines and lift pump stations. In addition to the sewer line proposed in Basic Alternative 1a, a new sewer line and pump stations would be installed to convey wastewater generated from Barrigada housing to the NDWWTP.

Indirect impacts are the same as described above under Basic Alternative 1a Construction

Vegetation

Construction of a new sewer line from the Former FAA parcel to the NDWWTP and a new force main from the NDWWTP to the southeast where it would intersect road corridors would require a 24 ft (7.3 m) corridor approximately 15,000 ft (4,572 m) in length for a total of 8.3 ac (3.3 ha). The sewer line would follow trails that are evident on aerial photographs and traverse primarily through shrub/grassland and tangantangan habitat. Based on vegetation mapping by the U.S. Forest Service (2006), at most 1,000 ft (305 m) would traverse through disturbed limestone habitat in the northern segment, although there are also open trails in through these areas that would be used for some of the pipeline corridor. Assuming the entire 1,000 ft (305 m) would need to be cleared, 0.6 ac (0.2 ha) disturbed limestone forest would be cleared, in addition to areas of shrub/grassland and tangantangan. Impacts from this removal would be less than significant because no primary limestone forest would be removed. Other sewer line installations or upgrades would occur along existing disturbed utility or roadway corridors and would result in a less than significant impact.

Wildlife

Based on studies by others and observations in other similar areas on the Former FAA parcel and South Finegayan, (discussed in Volume 2, Chapter 10, Section 10.1), the only native bird species likely to be present in the project areas are the yellow bittern and possibly the Pacific golden plover in open areas; both species are ubiquitous throughout Guam. The GDAWR has noted in comments on the Draft EIS that the area serves as a refuge for breeding yellow bitterns. Native species of skinks and geckos have not been reported in nearby project areas and were not observed in surveys conducted in project areas for this EIS (NAVFAC Pacific 2010).

Proposed construction activities would displace the yellow bittern and other wildlife from suitable habitat in the proposed project areas. Smaller, less-mobile species and those seeking refuge in burrows could inadvertently be killed during construction activities; however, long-term, permanent impacts on populations of such species would be less than significant because the species are abundant in surrounding areas. DoD would minimize impacts on all migratory birds during the project. Due to the ubiquitous nature of the yellow bittern on Guam, per numerous reports and our field observations during project field studies, the proposed removal of habitat is not expected to adversely affect the population of yellow bitterns on Guam. Overall, there would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Therefore, impacts on wildlife due to proposed construction activities would be less than significant under Alternative 1b.

Special-Status Species

No special-status species have been identified in the area of proposed new gravity sewer or force main in recent studies or in recent project-specific surveys in similar nearby areas at South Finegayan and Former FAA parcel (NAVFAC Pacific 2010). However, recovery habitat for the Guam rail has recently been mapped by the USFWS in the area. Proposed construction would be along existing cleared corridors in many areas and overall would not reduce the amount of shrubby edge habitat that is preferred habitat of the Guam rail. Other sewer line installations or upgrades would occur along existing disturbed utility or roadway corridors and would result in a less than significant impact. Impacts on the Guam rail would be less than significant.

Operation

Terrestrial biological resources would not be affected under this alternative as proposed activities involve only upgrades to existing facilities and infrastructure, sewer pipelines would be placed underground, and the pump station would be located within already developed area.

12.2.4.3 Summary of Impacts

Table 12.2-8 summarizes the potential impacts of each alternative.

Table 12.2-8. Summary of Potential Impacts on Terrestrial Biological Resources – Wastewater

*Basic Alternative 1a**	*Basic Alternative 1b*
Construction Impacts (there are direct impacts only)	
VG – LSI • Less than significant impacts on vegetation WF – LSI • Less than significant impacts on wildlife SS – LSI • Less than significant impacts on special-status species	VG – LSI • Less than significant impacts on vegetation WF – LSI • Less than significant impacts on wildlife SS – LSI • Less than significant impacts on special-status species
Operation Impacts	
VG, WF, SS – NI • No impact	VG, WF, SS – NI • No impact

Legend: LSI = Less than significant impact; NI = No impact; SS = Special-Status Species; VG = Vegetation; WF = Wildlife. *Preferred Alternative.

Installation of a new sewer line from Former FAA parcel to the NDWWTP would traverse disturbed and developed vegetation in areas with wildly distributed wildlife species so impacts would be less than significant. No special-status species or recognized habitat areas are in the area so there would be no impact.

12.2.5 Solid Waste

12.2.5.1 Basic Alternative 1 (Preferred Alternative)

The Preferred Alternative would be to continue to use the Navy landfill at Apra Harbor for municipal solid waste (MSW) until the new Government of Guam (GovGuam) Layon landfill at Dandan is available for use. Disposal of other waste streams excluded from Layon landfill would continue at the Navy landfill. Construction and demolition (C&D) debris would continue to be disposed at the Navy hardfill.

The existing Navy landfill and landfill extent would be used and not expanded until the GovGuam landfill was ready. Since operations would not change substantially from present conditions, terrestrial biological resources would not be affected under this alternative. The proposed Layon landfill and its impacts were analyzed in a separate EIS by the GovGuam.

12.2.5.2 Summary of Impacts

Table 12.2-9 summarizes the potential impacts of Alternative 1.

Table 12.2-9. Summary of Potential Impacts on Terrestrial Biological Resources – Solid Waste

Basic Alternative 1
Construction and Operation
VG, WF, SS – NI • No impact

Legend: NI = No impact; VG = Vegetation; WF = Wildlife; SS = Special-Status Species.

There would be no impacts on any terrestrial biological resources because the proposed alternative involves no expansion of the fill area of the existing Navy landfill that would be used until the new GovGuam landfill opens. No special-status species are known to reside in the area of the landfill. The proposed Layon landfill and its impacts were analyzed in a separate EIS by the GovGuam.

12.2.6 Off Base Roadways

As discussed in Volume 6, Chapter 2, Section 2.5, some Guam Road Network (GRN) projects involve road widening, bridge and culvert replacements, new road construction or roadway realignment, and pavement strengthening projects (some pavement strengthening projects can include road widening).This section addresses the potential direct and indirect impacts of the proposed GRN projects to terrestrial biological resources and also describes mitigation measures to avoid or minimize these potential impacts. Each project included under the alternatives described in Volume 6, Chapter 2, Section 2.5 is analyzed below and grouped by each region (North, Central, Apra Harbor, and South). The type and duration of the impact may vary depending on the project location and the project description. For instance, projects that involve pavement strengthening would occur within the existing roadway corridor on previously developed surfaces and no direct impacts on terrestrial biological resources are anticipated; however, surrounding areas outside of the roadway corridor may be subject to indirect impacts associated with runoff during the construction phase of the pavement strengthening activity. Other project types may potentially directly or indirectly impact terrestrial biological resources. Potential runoff impacts would be addressed with BMPs. Table 12.2-10 describes the direct and indirect impacts for each type of roadway project (non-widening pavement strengthening, intersection improvements, projects that require vegetation removal [e.g., roadway widening, new road construction, and roadway realignment projects], military access point modification or construction, and bridge and culvert replacements). Table 12.2-11 describes potential direct and indirect impacts for each roadway improvement project within the North Region. Table 12.2-12, Table 12.2-13, and Table 12.2-14 describe the same information for projects within the Central, Apra Harbor, and South regions, respectively.

Table 12.2-10. GRN Project Type and Potential Impacts on Terrestrial Biological Resources

Project Type [1]	*Type of Impact Evaluated*	*Potential Impact Description* [2]
Pavement Strengthening	Indirect impacts during construction phase	Uncontrolled runoff may impact downstream or downgradient vegetation communities, wildlife, and special status species that utilize these areas during the construction phase. Construction noise may disturb special status species and wildlife within the vicinity of construction activity.
Intersection Improvements		
Roadway Widening, New Road Construction (Finegayan Connection), Military Access Point Modifications / Construction, &Road Realignment (Route 15)	Direct impacts	Removal of vegetation. Some vegetation may support special status species habitat, and displacement of wildlife.
	Indirect impacts-construction phase	Uncontrolled runoff may impact downgradient vegetation communities, wildlife, and special status species that utilize these areas during the construction phase. Construction noise may disturb special status species and wildlife within the vicinity of construction activity.
	Indirect impacts-operational phase	Additional impervious cover would contribute runoff to adjacent terrestrial habitats. Increased potential for wildland fires and non-native invasive species encroachment along new edges.
Bridge and Culvert Replacements (Agana, Aguada, Asan #1, Asan #2, Atantano, Fonte, Laguas, & Sasa Bridges)	Direct impacts	Removal of vegetation on streambed slopes adjacent to bridge and culvert structures. Disturbance of aquatic habitats under and adjacent to the bridge structures during construction.
	Indirect impacts-construction phase	Uncontrolled runoff may impact downstream aquatic communities, wildlife, and special status species that utilize these areas during the construction phase. Construction noise may disturb special status species and wildlife within the vicinity of the bridge replacement.
	Indirect impacts-operational phase	Alteration of the hydraulic conveyance due to the new bridge design may impact downstream aquatic habitats.

Notes:

[1] The GRN project descriptions and alternatives are included in Volume 6, Chapter 2, Section 2.

[2] Mitigation measures are included later in this chapter that minimize or avoid potential direct or indirect impacts.

Legend: GRN = Guam Road Network.

Table 12.2-11. North Region GRN Projects, Alternatives, and Potential Impacts

GRN #	*Alternatives*[1]				*Potential Impact Type and Description*[2]	
	1	*2*	*3*	*8*	*Indirect*	*Direct*
8	x	x	x	x	Runoff during the construction phase for this project and construction noise in areas north of Okkodo School (e.g., Navy Refuge Overlay unit).	***None:*** This project does not require widening, only pavement strengthening, to modify the access to Okkodo High School on the interior portion of the road.
9	x	x	x	x	Runoff during the construction phase for this project and construction noise in areas west of Route 3 (e.g., Navy Refuge Overlay unit and Andersen AFB Refuge Overlay unit). Increased potential for non-native invasive species encroachment and wildland fires along new edges after construction.	Wildlife displacement and removal of vegetation communities through the road widening areas from NCTS Finegayan to Route 28 along Route 3, including Navy Refuge Overlay lands, recovery habitat areas, and lands designated as recovery zones.
10	x	x	x	x		Wildlife displacement and removal of vegetation communities through the road widening areas from NCTS Finegayan to Route 9 along Route 3.
22	x	x	x	x	Runoff during the construction phase for this project and construction noise in areas north of Route 9 (e.g., Andersen AFB Refuge Overlay units). Increased potential for non-native invasive species encroachment and wildland fires along new edges after construction.	Wildlife displacement and removal of vegetation communities through the road widening areas from Route 3 to the proposed Andersen AFB North Gate along Route 9.
22A	X	x	x	x	Runoff during the construction phase for the medians and shoulders and construction noise in areas north of Route 9 (e.g., Andersen AFB Refuge Overlay units).	Although this project is a pavement strengthening project, medians and shoulders would be added, that would expand the project footprint into forested areas of Andersen AFB along Route 9 between the Andersen AFB North Gate and the Andersen AFB Main Gate.
23	x	x	x	x	Runoff during the construction phase for these projects and construction noise in areas north of Route 9 (e.g., Andersen AFB Refuge Overlay units). Increased potential for non-native invasive species encroachment and wildland fires along new edges after construction.	***None:*** This project does not require widening, only pavement strengthening, from Chalan Lujuna to Route 9.
38		x	x			These MAP projects would require the removal of limestone forest within recovery habitat areas for the Mariana crow, Mariana fruit bat, and Micronesian kingfisher.
38A	x			x		
39		x	x			These MAP projects would require the removal of limestone forest within recovery habitat areas for the Mariana crow, Mariana fruit bat, and Micronesian kingfisher.
39A	x			x		
41		x				These MAP projects would require the removal of limestone forest within recovery habitat areas for the Mariana crow, Mariana fruit bat, and Micronesian kingfisher.
41A	x			x		
42	x	x	x	x		This MAP project, although within limestone forests, was analyzed as part of the Intelligence, Surveillance, and Reconnaissance/Strike Final EIS (Andersen AFB 2006).

GRN #	*Alternatives*[1]				*Potential Impact Type and Description*[2]	
	1	*2*	*3*	*8*	*Indirect*	*Direct*
57	x	x	x	x	Runoff during the construction phase for these projects.	This road widening project would require the removal of scrub forest vegetation that may contain important resources for the recovery of special-status species.
117	x	x	x	x		***None:*** This intersection project would occur in previously developed lands with no disturbance to vegetation communities other than urban cultivated areas.
124	x	x		x	Runoff during the construction phase for this project and construction noise in areas along the new road corridor (e.g., Navy Refuge Overlay unit). Increased potential for non-native species encroachment and wildland fires along new edges after construction.	The Finegayan connector road would require clearing through limestone forest, scrub forests, and tangantangan thickets. Although most of the road corridor is through previously developed areas, the limestone and scrub forest communities may contain important resources for the recovery of special-status species.

Notes:

[1] The GRN project descriptions and alternatives are described in detail in Volume 6, Chapter 2, Section 2.5.

[2] Mitigation measures are included later in this chapter that minimize or avoid potential direct or indirect impacts.

Legend: AFB = Air Force Base; GRN = Guam Road Network; MAP = Military Access Point; NCTS = Naval Computer and Telecommunications Station.

Table 12.2-12. Central Region GRN Projects, Alternatives, and Potential Impacts

GRN #	*Alternatives* [1]				*Potential Impact Type and Description* [2]	
	1	*2*	*3*	*8*	*Indirect*	*Direct*
1	x	x	x	x	***None:*** The proposed intersection improvement for Route 1 and 8 (GRN # 1) and Route 1 and 3 (GRN # 2) would occur in a previously developed commercial area in Hagatna. Runoff or construction noise would not impact terrestrial biological resources (i.e., vegetation communities, wildlife, or special-status species).	***None:*** Intersection improvements Routes 1/8 and Routes 1/3 on previously cleared land in developed areas and would not directly impact terrestrial biological resources.
2	x	x	x	x		
3	x	x	x	x	Potential sedimentation along the 260 feet (80 meter) streambed of the Agana River between Agana Bridge and the river terminus (between East Hagatna Beach and Paseo de Susana Park).	The Agana bridge replacement occurs over riverine aquatic habitat away from sea turtle nesting and other special status species locations; therefore, no direct impacts on special status species. Construction activities would remove vegetation and alter aquatic habitats in the immediate project footprint.
6	x	x	x	x	***None:*** The proposed road widening would occur in previously developed mixed commercial / light industrial areas (e.g., Tumon Tank Farm). Runoff or construction noise would not impact terrestrial biological resources.	***None:*** Construction (road-widening) on previously cleared land and would not impact terrestrial biological resources.
7	x	x	x	x	***None:*** The proposed road widening would occur in previously developed mixed commercial / light industrial areas (e.g., Micronesia Mall). Runoff or construction noise would not impact terrestrial biological resources.	

GRN #	*Alternatives* [1]				*Potential Impact Type and Description* [2]	
	1	*2*	*3*	*8*	*Indirect*	*Direct*
11	x	x	x	x	***None:*** The proposed roadway improvement along Chalan Lujuna would occur in residential areas (e.g., Perez Acres subdivision). Potential runoff or noise would not impact terrestrial biological resources.	***None:*** This project does not require widening, only pavement strengthening, from Route 1 to Route 15 along Chalan Lujuna to improve flow for truck traffic.
12	x	x	x	x	Runoff during the construction phase for this project. Special status species are not expected to utilize the area, so construction noise would not impact special status species.	***None:*** This project does not require widening, only pavement strengthening, from the Smith Quarry to Chalan Lujuna on Route 15 to Route 3 along Chalan Lujuna.
13	x	x	x	x	Runoff during the construction phase for this project, particularly into Asan River. Special status species are not expected to utilize the area, so construction noise would not impact special status species.	***None:*** These projects do not require widening, only pavement strengthening along Route 1 from 11 to Asan Bridge (GRN # 13), Asan Bridge to Route 6 (GRN # 14), and Route 6 to Route 4.
14	x	x	x	x		
15	x	x	x	x		
16	x	x	x	x	***None:*** The proposed roadway improvements along Route 8 would occur in commercial (Home Depot) and industrial (Airport) areas. Potential runoff or noise would not impact terrestrial biological resources.	***None:*** These projects do not require widening, only pavement strengthening from Tiyan Parkway to Route 1 along Route 8 (GRN # 16) and Route 10 to Tiyan Parkway (GRN # 17).
17	x	x	x	x		
18	x	x	x	x	***None:*** The proposed roadway improvements along Route 8 would occur in commercial areas (e.g., Harmon Flea Market, Compadres Mall) and industrial areas (e.g., Guam Power Authority substations). Potential runoff or noise would not impact terrestrial biological resources.	***None:*** These projects do not require widening, only pavement strengthening along Route 16 from Route 27 to Route 10A (GRN # 18), Route 10A to Sabana Barrigada Drive (GRN # 19), Sabana Barrigada Drive to Route 8/10 (GRN # 20).
19	x	x	x	x		
20	x	x		x		
21	x	x	x	x	***None:*** The proposed roadway improvements along Route 27 would occur in commercial areas (e.g., Compadres Mall), residential areas (e.g., Las Palmas Subdivision), and recreational areas (e.g., Robbie Webber Soccer Field). Potential runoff or noise would not impact terrestrial biological resources.	***None:*** This project does not require widening, only pavement strengthening along Route 27.
28	x	x	x	x	***None:*** The proposed roadway improvements along Route 26 would occur in commercial areas (e.g., Dededo Mall), and residential areas (e.g., Summer Place Subdivision). Potential runoff or noise would not impact terrestrial biological resources.	***None:*** This project does not require widening, only pavement strengthening along Route 26 between Route 1 and route 15.
29	x	x	x	x	***None:*** The proposed roadway improvements along Route 25 would occur in residential areas, and some open fields of tangantangan of no value to special status species or wildlife resources.	***None:*** Although road widening is necessary for this project, the project occurs in previously developed areas and would not impact terrestrial biological resources.

GRN #	*Alternatives* [1]				*Potential Impact Type and Description* [2]	
	1	*2*	*3*	*8*	*Indirect*	*Direct*
30	x	x	x	x	***None:*** The proposed roadway improvements along Route 10 would occur in residential areas, and some open fields of tangantangan of no value to special status species or wildlife resources.	***None:*** This project does not require widening, only pavement strengthening along Route 10 between Route 15 and route 18.
31	x	x		x	***None:*** The proposed roadway improvements along Route 10 would occur in residential areas, and some open fields of tangantangan of no value to special status species or wildlife resources.	***None:*** This project does not require widening, only pavement strengthening along Route 8A between Route 16 and the NAVCAMS Barrigada.
32	x	x	x	x	***None:*** The proposed roadway improvements along this section of Route 15 would occur along residential areas, recreational areas (Navy recreational fields), and open fields of tangantangan of no value to special status species or wildlife resources.	***None:*** This project does not require widening, only pavement strengthening and intersection improvements along Route 15 between Route 10 to Chalan Lujuna.
33	x	x	x	x	Portions of the proposed roadway improvements along Route 1 are adjacent to Asan Bay and Hagatna beaches; however, sea turtle nesting is not known to occur here. Potential for runoff into Agana River and stormwater drainages that terminate into Tumon Bay and Tumon Bay Marine Preserve.	***None:*** This project does not require widening, only pavement strengthening and intersection improvements along Route 1 between Route 8 to Route 13.
35	x	x	x	x	Potential sedimentation between each bridge and the spanned river terminus. Aguada, Laguas Bridge, and Sasa Bridge replacements are upstream of mangrove and estuarine areas of Sasa Bay Marine Preserve. These habitats are not preferred Mariana common moorhen habitat, but may occasionally support foraging habitat for this species.	The bridges proposed for replacement occur over riverine aquatic habitats that may directly or indirectly impact wetland communities within the drainage. Furthermore, these areas may represent Mariana common moorhen habitat.
36	x	x	x	x	Runoff during the construction phase for this project and construction noise in areas, primarily to the south (downgradient) of the proposed route. Increased potential for non-native species encroachment and wildland fires along new edges after construction.	The relocation of Route 15 would require clearing through limestone forest, scrub forests, and tangantangan thickets. Although most of the road corridor is through previously developed areas, the limestone and scrub forest communities may contain important resources for the recovery of special-status species.
44	x	x	x	x	***None:*** The proposed MAP improvement would occur in previously developed and degraded areas of Andersen South. Runoff or construction noise would not impact terrestrial biological resources.	***None:*** This MAP project would occur in previously developed lands with no disturbance of vegetation communities other than degraded tangantangan thickets.
46	x	x	x	x		

GRN #	*Alternatives*[1]				*Potential Impact Type and Description*[2]	
	1	*2*	*3*	*8*	*Indirect*	*Direct*
47			x		***None:*** The proposed MAP improvement would occur in a previously developed and degraded area of Barrigada (Navy). Runoff or construction noise would not impact terrestrial biological resources.	***None:*** These MAP projects would occur in previously developed lands with no disturbance of vegetation communities other than urban cultivated areas.
48			x			
49			x		***None:*** The proposed MAP improvement would occur in a previously developed and degraded area of Barrigada (Air Force). Runoff or construction noise would not impact terrestrial biological resources.	***None:*** These MAP projects would occur in previously developed lands with no disturbance of vegetation communities other than urban cultivated areas in the vicinity of Barrigada (Air Force).
49A			x	x		
63			x			
74			x			
113	x	x	x	x		

Notes:

[1] The GRN project descriptions and alternatives are described in detail in Section 2.5 of this Volume.

[2] Mitigation measures are included later in this chapter that minimize or avoid potential direct or indirect impacts.

Legend: GRN = Guam Road Network; MAP = Military Access Point; NAVCAMS = Naval Communication Area Master Station

Table 12.2-13. Apra Harbor GRN Projects, Alternatives, and Potential Impacts

GRN #	*Alternative*[1]				*Potential Impact Type and Description*[2]	
	1	*2*	*3*	*8*	*Indirect*	*Direct*
4	x	x	x	x	***None:*** The proposed MAP improvement would occur in a previously developed and degraded area along Route 11. Runoff or construction noise would not impact terrestrial biological resources.	***None:*** The proposed improvements along Route 11 between the commercial port and Route 1 (GRN # 4) do not require road widening (only pavement strengthening); therefore, no terrestrial biological resources would be affected because all work would be confined within the existing road corridor. The addition of the weigh station would require some vegetation removal (tangantangan thickets and grasses), but there are no biological resources along Route 11 that would be affected by the proposed project. The Route 11 and Route 1 intersection improvement (GRN #5) would be constructed on grounds that have been previously cleared and would not impact terrestrial biological resources.
5	x	x	x	x		
24	x	x	x	x	Portions of the proposed roadway improvements along Route 1 are adjacent to Sasa Bay Marine Preserve (on the west side of Route 1) and freshwater wetlands (on the east side of Route 1). Potential for runoff during the construction phase into Sasa Bay and Sasa River, Laguas River, Aguada River, and Atantano River, which terminate at Sasa Bay or Inner Apra Harbor.	***None:*** These projects do not require road widening (only pavement strengthening); therefore, no terrestrial biological resources would be affected because all work would be confined within the existing road corridor with no gain in impervious cover.

GRN #	*Alternative* [1]				*Potential Impact Type and Description* [2]	
	1	*2*	*3*	*8*	*Indirect*	*Direct*
26	x	x	x	x	Portions of the proposed roadway improvements along Route 2A are adjacent freshwater wetlands formed by the Atantano River. Potential for runoff during the construction phase into the wetlands and other stormwater drainages that terminate at Inner Apra Harbor.	***None:*** These projects do not require road widening (only pavement strengthening); therefore, no terrestrial biological resources would be affected because all work would be confined within the existing road corridor with no gain in impervious cover.
50	x	x	x	x	***None:*** The proposed MAP improvement would occur in a previously developed and degraded area of Naval Base Guam. Runoff or construction noise would not impact terrestrial biological resources.	***None:*** This MAP project would occur in previously developed lands with no disturbance of vegetation communities around the proposed location at Naval Base Guam.

Notes:

[1] The GRN project descriptions and alternatives are described in detail in Section 2.5 of this Volume.

[2] Mitigation measures are included later in this chapter that minimize or avoid potential direct or indirect impacts.

Legend: GRN = Guam Road Network; MAP = Military Access Point.

Table 12.2-14. South Region GRN Projects, Alternatives, and Potential Impacts

GRN #	*Alternatives* [1]				*Potential Impact Type and Description* [2]	
	1	*2*	*3*	*8*	*Indirect*	*Direct*
25	x	x	x	x	Although most of the portions of the proposed roadway improvements along Route 5 are adjacent to residential areas (e.g., Apra Heights), some portions have potential for construction runoff into freshwater wetlands formed by the Namo River near the Agat Commercial Center. The Namo River terminates at Agat Bay.	***None:*** These projects do not require widening, only pavement strengthening along Route 5 from Route 2A to Route 17 (GRN # 25), and Route 17 to the NMS. (GRN # 27).
27	x	x	x	x		
52	x	x	x	x	Potential for runoff during the construction phase into upper reaches of the Namo River.	***None:*** This MAP project at NMS would occur in previously disturbed lands with no disturbance of vegetation communities other than degraded tangantangan thickets.
110	x	x	x	x	***None:*** The proposed intersection improvement for Route 2 and 12 would occur near commercial and light industrial areas (e.g., Agat Commercial Center). Runoff or noise during the construction phase would not impact terrestrial biological resources.	***None:*** The Route 2 and Route 12 intersection improvement would be constructed on grounds that have been previously cleared and would not impact terrestrial biological resources.

Notes:

[1] The GRN project descriptions and alternatives are described in detail in Volume 6, Chapter 2, Section 2.5.

[2] Mitigation measures are included later in this chapter that minimize or avoid potential direct or indirect impacts.

Legend: GRN = Guam Road Network.

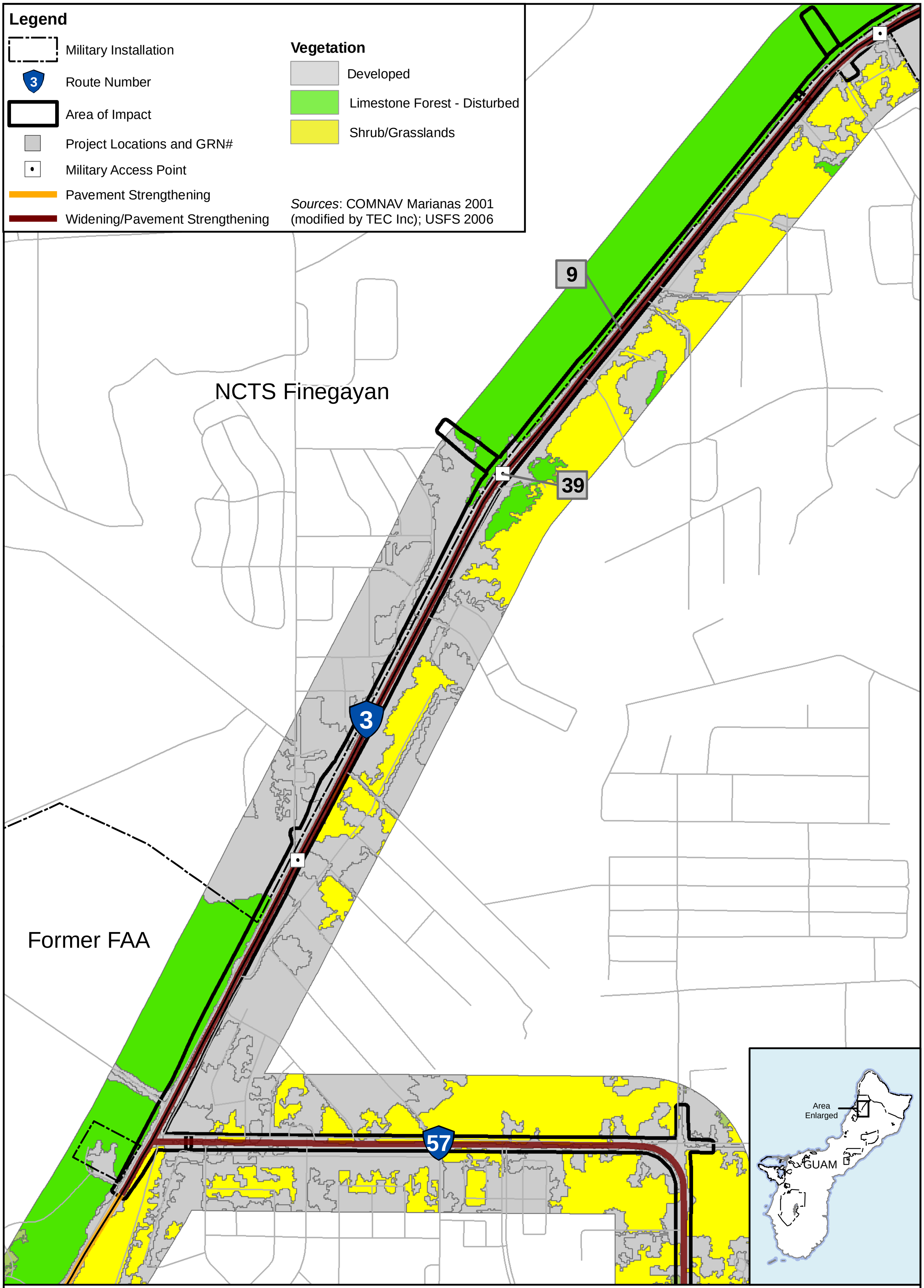

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Figure 12.2-3
GRN Projects in the North Region Considered for Analysis - Map 1

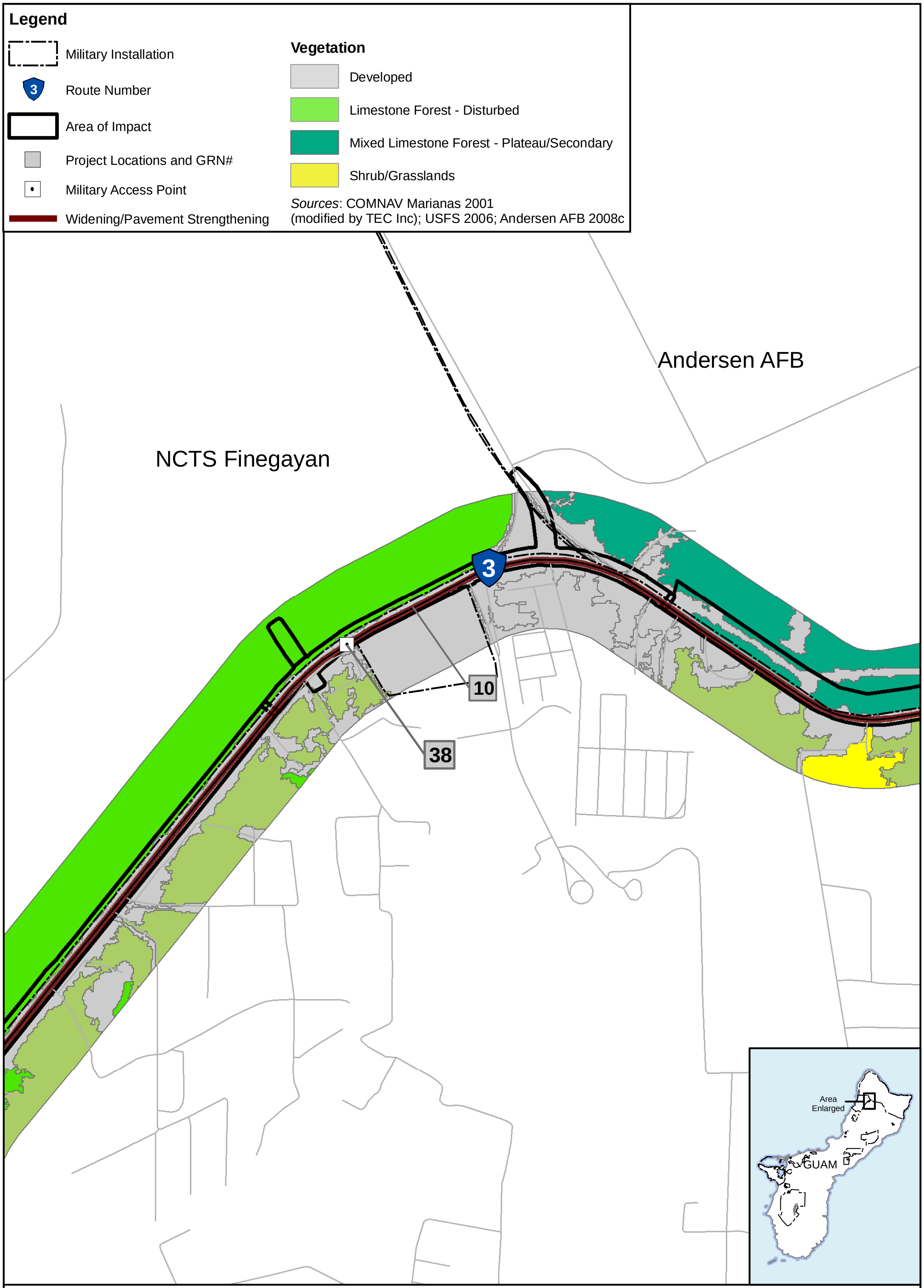

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Figure 12.2-4
GRN Projects in the North Region Considered for Analysis - Map 2

Feet
0 630 1,260
0 175 350
Meters

N W E S

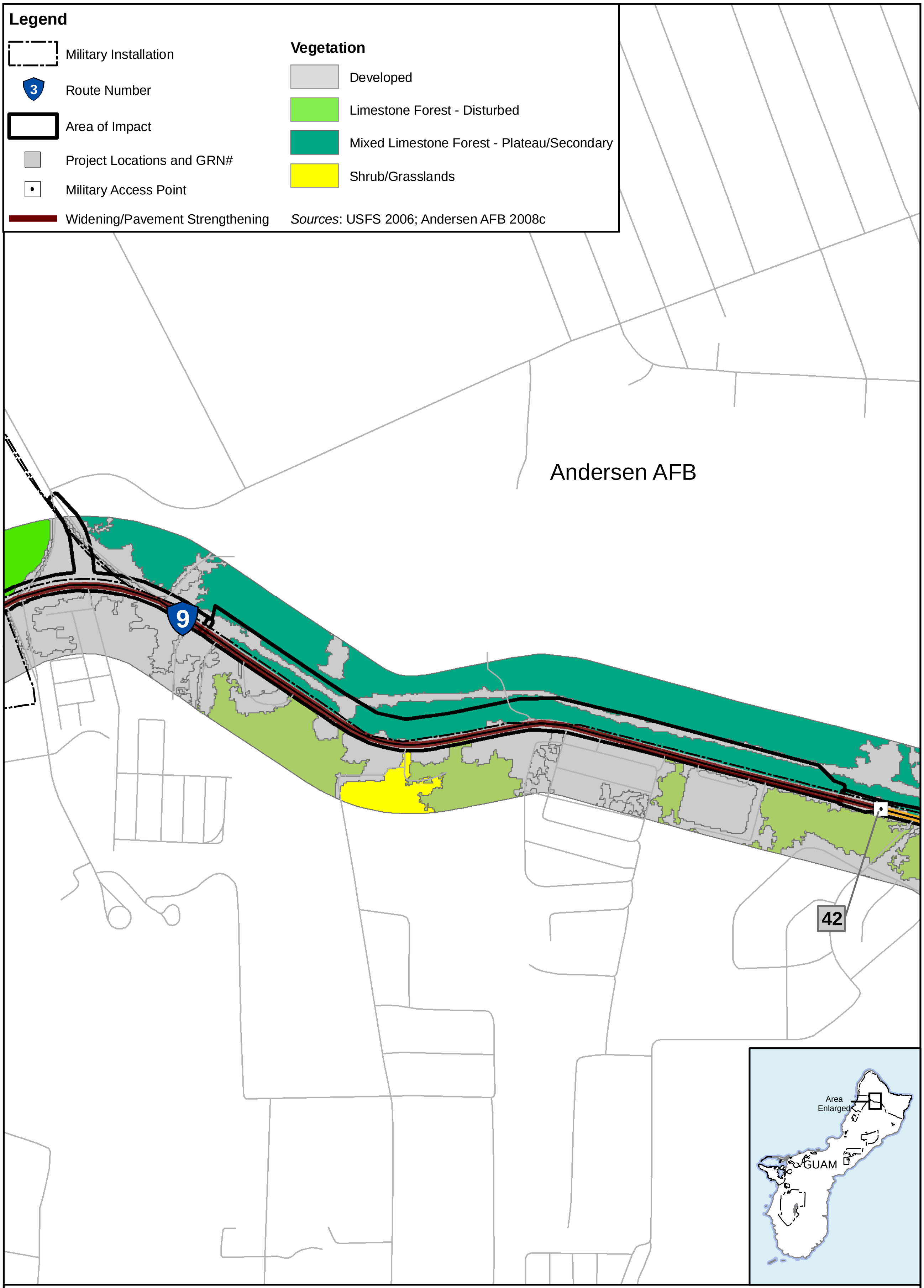

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Figure 12.2-5
GRN Projects in the North Region Considered for Analysis - Map 3

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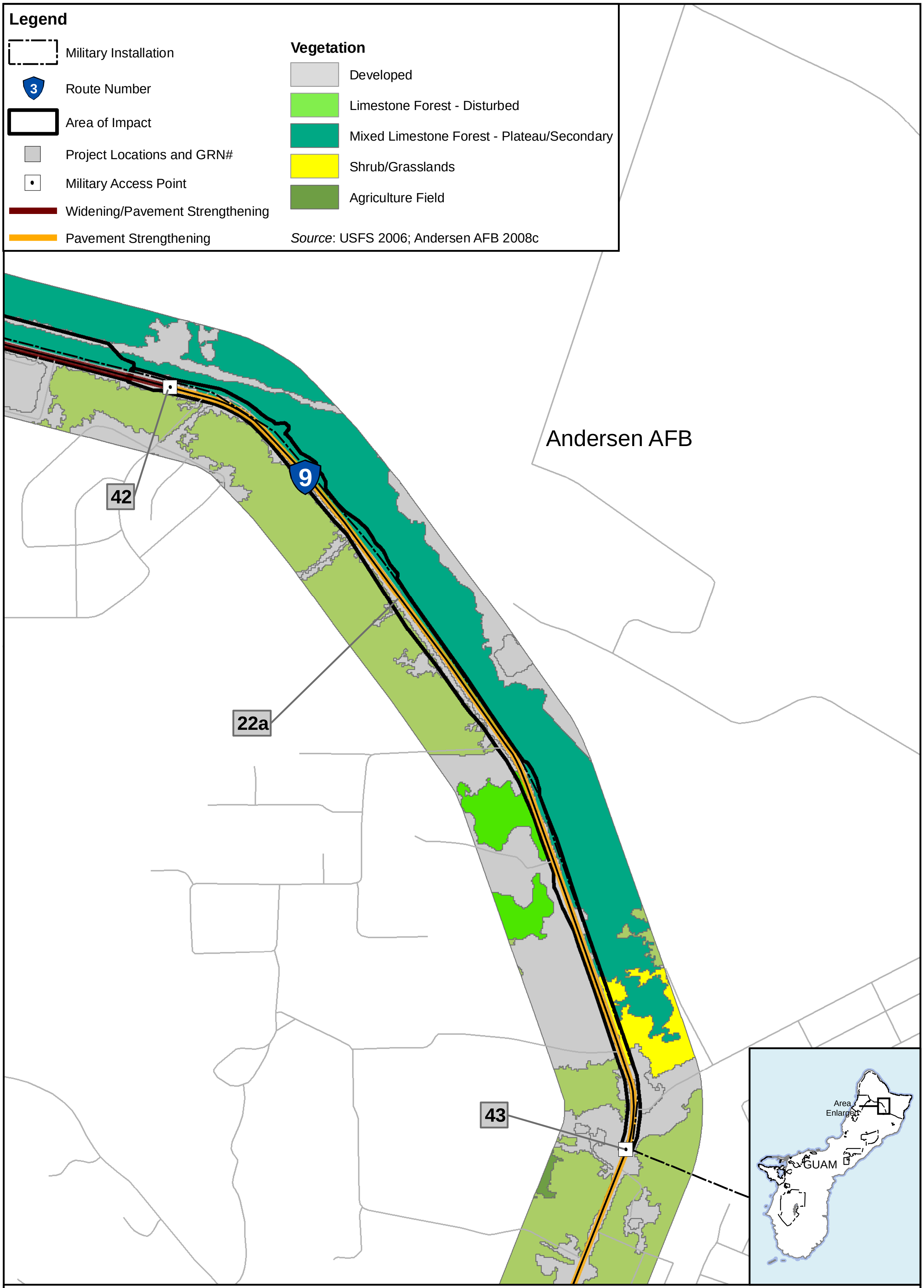

Source: USFS 2006; Andersen AFB 2008c

Figure 12.2-6
GRN Projects in the North Region Considered for Analysis - Map 4

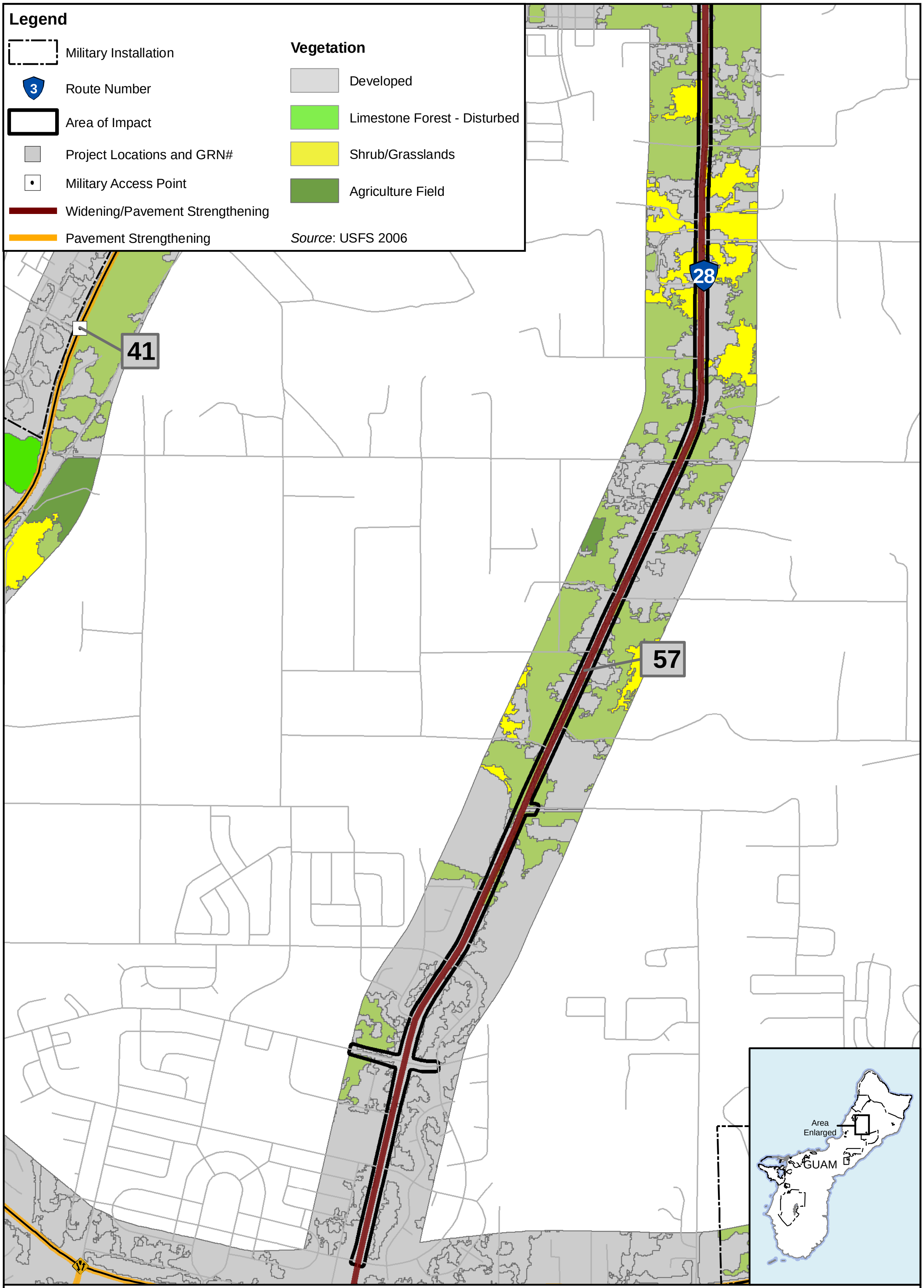

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Figure 12.2-7
GRN Projects in the North Region Considered for Analysis - Map 5

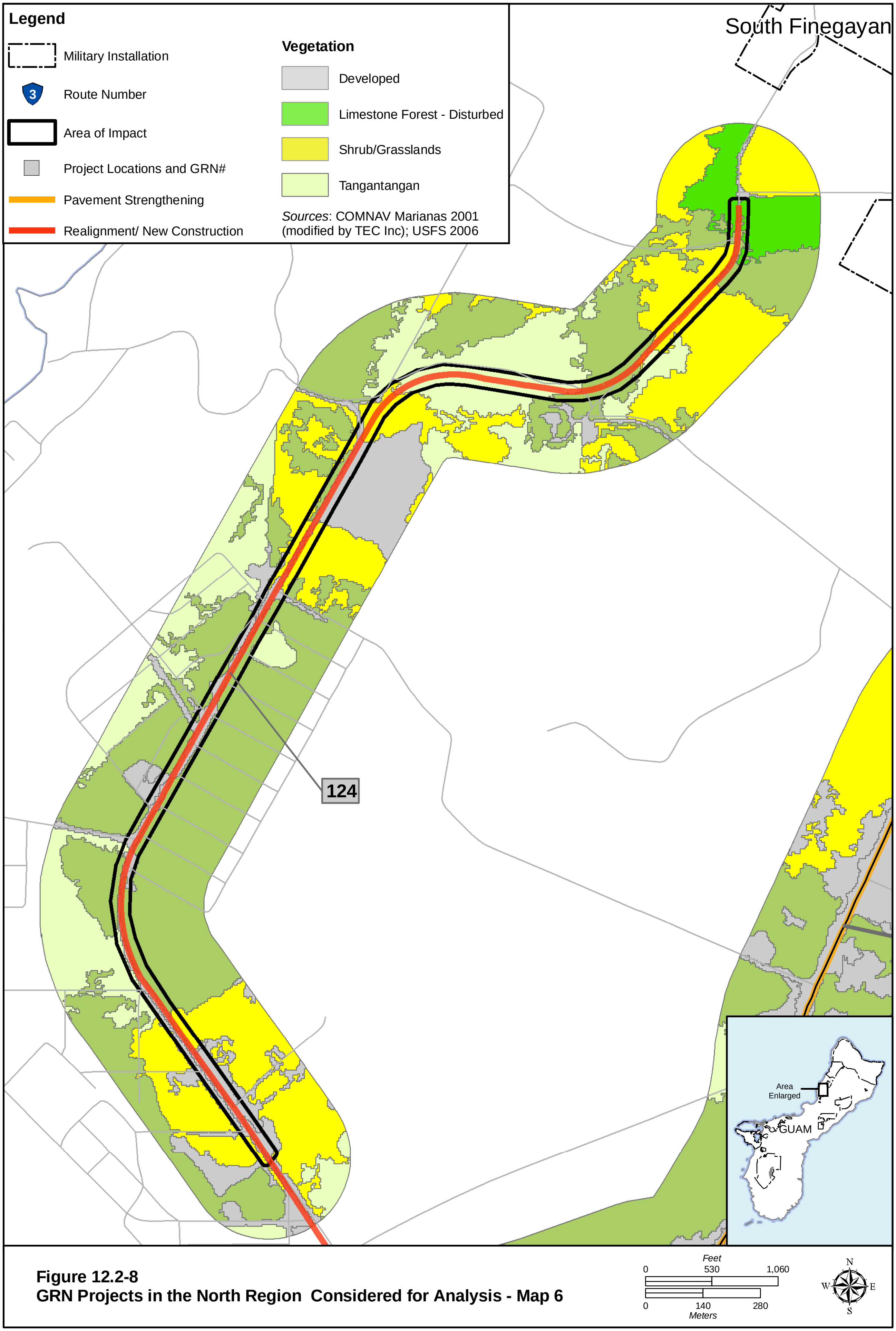

Figure 12.2-8
GRN Projects in the North Region Considered for Analysis - Map 6

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Figure 12.2-9
GRN Projects in the Central Region Considered for Analysis - Route 15 Relocation

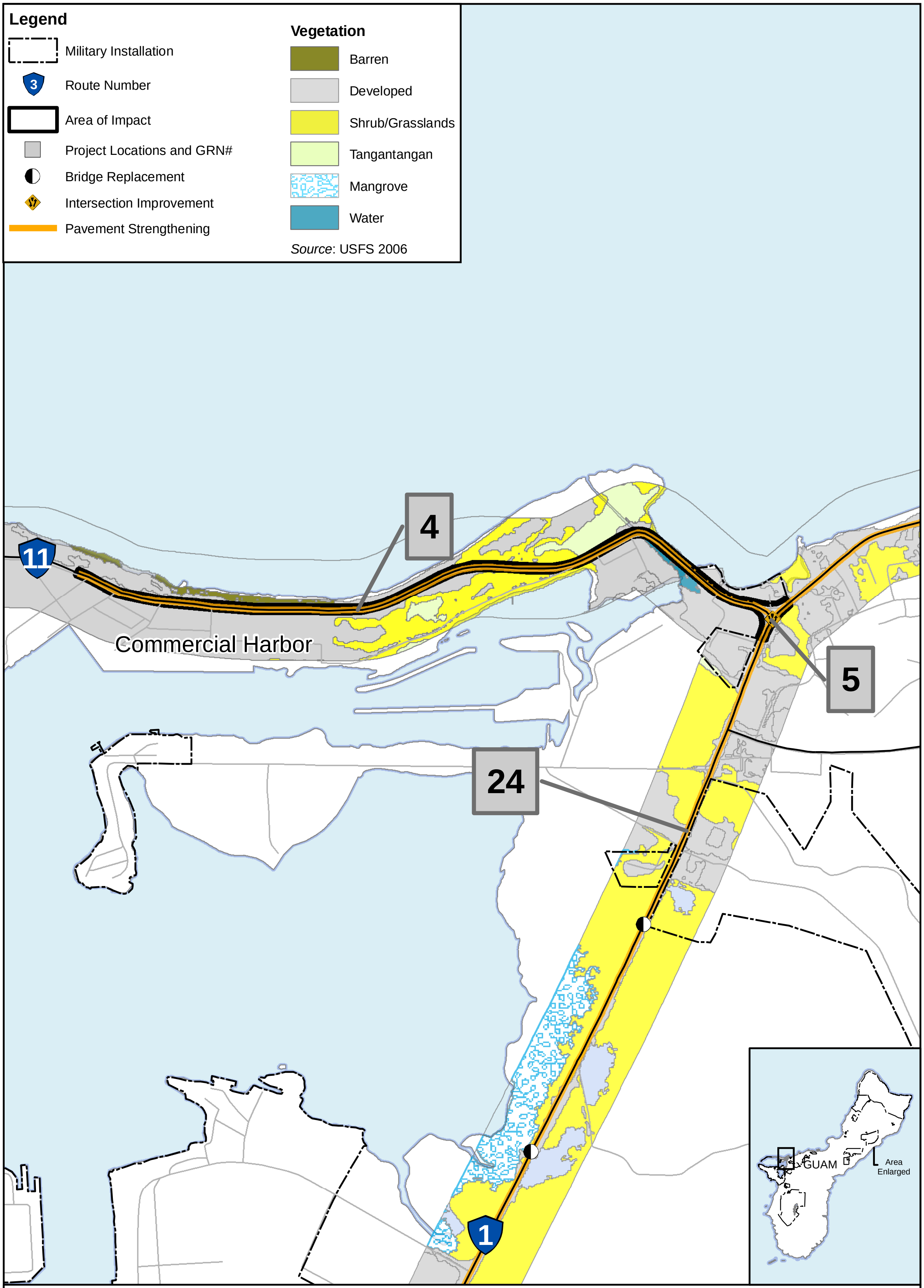

Figure 12.2-10
GRN Projects in the Apra Harbor Region Considered for Analysis

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12.2.6.1 Alternative 1

Volume 6, Chapter 2, Section 2.5 describes Alternative 1 for the proposed GRN and how they relate to alternatives associated with the proposed military relocation. As described earlier, GRN #9, 10, 22, 22A, 38A, 39A, 41, 42A, 57, and 124 were identified as having potential impacts on terrestrial biological resources within the North Region.

North

Vegetation

Direct impacts associated with these projects include clearing vegetation, primarily on the northern side of Route 9 and the western side of Route 3, and other road projects within the North Region. The vegetation community types subject to removal for each road project proposed for the North Region are listed in Table 12.2-15.

Impacts on vegetation would be less than significant because no primary limestone forest would be removed. Vegetation removed does provide habitat for wildlife and special-status species. These impacts are evaluated in subsequent sections.

Table 12.2-15. Potential Direct Impacts on Vegetation Communities with Implementation of Roadways Alternative 1

GRN #	*Limestone Forest, Disturbed ac (ha)*	*Mixed Limestone Forest-Plateau/ Secondary ac (ha)*	*Tangantangan (Leucaena) ac (ha)*	*Scrub Forest ac (ha)*	*Mixed Herbaceous Scrub ac (ha)*	*Developed Land ac (ha)*
Option A						
09 (North)	16 (6.5)	0	0	1.1 (0.4)	0	34 (14)
10 (North)	6.8 (2.8)	1.0 (0.4)	0	0.0	0	13 (5.3)
22 (North)	0.3 (0.1)	30 (12.1)	0	0.4 (0.2)	0	14 (5.7)
22A (North)	0	13 (5.3)	0	1.2 (0.5)	1.1 (0.4)	16 (6.5)
38A (North)	1.6 (0.7)	0	0	0	0	0
39A (North)	0	0	0	0	0	2.4 (1.0)
41 (North)	1.9 (0.8)	0	0	0	0.2 (0.1)	0.3 (0.1)
42A (North)	0	1.4 (0.6)	0	0	0	0.2 (0.1)
57 (North)	0	0	0	13 (5.3)	2.5 (1.0)	58 (23)
124 (North)	0.9 (0.4)	0	5.9 (2.4)	11 (4.5)	7.7 (3.1)	12 (4.9)
3 (Central)*	0	0	0	0	<0.1 (<0.1)	<0.1 (<0.1)
35 (Central)*	0	0	0	0	0.2 (<0.1)	0.2 (<0.1)
36 (Central)	30 (12.1)	0	5.5 (2.2)	8.2 (3.3)	2.4 (1)	16 (6.5)
Totals	58 (23.3)	46 (19)	11 (4.5)	35 (14)	14 (5.7)	166 (67)
Option B (identical to Option A except removing GRN #36 (Route 15 realignment)						
Totals	28 (11)	46 (19)	5.9 (2.4)	27 (11)	12 (4.9)	150 (61)

Note: Impacts associated with bridge replacement projects, such as GRN # 3 (Agana Bridge) and GRN # 35 (Aguada, Asan # 1, Asan # 2, Atantano, Fonte, Laguas, and Sasa Bridges), are shown in Table 12.2-17.
Legend: ac = acre; GRN = Guam Road Network; ha = hectare.

Wildlife

Based on observations during field visits and observations in other similar areas on Andersen AFB, NCTS Finegayan, and Andersen South (discussed in Volume 2, Chapter 10, Section 10.1), the only native bird species likely to be present in the project areas are the yellow bittern and possibly the Pacific golden plover in open areas; both species are common throughout Guam. Also abundant throughout Guam are the blue-tailed skink, mutilating gecko, and mourning gecko found in the area.

Proposed construction activities would displace the species and other wildlife from suitable habitat in the proposed project areas. Smaller, less-mobile species and those seeking refuge in burrows could inadvertently be killed during construction activities; however, long-term, permanent impacts on populations of such species would be less than significant because the species are abundant in surrounding areas. Therefore, impacts on wildlife would be less than significant with implementation of Alternative 1 roadways.

Special-Status Species

The ESA-listed species potentially affected by the removal of habitat include the Mariana fruit bat, the Mariana crow, the Guam Micronesian kingfisher, and the Guam rail. Table 12.2-16 lists the areas subject to removal of Overlay Refuge lands and special-status species recovery habitat.

Table 12.2-16. Potential Direct Impacts on Special Status Species Habitat with Implementation of Roadways Alternative 1

GRN #	*Overlay Refuge ac (ha)*	*Recovery Habitat – Bat and Kingfisher ac (ha)*	*Recovery Habitat – Crow ac (ha)*	*Recovery Habitat – Rail ac (ha)*	*Recovery Habitat – Serianthes ac (ha)*
Direct Impacts from Construction – Habitat Removed					
Options A and B					
09 (North)	8.1 (3.3)	10.9 (4.4)	10.9 (4.4)	25.5 (10.3)	6.9 (2.3)
10 (North)	8.1 (3.3)	1.3 (3.3)	1.3 (3.3)	12.4 (5.0)	1.3 (3.3)
22 (North)	30 (12)	25.6 (10.3)	22.7 (9.2)	11.8 (4.8)	24.2 (9.8)
22A (North)	3.1 (1.3)	11.2 (4.5)	11.7 (4.7)	12.5 (5.1)	5.1 (2.1)
38A (North)	1.6 (0.6)	1.7 (0.7)	1.7 (0.7)	0	1.7 (0.7)
39A (North)	2.4 (1.0)	1.5 (0.6)	1.5 (0.6)	0.9 (0.4)	1.5 (0.6)
41 (North)	2.4 (1.0)	1.5 (0.6)	1.5 (0.6)	0.9 (0.4)	1.5 (0.6)
42A (North)	1.7 (0.7)	1.7 (0.7)	1.7 (0.7)	0	1.7 (0.7)
57 (North)	0	0	0	32.5 (13.2)	0
124 (North)	0	0.9 (0.4)	0.9 (0.4)	22.2 (9.0)	0
3 (Central)*	0	0	0	0	0
35 (Central)*	0	0	0	0	0
36 (Central)	0	0	0	47.3 (19.1)	0
Total area removed	**57 (23)**	**56 (23)**	**54 (22)**	**166 (67)**	**44 (18)**
Total Habitat Area - DoD Lands	21, 690 (8,778)	16,105 (6,517)	16,087 (6,510)	8,976 (3,632)	9,082 (3,654)
Total Habitat Area - Non-DoD Lands	0	12,550 (5,079)	11,037 (4,467)	40,588 (16,425)	2,640 (1,068)
Percentage of Habitat Area on Guam that is Removed (DoD and Non-DoD Lands)	0.26%	0.20%	0.20%	0.33%	0.37%

Note: Each habitat category is considered independently of others and is not an additive.
Legend: ac = acre; DoD = Department of Defense; GRN = Guam Road Network; ha = hectare.

Mariana fruit bat. Specific designated habitat areas would be removed under Alternative 1 including Overlay Refuge and recovery habitat for the fruit bat (Table 12.2-16).There would be no temporary direct impacts from noise and activity during construction at Andersen AFB to roosting and foraging activities of the Mariana fruit bat. Removal of these areas due to construction would have a significant impact on recovery habitat available for the species. The magnitude of the impacts would be reduced with a suite of actions described in Volume 2, Chapter 10, Section 10.2.2.6.

Mariana crow. Specific designated habitat areas would be removed under Alternative 1, including Overlay Refuge and recovery habitat for the crow (Table 12.2-16). The Mariana crow is not currently present in areas where these projects would occur so there would be no noise or disturbance impacts from construction. Removal of these areas due to construction would have a significant impact on recovery habitat available for the species. The magnitude of the impacts would be reduced with a suite of actions described in Volume 2, Chapter 10, Section 10.2.2.6.

Guam Micronesian kingfisher. The kingfisher survives only in captivity at this time. Identified kingfisher recovery habitat would be removed under Alternative 1, including Overlay Refuge (Table 12.2-16). Removal of these areas due to construction would have a significant impact on recovery habitat available for the species. The magnitude of the impacts would be reduced with a suite of actions described in Volume 2, Chapter 10, Section 10.2.2.6.

Guam rail. The rail survives only in captivity at this time. Proposed construction activities would include the loss of shrub/grassland habitat that has been identified as rail recovery habitat. Only a very small portion of the area is scrub and shrublands that is suitable potential rail recovery habitat. Because of minimal loss of habitat for a species not currently present, removal of these areas due to construction would result in a less than significant impact.

Pacific slender-toed gecko. The gecko was found in recent surveys (NAVFAC Pacific 2010) in northeastern NCTS Finegayan in a forested area. However, because the roadway impacts would be in or along adjacent disturbed areas, the species would be unlikely to be present in the project areas. Impacts would be less than significant.

The DoD has completed section 7 ESA consultation with the USFWS to avoid, minimize, or offset the potential direct and indirect impacts on ESA-listed species associated with Alternative 1.

Indirect impacts associated with these projects may further degrade limestone forests that are important to species recovery efforts. The indirect impacts may include: increasing edge effect of limestone forests, thereby facilitating the further encroachment of aggressive non-native vines and herbaceous vegetation; possible facilitation of access to poachers into habitat areas for the Mariana fruit bat during construction phases; increased wildland fire risk in fine fuels due to construction activities (canopy fires are not expected in northern Guam) that would encourage non-native invasive species encroachment; increased noise and activity levels during construction and operation; and displacement of ungulates (i.e., Philippine deer, carabao, and feral pig), along with other non-native invasive species (e.g., BTS, feral cat, and dog, rat, cane toad) into adjacent habitats. However, since roadways projects are along existing transportation corridors and heavily disturbed habitat, these impacts are expected to be less than significant with implementation of standard BMPs.

Central

Vegetation

Direct impacts associated with these projects include the proposed clearing of vegetation through the relocated Route 15 road corridor and eight bridge and culvert replacements proposed for the Central Region. The vegetation community types subject to removal for each road project proposed for the Central Region are listed in Table 12.2-15. The proposed Route 15 relocation would clear areas that transition from disturbed limestone forest in the west to scrub forest towards the east of the proposed route. Some areas of the Andersen South parcel, especially the southeast and southwest corners of the parcel, contain mature vegetation canopy layers with some areas dominated by native species. Reconnaissance surveys in support of this EIS and separate reconnaissance surveys conducted in support of the proposed Route 15 relocation indicate a high feral pig population, as evidenced by heavy damage to substrates, vegetation impacts, and numerous wallows.

Impacts on vegetation associated with the road improvements and bridge and culvert replacements would be less than significant because minimal primary limestone forest would be removed. Vegetation removed does provide habitat for wildlife and special-status species. These impacts are evaluated in subsequent sections.

Wildlife

Impacts on aquatic environments associated with the bridge and culvert replacements are shown in Table 12.2-17. The eight bridge and culvert replacements are proposed to span crossings along Route 1 over the Agana River, Atantano River, Laguas River, Sasa River, and Fonte River. These rivers are considered perennial (flowing water for all or most of the year). As shown in Table 12.2-17, construction activities associated with the eight bridge and culvert replacements would temporarily remove a total area of approximately 1.52 ac (0.61 ha). Temporary direct impacts associated with construction activities include the potential for increased erosion associated with grading into the subsoil within and outside the stream channel and potential impacts on aquatic communities in the immediate area of the bridge replacement.

Indirect impacts may occur further downstream outside of the immediate construction area and be prolonged in time. These indirect effects may include degradation of stream channel aquatic habitats and marine habitats supporting coral communities and fisheries. Federal Highway Administration (FHWA) and Guam Environmental Protection Agency have mandated Standard Operating Procedures and BMPs specific to sediment control that accounts for stormwater runoff and other Guam-specific criteria for pollution prevention during construction and operation of the proposed roads. Hydraulic conveyance under the new bridge and culvert replacements would improve, which may benefit downstream stream segments, wetland areas and open water habitats by decreasing scour along the stream bank near the bridge and culvert replacements and decreasing sediment inputs into downstream freshwater and marine habitats. In summary, the bridge and culvert replacement would potentially impact 1.52 ac (0.61 ha) of riverine aquatic habitats and indirectly impact aquatic habitats downstream; however, the impacts would be minimized through individual BMPs cooperatively developed by the FHWA and Guam Environmental Protection Agency, the temporary nature of the impact, and possible improved hydraulic conveyance under the proposed bridge and culvert replacements. With the BMPs, impacts would be less than significant.

Table 12.2-17. Potential Direct Impacts on Special Status Species Habitat with Implementation of Roadways Alternative 1

GRN Project #	*Bridge Name*	*Potential Direct Impacts on Aquatic Habitats* [1]		*Potential Indirect Impacts on Aquatic Habitats* [2]
		Acres	*Hectares*	
3	Agana Bridge	0.15	0.06	Potential sedimentation along the 260 ft (80 m) streambed of the Agana River between Agana Bridge and the river terminus (between East Hagatna Beach and Paseo de Susana Park).
35	Atantano Bridge	0.14	0.06	Potential sedimentation along the 1,150 ft (350 m) streambed of the Aguada River between Route 1 and the shoreline of Sasa Bay. The Aguada River flows through the Sasa Bay Marine Preserve, which supports the largest mangrove forested area within the Mariana Islands.
	Aguada Bridge	0.015	0.06	Potential sedimentation along the 1,150 ft (350 m) streambed of the Aguada River between Route 1 and the shoreline of Sasa Bay. The Aguada River flows through the Sasa Bay Marine Preserve, which supports the largest mangrove forested area within the Mariana Islands.
	Asan # 1	0.28	0.11	Potential sedimentation along the 320 ft (98 m) streambed of this length of the Asan River between the box culvert and the shoreline of Asan Bay.
	Asan # 2	0.26	0.11	Potential sedimentation along the 99 ft (30 m) streambed of this drainage between the box culvert and the shoreline of Asan Bay.
	Fonte Bridge	0.28	0.11	Potential sedimentation along the 290 ft (90 m) streambed of the Fonte River between Fonte Bridge and the river terminus (between West Hagatna Beach and the Governor's Complex).
	Laguas Bridge	0.13	0.05	Potential sedimentation inputs along the 1,600 ft (480 m) streambed of the Sasa River between Sasa Bridge and the river terminus and 800 ft (240 m) streambed of the Laguas River to the river terminus. Both rivers flow through the Sasa Bay Marine Preserve, which supports the largest mangrove forested area within the Mariana Islands.
	Sasa Bridge	0.13	0.05	
Total Area		**1.52**	**0.61**	

Notes:

[1] Stream channel widths were calculated by averaging the width of four cross-stream lines between observed OHWM) for each bridge. Two upstream lines and two downstream lines were measured for each bridge.

The estimated area of direct impacts on potential waters of the U.S. was calculated by the following equation: (Stream channel width) x (Structure width) + (Assumed area of upstream channel modifications [30 square feet]) + (Assumed area of downstream channel modifications [30 square feet]).

[2] Potential indirect impacts are considered temporary for construction activities. Mitigations (BMPs) are in development as a joint effort between GEPA, FHWA, and FHWA design contractors to minimize or avoid impacts during and after the construction phase. Examples of mitigative BMPs are included in CNMI and Guam Stormwater Management Manual (CNMI and Guam 2006).

Legend: BMP = Best Management Practice; ft = feet; HWA = Federal Highway Administration; GEPA = Guam Environmental Protection Agency; GRN = Guam Road Network; m = meter; NA = not applicable; OHWM = ordinary high water marks.

Based on observations during field visits and observations in other similar areas on Andersen AFB, NCTS Finegayan, and Andersen South (discussed in Volume 2, Chapter 10, Section 10.1), the only native bird species likely to be present in the inland project areas are the yellow bittern and Pacific golden plover. At the bridge and culvert crossings near the coast various migratory birds are likely to utilize the area, and tidal influences (e.g., exposed tidal mudflats) and estuarine banks provide seasonal foraging and loafing habitat. Annual migrants to Guam that might be found there are Pacific golden plover, greenshank, Mongolian plover, gray-tailed tattler, whimbrel, ruddy turnstone, and cattle egret (Commander Navy Region Marianas 2008, Eggleston 2009, NAVFAC Pacific 2010). A recent field survey of the proposed bridge crossings (NAVFAC Pacific 2010) did not record any native bird species. The species that are likely to regularly use the area, particularly near roadways, would be species common on Guam.

During recent surveys conducted in support of this EIS, three native reptile species were found within the forested areas at Polaris Point: Pacific blue-tailed skink, mourning gecko, and mutilating gecko (NAVFAC Pacific 2010). Native land hermit crabs and coconut crabs are present on the base in coastal and estuarine areas (Commander Navy Region Marianas 2008). The presence of these species is unknown in the Biological Resource Study Area.

Proposed construction activities would displace these species of wildlife from suitable habitat in the proposed project areas. Smaller, less-mobile species and those seeking refuge in burrows could inadvertently be killed during construction activities; however, long-term, permanent impacts on populations of such species would be less than significant because the area affected does not expand greatly from presently disturbed areas and would be very small in comparison to the total habitat available. In addition, most species known to be present are abundant in surrounding areas (with the possible exception of the coconut crab). Overall, impacts on wildlife would be less than significant with implementation of Alternative 1 roadways.

Special-Status Species

Construction within the Central Region would not remove recovery habitat for the Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher or Guam rail; or areas designated as Overlay Refuge. The shrub/grassland habitat that would be removed is potential habitat for reintroduction of the Guam rail in the future, but the areas removed have no special habitat designation. Wetlands and stream corridors may be considered primary or secondary habitats for the Mariana common moorhen; the only wetlands directly affected through road construction activities are associated with bridge and culvert replacements along the Atantano, Asan, Aguada, Agana, Fonte, Laguas, and Sasa rivers. Moorhens prefer calm palustrine and estuarine wetlands and are not likely to use the more dynamic stream corridors. Direct impacts on special-status species in the Central Region would be less than significant.

Potential indirect impacts associated with GRN projects may include increasing edge effects for non-native species, displacement of ungulates, increased noise and activity levels, and wildland fire risk. For the Mariana common moorhen, construction noise at projects near known moorhen habitat areas (e.g., Agana swamp, Sasa Bay Marine Preserve, Harmon Sink) may cause temporary disturbance to nesting or foraging moorhens, although these areas are along existing road corridors subject to ambient and episodic noise events associated with normal traffic. Preconstruction surveys and monitoring of known or suspected moorhen areas along road corridors would be conducted. Indirect effects associated with roadway construction and operations are expected to be less than significant because these projects are along existing roadway corridors and heavily disturbed habitat.

Apra Harbor

There were no projects proposed for the Apra Harbor Region identified as having potential to impact terrestrial biological resources under Alternative 1. Therefore, there would be no significant impacts on terrestrial biological resources (vegetation communities, wildlife resources, and special-status species) associated with Alternative 1.

South

There were no projects proposed for the South Region identified as having potential to impact terrestrial biological resources under Alternative 1. Therefore, there would be no significant impacts on terrestrial biological resources (i.e., vegetation communities, wildlife resources, and special-status species) associated with Alternative 1 implementation.

Proposed Mitigation Measures

Impacts on terrestrial vegetation communities, aquatic habitats and special-status species habitat resulting from proposed roadway projects would be mitigated with a suite of protection and conservation measures for all impacts on Guam described in this EIS. See Volume 7, Chapter 2 for a summary table of these measures and Volume 2, Chapter 10 for details of these measures. Specifically, the USFWS during review of the Draft EIS raised the concern that Mariana common moorhens may temporarily be disturbed by noise events associated with construction where road projects are adjacent to known or suspected moorhen habitats. As a result, the FHWA would conduct pre-construction surveys in wetland areas along Route 1 and other pavement strengthening projects adjacent to the Barrigada Sink.

The biosecurity plan is described in Volume 2, Chapter 10. Because the eight bridge and culvert replacements occur within potential waters of the U.S., the FHWA would be engaging the U.S. Army Corps of Engineers Honolulu District Office in the Section 404 Clean Water Act permitting process. During this process additional BMPs or mitigations may be required as part of the permit conditions.

12.2.6.2 Alternative 2 (Preferred Alternative)

Volume 6, Chapter 2 describes Alternative 2 for the proposed GRN and how this alternative relates to the alternatives associated with the proposed military relocation. Alternative 2 differs from Alternative 1 in the way that NCTS Finegayan would be utilized. Proposed road projects under Alternative 2 are the same as the proposed road projects under Alternative 1, with the exception of military access point locations at NCTS Finegayan and Andersen AFB. These military access point projects that are included as part of Alternative 2 (GRN #s 38, 39, and 41) would have the same direct and indirect impacts as those military access point projects included as part of Alternative 1 (GRN #s 38A, 39A, and 41A); therefore, impacts on terrestrial biological resources of Alternative 2 are similar to Alternative 1 for each region.

Proposed Mitigation Measures

The mitigation measures for Alternative 2 are the same as those for Alternative 1.

12.2.6.3 Alternative 3

Volume 6, Chapter 2 describes Alternative 3 for the proposed GRN and how this alternative relates to the alternatives associated with the proposed military relocation. Alternative 3 differs from Alternative 1 and 2 in the way that NCTS Finegayan would be utilized, as well as other federal parcels. The land use differences require a different configuration of the proposed GRN military access point configurations. Proposed road projects under Alternative 3 are the same as the proposed road projects under Alternative 1, except that Alternative 3 includes GRN #s 38, 47, 48, 49, 63, and 74, and it excludes GRN #s 20, 31, 38A, 39A, 41A, and 124. GRN # 47, 48 and 49 are associated with new access to Barrigada (Navy and Air Force); however, these projects would occur in previously disturbed areas of no value to special status species or wildlife. Further, indirect impacts associated with increased impervious cover (e.g., runoff during the construction phase of the projects) would not degrade these habitats. Gate locations for Alternative 3 are the same for Alternative 1, except that NCTS Finegayan Main Gate and commercial gate locations (GRN #s 38 and 39) are in different locations than the Main Gate and commercial gate locations in Alternative 1 (GRN #s 38A and 39A). The GRN # 38 and 39 locations would have the same direct and indirect impacts as GRN #s 38A and 39A. Therefore, impacts on terrestrial biological resources of Alternative 3 are similar to Alternative 1 for each region.

Proposed Mitigation Measures

The mitigation measures for Alternative 3 are the same as those for Alternative 1.

12.2.6.4 Alternative 8

Volume 6, Chapter 2 describes Alternative 8 for the proposed GRN and how this alternative relates to the alternatives associated with the proposed military relocation. Alternative 8 differs from Alternative 1 in the way that NCTS Finegayan would be utilized, as well as other federal parcels. Proposed road projects under Alternative 8 are the same as the proposed road projects under Alternative 1, with the exception of the military access point location at Air Force Barrigada. This gate location project included as part of Alternative 8 (GRN # 49A) would have the same direct and indirect impacts as the military access point project included as part of Alternative 3 (GRN # 49); therefore, impacts on terrestrial biological resources of Alternative 8 are similar to Alternatives 1 and 3 for each region.

Proposed Mitigation Measures

The mitigation measures for Alternative 8 are the same as those for Alternative 1.

12.2.6.5 Firing Range Option

The alternatives described in Volume 2, Chapter 2, for the relocation include the Main Cantonment action alternatives with either a Firing Range Option A or B. Option A would require the realignment of Route 15 (GRN #36), while Option B does not require realignment of Route 15; therefore, by choosing Option B, the impacts associated with proposed road projects within the Central Region study area to terrestrial biological resources would not occur.

12.2.6.6 Summary of Impacts

Table 12.2-18 summarizes the potential impacts of each alternative.

There would be no removal of primary limestone forest habitat; therefore, impacts on vegetation would be less than significant. Wildlife species that are documented as present are common species and the proposed roadway improvements would not affect populations of these species so impacts would be less than significant. The removal of recovery habitat for ESA-listed species in the North Region would be a significant impact, mitigated to less than significant. The encroachment would also remove habitat from the Refuge Overlay units on Finegayan and Andersen AFB.

Table 12.2-18. Summary of Potential Impacts on Terrestrial Biological Resources, Roadway Projects

Alternative 1	*Alternative 2**	*Alternative 3*	*Alternative 8*
Vegetation			
LSI • There would be no removal of primary limestone forest.	LSI • There would be no removal of primary limestone forest.	LSI • There would be no removal of primary limestone forest.	LSI • There would be no removal of primary limestone forest.
Wildlife			
LSI • Less than significant impacts on wildlife.	LSI • Less than significant impacts on wildlife.	LSI • Less than significant impacts on wildlife.	LSI • Less than significant impacts on wildlife.
Special-Status Species			
SI-M • Significant direct impact due to the removal of identified recovery habitat for 3 endangered species and Overlay Refuge.	SI-M • Significant direct impact due to the removal of identified recovery habitat for 3 endangered species and Overlay Refuge.	SI-M • Significant direct impact due to the removal of identified recovery habitat for 3 endangered species and Overlay Refuge.	SI-M • Significant direct impact due to the removal of identified recovery habitat for 3 endangered species and Overlay Refuge.

Legend: LSI = Less than significant impact; SI-M = Significant impact mitigable to less than significant. *Preferred Alternative.

12.2.6.7 Summary of Mitigation Measures

Table 12.2-19 summarizes the proposed mitigation measures for roadway projects impacts on terrestrial biological resources.

Table 12.2-19. Summary of Proposed Mitigation Measures for Roadway Projects Impacts to Roadway Biological Resources

Phase	*Mitigation Measure*
Construction	Pre-construction surveys for Mariana common moorhen in wetland areas along Route 1 adjacent to the bridge replacement projects and other pavement strengthening projects adjacent to the Barrigada Sink.
Operation	None

CHAPTER 13.
MARINE BIOLOGICAL RESOURCES

13.1 INTRODUCTION

This chapter contains a discussion of the potential environmental consequences associated with implementing the alternatives within the region of influence (ROI) for this resource. For a description of the affected environment for all resources, refer to the respective chapter of Volume 2. The locations described in Volume 2 include the ROI for the utilities and roadway projects and Volume 2, Chapter 11 includes Marine Biological Resources. See Volume 2, Chapter 16, Section 16.1.6 for a discussion of recreational and traditional fishing and coral reef ecosystem as it relates to the overall increased human population associated with the proposed project.

The analysis contained in this chapter focuses on marine biological resources in both ocean and near-shore waters around Guam. There is some overlap of information in this chapter with analysis and information in Volume 6, Chapter 6, Water Resources. This is because freshwater streams and surface water runoff which is addressed in the Water Resources chapter may eventually make its way to near-shore marine environments. Therefore, both Chapter 13 (Marine Resources) and Chapter 6 (Water Resources) discuss this connection between surface and marine waters.

13.2 ENVIRONMENTAL CONSEQUENCES

13.2.1 Approach to Analysis

13.2.1.1 Methodology

The methodology for identifying, evaluating, and mitigating impacts to marine biological resources was based on federal laws and regulations including the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), Magnuson-Stevens Fishery Conservation and Management Act (M-SA), Clean Water Act (CWA), and Executive Order (EO) 13089, Coral Reef Protection. Significant marine biological resources include all special-status species including species that are ESA-listed as threatened and endangered or candidates for listing under ESA, species protected under the MMPA, or species with designated Essential Fish Habitat (EFH) or Habitat Area of Particular Concern (HAPC) established under the M-SA. The M-SA defines EFH as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." 'Waters' include aquatic areas and their associated physical, chemical, and biological properties that are used by fish. 'Substrate' includes sediment, hard bottom, structures underlying the waters, and associated biological communities. 'Necessary' means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem, and 'spawning, breeding, feeding, or growth to maturity' covers a species' full life cycle (16 United States Code 1801 et seq.). Additionally, at least one or more of the following criteria established by the National Marine Fisheries Service (NMFS) must be met for HAPC designation: (1) the ecological function provided by the habitat is important; (2) the habitat is sensitive to human-induced environmental degradation; (3) development activities are, or will be, stressing the habitat type; or (4) the habitat type is rare. It is possible that an area can meet one HAPC criterion and not be designated an HAPC. The Western Pacific Regional Fishery Management Council (WPRFMC) used a fifth HAPC criterion, not established by the National Marine Fisheries Service (NMFS), that includes areas that are already protected, such as Overlay Refuges (WPRFMC 2009).

In general, the main intentions of the three federal acts and the EO listed above are as follows:

- The ESA establishes protection over and conservation of threatened and endangered species and the ecosystems upon which they depend, and requires any action that is authorized, funded, or carried out by a federal entity to ensure its implementation would not jeopardize the continued existence of listed species or adversely modify critical habitat.
- The MMPA was established to protect marine mammals by prohibiting take of marine mammals without authorization in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S.
- The M-SA requires NMFS and regional fishery management councils to minimize, to the extent practicable, adverse effects to EFH caused by fishing activities. The M-SA also requires federal agencies to consult with NMFS about actions that could damage EFH.
- The CWA is the primary federal law in the U.S. governing water pollution. The act established the goals of eliminating releases to water of high amounts of toxic substances, eliminating additional water pollution, and ensuring that surface waters would meet standards necessary for human sports and recreation.
- EO 13089 mandates preservation and protection of U.S. coral reef ecosystems that are defined as "… those species, habitats and other natural resources associated with coral reefs in all maritime areas and zones subject to the jurisdiction and control of the U.S." This guidance is intended to clarify and reemphasize the protection afforded the Nation's valuable coral reef ecosystems under the CWA Section 404 regulatory program, the Marine Protection, Research, and Sanctuaries Act Sections 102 and 103 provisions, Rivers and Harbors Act Section 10 requirements, and Federal Projects conducted by the USACE.

The ESA, MMPA, and M-SA require that NMFS and/or U.S. Fish and Wildlife Service (USFWS) be consulted when a proposed federal action may adversely affect an ESA-listed species, a marine mammal, EFH or HAPC. In addition, while all habitats are important to consider, 'coral reef ecosystems' are perhaps the most important habitats and the analysis of this special aquatic site (SAS) is included under EFH (see also Volume 2 and 4, chapter 11). SAS are geographic areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values. These areas are generally recognized as significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem of a region.

Best Management Practices (BMPs) and Protective Measures

The implementation of construction and industrial permit BMPs, Navy Low Impact Development (LID) concept plans and Industrial Management Practices, and general maritime measures in place by DoD is assumed for each resource and anticipated to reduce any construction- and operation-related impacts to marine biological resources. With respect to possible construction impacts on the nearshore marine environment, the implementation and management of such plans would reduce/eliminate any construction-related stormwater runoff into the nearshore environment. The LID concept plan would support master planning activities, and through these joint efforts, a sustainable development strategy would be implemented where pre-construction site hydrology would be equal or nearly equal to post- construction hydrology. Stormwater would be treated for pollutants prior to discharge to the porous ground surface. Volume 6, Chapter 6 contains a more detailed discussion of BMPs and LIDs to be implemented as part of the utilities alternatives, along with a discussion of potential impacts to surface waters (inland waters) and near-shore waters. This chapter focuses on potential impacts to marine waters and the ocean.

A detailed listing of BMPs is provided in Volume 7 of this Environmental Impact Statement.

13.2.1.2 Determination of Significance

This section analyzes the potential for impacts to marine biological resources from implementation of the utilities and roadway alternatives and the no-action alternative. Factors considered in the analysis of potential impacts to marine biological resources include: (1) importance (i.e., legal, commercial, recreational, ecological, or scientific) of the resource; (2) proportion of the resource that would be affected relative to its occurrence in the region; (3) sensitivity of the resource to proposed activities; and (4) duration of ecological ramifications. The factors used to assess significance of the effects to marine biological resources include the extent or degree that implementation of a utility or roadway alternative would result in permanent loss or long-term degradation of the physical, chemical, and biotic components that make up a marine community. The following significance criteria were used to assess the impacts of implementing the alternatives:

- The extent, if any, that the alternative would diminish suitable habitat for a special-status species or permanently lessen designated EFH or HAPC for the sustainment of managed fisheries.
- The extent, if any, that the alternative would disrupt the normal behavior patterns or habitat of a federally listed species, and substantially impede the Navy's ability to either avoid jeopardy or conserve and recover the species.
- The extent, if any, that the alternative would diminish population sizes or distribution of special- status species or designated EFH or HAPC.
- The extent, if any, that the alternative would be likely to jeopardize the continued existence of any special-status species or result in the destruction or adverse modification of habitat of such species or designated EFH or HAPC.
- The extent, if any, that the alternative would permanently lessen physical and ecological habitat qualities that special-status species depend upon, and which partly determines the species' prospects for conservation and recovery.
- The extent, if any, that the alternative would result in a substantial loss or degradation of habitat or ecosystem functions (natural features and processes) essential to the persistence of native flora or fauna populations.

ESA specifically requires agencies not to "jeopardize" the continued existence of any ESA-listed species, or destroy or adversely modify habitat critical to any ESA-listed species. Under Section 7, "jeopardize" means to engage in any action that would be expected to reduce appreciably the likelihood of the survival and recovery of a listed species by reducing its reproduction, numbers, or distribution. Section 9 of the ESA defines "take" as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect.

Effects determinations for EFH assessments are either "no adverse effect on EFH" or "may adversely affect EFH" (WPRFMC 2009). Pursuant to 50 CFR 600.910(a), an "adverse effect" on EFH is defined as any impact that reduces the quality and/or quantity of EFH. Adverse effects to EFH require further consultation if they are determined to be permanent versus temporary (NMFS 1999).

An example of temporary (or short-term) and localized impacts would be the increased barge traffic that may be associated with transport of construction materials. These increases may disturb special-status species and EFH, however as these species are highly mobile and speeds low, disturbances would be short-term and localized in nature. If disturbed by vessel traffic, sea turtles, dolphins, and finfish would likely avoid or leave the area for the duration of the disturbance, and return once the disturbance ceases.

Navy and NMFS EFH consultation is included in Volume 9, Appendix C. To help identify DoD activities falling within the adverse affect definition, the DoD has determined that temporary or minimal impacts are not considered to "adversely affect" EFH. 50 CFR 600.815(a)(2)(ii) and the EFH Final Rule (67 Federal Register [FR] 2354) were used as guidance for this determination, as they highlight activities with impacts that are more than minimal and not temporary in nature, opposed to those activities resulting in inconsequential changes to habitat. Temporary effects are those that are limited in duration and allow the particular environment to recover without measurable impact (67 FR 2354). Minimal effects are those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions (67 FR 2354). Whether an impact is minimal would depend on a number of factors (NAVFAC Pacific 2009):

- The intensity of the impact at the specific site being affected
- The spatial extent of the impact relative to the availability of the habitat type affected
- The sensitivity/vulnerability of the habitat to the impact
- The habitat functions that may be altered by the impact (e.g., shelter from predators)
- The timing of the impact relative to when the species or life stage needs the habitat

The proposed military relocation would have direct and indirect impacts. The direct impacts generally relate to the demand for utility services and roadways by the military population and facilities. For utilities and roadways, indirect impacts generally relate to population growth outside of the base and the demand that this off base population would have on existing utilities and roads. This population would include workers for the construction of facilities, their dependants, and people who migrate to Guam in response the economic growth, resulting from the military relocation (induced civilian population growth). The analysis of potential impacts to marine biological resources considers impacts related to utilities and roadways such as the "taking" of special-status species, increased noise, decreased water quality, and lighting impacts resulting from construction or operation activities and sedimentation/siltation of coral reef ecosystems resulting from construction or operational activities Cumulative impacts are also described in detail in Volume 7 of this EIS.

If marine biological or aquatic resources could be significantly affected by proposed project activities, potential impacts may be reduced or offset through implementation of appropriate BMPs and/or mitigation measures. "Significantly" as used in National Environmental Policy Act (per 43 FR 56003, November 29, 1978; 44 FR 874, January 3, 1979) requires considerations of both context and intensity:

- Context. This term means that the significance of an action must be analyzed in several contexts, such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend on the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant.
- Intensity. This term refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. The following should be considered in evaluating intensity:
- Impacts that may be both beneficial and adverse. A significant effect may exist even if the federal agency believes that on balance the effect would be beneficial.
- The degree to which the proposed action affects public health or safety.
- Unique characteristics of the geographic area, such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.

- The degree to which the effects on the quality of the human environment are likely to be highly controversial.
- The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.
- The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.
- Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.
- The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.
- The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the ESA of 1973.
- Whether the action threatens a violation of federal, state, or local law or requirements imposed for the protection of the environment.

13.2.1.3 Issues Identified During Public Scoping Process

The following analysis focuses on possible effects to marine biological resources that could be affected by the proposed action. As part of the analysis, concerns relating to marine biological resources that were mentioned by the public, including regulatory stakeholders, during scoping meetings were addressed. A general account of these comments includes the following:

- Potential impacts to endangered species (including nesting habitats), species of concern, and federal trust species such as corals and marine mammals
- Potential impacts on the marine resources from military expansion at all project sites, including removal or disturbance of the marine habitat through decreased water quality
- Impacts to culturally significant marine-related areas for subsistence fishing and beliefs
- Increased land runoff impacting beaches and marine life (erosion and sediment stress)
- Increased anthropogenic factors impacting the coral reef ecosystem

13.2.2 Power

13.2.2.1 Basic Alternative 1 (Preferred Alternative)

The Basic Alternative 1 would recondition existing Guam Power Authority (GPA) Combustion Turbines (CTs) and upgrade Transmission and Distribution (T&D) systems. This work would be undertaken by GPA on its existing permitted facilities and would not require new construction or enlargement of the existing footprint of the facilities. Reconditioning would be made to existing permitted facilities at the Marbo, Yigo, Dededo (2 units), and Macheche CTs. These CTs are currently being used very little and after reconditioning would be available for peaking and reserve power. T&D system upgrades would be on existing above ground and underground transmission lines. This alternative supports Main Cantonment Alternatives 1 and 2 and Main Cantonment Alternatives 3 and 8 would require additional upgrades to the T&D system.

It is anticipated that these units would require general overhaul, capabilities testing, and controlled startup that could take up to 12 months. The amount of reconditioning would not be known until the units are inspected and tested as part of an ongoing study by DoD. Upgrades would also be required to the T&D

system. No direct impact to marine biological resources is expected by this alternative. Potential indirect impacts are described below for each marine resource category. Table 13.2-1 includes seasonally sensitive marine organisms and their known occurrence in the project area.

Table 13.2-1. Sensitive Months for Certain Species within Apra Harbor and Coastal Waters of Naval Computer and Telecommunications Station Finegayan

Species	*Status*	*Location*	*Months*
Green Sea Turtle	ESA-listed, Threatened	see Figure 13.2-1 and Figure 13.2-2	Nesting (Jan – Mar)
Hawksbill Sea Turtle	ESA-listed, Endangered	see Figure 13.2-1 and Figure 13.2-2	Nesting (Apr – Jul)
Green and Hawksbill Sea Turtles	ESA-listed	see Figure 13.2-1 and Figure 13.2-2	Foraging (Jan – Dec)
Adult Bigeye Scad	EFH-CHCRT	see Figure 13.2-1	Jun – Dec
Scalloped Hammerhead	EFH-PHCRT	aircraft carrier turning basin, see Figure 13.2-1	Pupping (Jan – Mar)
Juvenile Fish*	EFH	Sasa Bay and other nearshore environments	Nursery (Jan – Dec)
Hard Corals	EFH-PHCRT	Apra Harbor	Full Moon Spawning (July-Aug)

Note: *Includes barracudas, emperors, goatfishes, groupers, mullets, parrotfishes, puffers, snappers, surgeonfishes, wrasses, and small-toothed whiptails.

Legend: CHCRT = current harvested coral reef taxa; EFH = Essential Fish Habitat; ESA = Endangered Species Act; PHCRT = potentially harvested coral reef taxa.

Construction

Marine Flora, Invertebrates and Associated EFH

Marine flora, invertebrates, and associated EFH in the project area would not be directly affected by construction activities associated with the Basic Alternative. Upgrades to the power systems, which include construction activities and increased road traffic may lead to temporary decreases in water quality from runoff, but these impacts would be minimized by the use of BMPs and restricted to the duration of the upgrades. Increased barge traffic is not likely to disturb flora or invertebrates. The Basic Alternative would result in temporary and minimal impacts to marine flora and invertebrates, and would have no adverse effect on associated EFH. Therefore, less than significant impacts are anticipated with the implementation of the Basic Alternative.

Essential Fish Habitat

EFH Management Unit Species (MUS) in the project area would not be directly affected by activities associated with the Basic Alternative, and indirect impacts would be minimal. Upgrades to the power systems, which include construction activities and increased road traffic may lead to temporary decreases in water quality from runoff, but these impacts would be minimized by the use of BMPs and restricted to the duration of the upgrades. Increased barge traffic is not likely to disturb EFH. If disturbed by vessel traffic, fish would likely avoid or leave the area for the duration of the disturbance, and return once the disturbance ceases. The sensitive months for seasonally sensitive species identified by NMFS would be taken into account for project activities. EFH would not be disturbed by vessel traffic. Activities associated with the Basic Alternative would result in temporary and minimal impacts to fish, and would have no adverse effect on EFH. Therefore, less than significant impacts are anticipated with the implementation of the Basic Alternative.

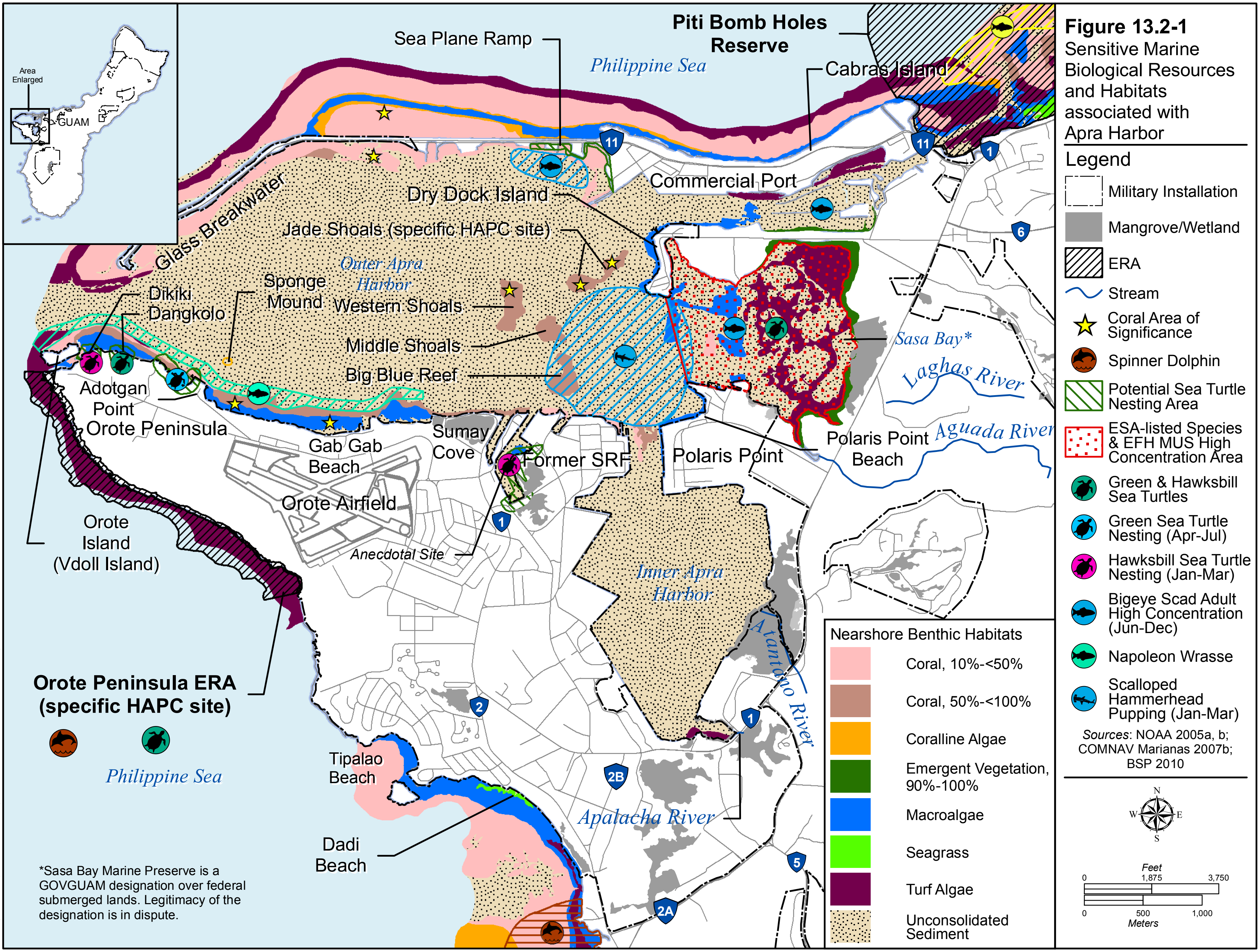

Figure 13.2-1
Sensitive Marine Biological Resources and Habitats associated with Apra Harbor

*Sasa Bay Marine Preserve is a GOVGUAM designation over federal submerged lands. Legitimacy of the designation is in dispute.

Sources: NOAA 2005a, b; COMNAV Marianas 2007b; BSP 2010

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Special-Status Species

Special-status species (sea turtles and dolphins) in the project area would not be directly affected by activities associated with the Basic Alternative, and indirect impacts would be minimal. Upgrades to the power systems, which include construction activities and increased road traffic may lead to temporary decreases in water quality from runoff, but these impacts would be minimized by the use of BMPs and restricted to the duration of the upgrades. Volume 6, Chapter 6 discusses stormwater runoff from construction activities and BMPs to control pollutant runoff in more detail. Increased barge traffic that may be associated with transport of construction materials is not likely to disturb special-status species, as these species are highly mobile. If disturbed by vessel traffic, sea turtles and dolphins would likely avoid or leave the area for the duration of the disturbance, and return once the disturbance ceases. Activities associated with the Basic Alternative may affect, but are not likely to adversely affect sea turtles. No serious injury or mortality of any marine mammal species, specifically spinner and bottlenose dolphins, is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of the Basic Alternative. Therefore, a less than significant impact is anticipated with the implementation of the Basic Alternative.

Non-native Species

Increased barge traffic associated with refurbishing of power utilities offers the potential for an increase in introductions of non-native invasive species into the project area. Existing U.S. Coast Guard (USCG) and Navy policies regarding hull and ballast water management would be required by vessels. The Navy is developing the Micronesia Biosecurity Plan (MBP) and would implement interim measures designed to reduce the potential of non-native invasive species introductions. Impacts from non-native invasive species would be minimal.

Operation

Marine Flora, Invertebrates, and Associated EFH

Marine flora, invertebrates and associated EFH in the project area would not be directly affected by activities (direct or indirect impacts of the military relocation) associated with the Basic Alternative, and indirect impacts would be minimal. Operation of the power systems may include increased road and or barge traffic involved in supporting maintenance operations, but these impacts are expected to be negligible. Increased entrainment of larvae by the saltwater intake systems at the Tanguisson and Cabra/Piti Power Plants is possible with the increased need for cooling water. However, these increases are anticipated to be minimal and impacts would likely be to a small number of organisms, so negligible. Likewise, increased thermal discharges would be minimal with little effect to the ambient conditions. The Basic Alternative would result in temporary and minimal impacts to marine flora and invertebrates, and would have no adverse effect on associated EFH.

Essential Fish Habitat

EFH MUS in the project area would not be directly affected by activities associated with the Basic Alternative (direct or indirect impacts of the military relocation), and indirect impacts would be minimal. Operation of the power systems may include increased road and or barge traffic involved in supporting maintenance operations, but these impacts are expected to be negligible. Increased barge traffic is not likely to disturb EFH. If disturbed by vessel traffic, fish would likely avoid or leave the area for the duration of the disturbance, and return once the disturbance ceases. The sensitive months for seasonally sensitive species identified by NMFS would be taken into account for project activities. EFH would not be disturbed by vessel traffic. Possible entrainment of larvae by the saltwater intake system is possible, but impacts would likely be to a small number of organisms, so minimal. The Basic Alternative would result in temporary and minimal impacts to fish, and would have no adverse effect on EFH.

Special-Status Species

Special-status species (sea turtles and dolphins) in the project area would not be directly affected by activities (direct or indirect impacts of the military relocation) associated with the Basic Alternative, and indirect impacts would be minimal. Operation of the power systems may include increased road and or barge traffic involved in supporting maintenance operations, but these impacts are expected to be negligible. Increased barge traffic is not likely to disturb special-status species, as these species are highly mobile. If disturbed by vessel traffic, sea turtles and dolphins would likely avoid or leave the area for the duration of the disturbance, and return once the disturbance ceases. Activities associated with the Basic Alternative may affect, but are not likely to adversely affect sea turtles. No serious injury or mortality of any marine mammal species, specifically spinner and bottlenose dolphins, is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of the Basic Alternative. Therefore, a less than significant impact is anticipated with the implementation of the Basic Alternative.

Non-native Species

Increased barge traffic associated with operation of power utilities offers the potential for an increase in introductions of non-native invasive species into the project area. Existing USCG and Navy policies regarding hull and ballast water management would be required by vessels. The Navy is developing the MBP and would implement interim measures designed to reduce the potential of non-native invasive species introductions. Impacts from non-native invasive species would be minimal.

Proposed Mitigation Measures

As impacts to marine resources are indirect and temporary, no mitigation measures are identified at this time. The use of BMPs as described in Volume 7 would be implemented as appropriate to avoid and minimize negative impacts to marine resources.

13.2.2.2 Summary of Impacts

Table 13.2-2 summarizes the impacts for Basic Alternative. The induced civilian population growth would have no impacts to marine biological resources since there would be limited construction and no change in operations of the power facilities.

Table 13.2-2. Summary of Potential Power Impacts on Marine Biological Resources

*Basic Alternative 1**
Construction Impacts (direct and indirect impacts are the same)
LSI • General overall minor indirect impacts from increased road and barge traffic • No adverse effect on special-status species or EFH • Minimal potential for increased introduction of non-native invasive species
Operation Impacts (direct and indirect impacts are the same)
LSI • General overall minor indirect impacts from increased road and barge traffic and possible larval entrainment in saltwater intake • No adverse effect on special-status species or EFH • Minimal potential for increased introduction of non-native invasive species

Legend: LSI = Less than significant impact. *Preferred Alternative.

13.2.3 Potable Water

As discussed in Chapter 2, potable water alternatives are not distinguished as interim or long-term but are basic alternatives that address both interim and long-term potable water demand.

13.2.3.1 Basic Alternative 1 (Preferred Alternative)

Basic Alternative 1 would provide additional water capacity of 11.3 MGd (42.8 MLd), which is anticipated to be met by an estimated 22 new wells at Andersen Air Force Base (AFB), rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 2.5 MG (9.5 ML) water storage tanks would be constructed at ground level at NCTS Finegayan. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

New Water Supply Facilities

Activities associated with Basic Alternative 1 include constructing up to 22 wells in the Andersen AFB area. Two wells located at the Naval Hospital would be rehabilitated to supplement the local supply and to the Navy island wide water system. Project activities include subgrade construction, cut/fill activities, and brush clearing. No structures would be modified or demolished for this action.

New Water Storage and Distribution Facilities

Many components are associated with the new water storage and distribution facilities for Basic Alternative 1. These include constructing pumps at each well station, installing two treated water transmission mains (including a connection to the GWA system), constructing a network of water distribution pipes on both DoD and non-DoD lands, and installation of one grade level water storage tank at Finegayan. Project activities include tree removal, cut/fill activities, and subgrade construction.

Construction

As described above, project activities planned for the area include subgrade construction, cut/fill activities, and brush clearing that are not directly associated with the marine environment, but may lead to indirect impacts. Potential indirect impacts are described below for each marine resource category. Volume 6, Chapter 6 has a more detailed discussion of control measures that would be used during construction to control pollutants in stormwater runoff.

Marine Flora, Invertebrates and Associated EFH

Marine flora, invertebrates and associated EFH in the project area would not be directly affected by activities (direct or indirect impacts of the military relocation) associated with Basic Alternative 1, and indirect impacts would be minimal. Upgrades to the potable water systems, which include construction activities and increased road traffic may lead to temporary decreases in water quality from runoff, but these impacts would be minimized by the use of BMPs and restricted to the duration of the upgrades. Volume 6, Chapter 6 has a more detailed discussion of BMPs that would be used during construction to control pollutants in stormwater runoff. Increased vessel traffic related to the delivery of construction materials is not likely to disturb marine flora or invertebrates. Basic Alternative 1 would result in temporary and minimal impacts to marine flora and invertebrates, and would have no adverse effect on associated EFH.

Essential Fish Habitat

EFH MUS in the project area would not be directly affected by activities (direct or indirect impacts of the military relocation) associated with Basic Alternative 1, and indirect impacts would be minimal.

Upgrades to the potable water systems, which include construction activities and increased road traffic may lead to temporary decreases in water quality from runoff, but these impacts would be minimized by the use of BMPs and restricted to the duration of the upgrades. Volume 6, Chapter 6 has a more detailed discussion of BMPs that would be used during construction to control pollutants in stormwater runoff. Increased vessel traffic related to the delivery of construction materials is not likely to disturb fish and associated EFH. If disturbed by vessel traffic, fish would likely avoid or leave the area for the duration of the disturbance, and return once the disturbance ceases. The sensitive months for seasonally sensitive species identified by NMFS would be taken into account for project activities. EFH would not be disturbed by vessel traffic. Basic Alternative 1 would result in temporary and minimal impacts to fish, and would have no adverse effect on EFH.

Special-Status Species

Special-status species (sea turtles and dolphins) in the project area would not be directly affected by activities (direct or indirect impacts of the military relocation) associated with Basic Alternative 1, and indirect impacts would be minimal. Upgrades to the potable water systems, which include construction activities and increased road traffic may lead to temporary decreases in water quality from runoff, but these impacts would be minimized by the use of BMPs and restricted to the duration of the upgrades. Volume 6, Chapter 6 has a more detailed discussion of BMPs that would be used during construction to control pollutants in stormwater runoff. Increased vessel traffic related to the delivery of construction materials is not likely to disturb special-status species, as these species are highly mobile. If disturbed by vessel traffic, sea turtles and dolphins would likely avoid or leave the area for the duration of the disturbance, and return once the disturbance ceases. Activities associated with Basic Alternative 1 may affect, but are not likely to adversely affect sea turtles. No serious injury or mortality of any marine mammal species, specifically spinner and bottlenose dolphins, is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Basic Alternative 1. Therefore, a less than significant impact is anticipated with the implementation of Basic Alternative 1.

Non-native Species

Increased vessel traffic associated with construction of potable water infrastructure offers the potential for an increase in introductions of non-native invasive species into the project area. Existing USCG and Navy policies regarding hull and ballast water management would be required by vessels. The Navy is developing the MBP and would implement interim measures designed to reduce the potential of non-native invasive species introductions. Interim measures may include incorporating into contractual agreements with vessels chartered to support the criteria specific to the military relocation to ensure low levels of biofouling and ballast water management. Impacts from introductions of non-native marine species would be minimal and limited to the construction phase of the proposed action.

Operation

Marine Flora, Invertebrates and Associated EFH

Marine flora, invertebrates and associated EFH in the project area would not be directly affected by activities (direct or indirect impacts of the military relocation) associated with Basic Alternative 1, and indirect impacts would be minimal. Operation of the potable water systems may include discharge of water to the ground involved in supporting maintenance operations, but these discharges are unlikely to reach marine waters, and if they do impacts are expected to be negligible. Basic Alternative 1 would result in no impacts to marine flora and invertebrates, and would have no adverse effect on associated EFH.

Essential Fish Habitat

EFH MUS in the project area would not be directly affected by activities (direct or indirect impacts of the military relocation) associated with Basic Alternative 1, and indirect impacts would be minimal. Operation of the potable water systems may include discharge of water to the ground involved in supporting maintenance operations, but these discharges are unlikely to reach marine waters, and if they do impacts are expected to be negligible. Basic Alternative 1 would result in no impacts to this resource, and therefore have no adverse effect on EFH.

Special-Status Species

Special-status species (sea turtles and dolphins) in the project area would not be directly affected by activities (direct or indirect impacts of the military relocation) associated with Basic Alternative 1, and indirect impacts would be minimal. Operation of the potable water systems may include discharge of water to the ground involved in supporting maintenance operations, but these discharges are unlikely to reach marine waters, and if they do impacts are expected to be negligible. Activities associated with Basic Alternative 1 would have no effect on ESA-listed sea turtles or any marine mammal species. Therefore, no impacts are anticipated to special-status species with the implementation of Basic Alternative 1.

Non-native Species

Since non-native marine species are associated with vessel hulls and discharges, and vessel traffic is not associated with the operation of the potable water system, then there would be no impacts related to the introduction of non-native marine species.

Proposed Mitigation Measures

As impacts to marine resources are indirect and temporary, no mitigation measures are identified at this time. The use of BMPs as described in Volume 6, Chapter 6 and summarized in Volume 7 would be implemented as appropriate to avoid and minimize negative impacts to marine resources. The Navy is developing the MBP and is implementing interim measures to reduce the likelihood of potentially invasive marine organisms.

13.2.3.2 Basic Alternative 2

Basic Alternative 2 would provide additional water capacity of 11.7 MGd (44.3 MLd), which is anticipated to be met by an estimated 20 new wells at Andersen Air Force Base (AFB) and 11 new wells at Air Force Base Barrigada, rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 1.8 MG (6.8 ML) water storage tanks would be constructed at ground level at NCTS Finegayan and one 1 MG (3.8 ML) water storage tank would be construction at Air Force Base Barrigada. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

New Water Supply Facilities

Activities associated with Alternative 2 are the same as for Basic Alternative 1 for the new water supply facilities. Impacts to the areas include subgrade construction, cut/fill activities, and brush clearing.

New Water Storage and Distribution Facilities

Many components are associated with the new water storage and distribution facilities for Basic Alternative 2. These include constructing pumps at each well station, installing two treated water transmission mains (including a connection to the GWA system), constructing a network of water distribution pipes on both DoD and non-DoD lands, and two grade level water storage tanks (one at Finegayan and one at Air Force Barrigada). Impacts to the areas include tree removal, cut/fill activities, and subgrade construction.

Volume 6, Chapter 2 figures provide the proposed project locations in relation to the marine environment on Andersen AFB, Finegayan, Andersen South, and Barrigada. Due to the large distance from shore, this alternative and its actions are not directly associated with the marine environment.

As described above, project activities planned for the area include subgrade construction, cut/fill activities, and brush clearing that are not directly associated with the marine environment, but may lead to indirect impacts. Potential indirect impacts are described below for each marine resource category.

Construction

Marine Flora, Invertebrates and Associated EFH

Marine flora, invertebrates and associated EFH in the project area would not be directly affected by activities (direct or indirect impacts of the military relocation) associated with Basic Alternative 2, and indirect impacts would be minimal. Upgrades to the potable water systems, which include construction activities and increased road traffic may lead to temporary decreases in water quality from runoff, but these impacts would be minimized by the use of BMPs and restricted to the duration of the upgrades. Volume 6, Chapter 6 has a more detailed discussion of BMPs that would be used during construction to control pollutants in stormwater runoff. Increased vessel traffic related to the delivery of construction materials is not likely to disturb marine flora or invertebrates. Basic Alternative 2 may result in temporary and minimal impacts to marine flora and invertebrates, and would have no adverse effect on associated EFH. Therefore, less than significant impacts are anticipated with the implementation of Basic Alternative 2.

Essential Fish Habitat

EFH MUS in the project area would not be directly affected by activities (direct or indirect impacts of the military relocation) associated with Basic Alternative 2, and indirect impacts would be minimal. Upgrades to the potable water systems, which include construction activities and increased road traffic may lead to temporary decreases in water quality from runoff, but these impacts would be minimized by the use of BMPs and restricted to the duration of the upgrades. Volume 6, Chapter 6 has a more detailed discussion of BMPs that would be used during construction to control pollutants in stormwater runoff. Increased vessel traffic related to the delivery of construction materials is not likely to disturb EFH MUS. If disturbed by vessel traffic, fish would likely avoid or leave the area for the duration of the disturbance, and return once the disturbance ceases. The sensitive months for seasonally sensitive species identified by NMFS would be taken into account for project activities. EFH would not be disturbed by vessel traffic. Basic Alternative 2 would result in temporary and minimal impacts to fish, and would have no adverse effect on EFH.

Special-Status Species

Special-status species (sea turtles and dolphins) in the project area would not be directly affected by activities (direct or indirect impacts of the military relocation) associated with Basic Alternative 2, and indirect impacts would be minimal. Upgrades to the potable water systems, which include construction activities and increased road traffic may lead to temporary decreases in water quality from runoff, but these impacts would be minimized by the use of BMPs and restricted to the duration of the upgrades. Volume 6, Chapter 6 has a more detailed discussion of BMPs that would be used during construction to control pollutants in stormwater runoff. Increased vessel traffic related to the delivery of construction materials is not likely to disturb special-status species, as these species are highly mobile. If disturbed by vessel traffic, sea turtles and dolphins would likely avoid or leave the area for the duration of the disturbance, and return once the disturbance ceases. Activities associated with Basic Alternative 2 may affect, but are not likely to adversely affect sea turtles. No serious injury or mortality of any marine mammal species, specifically spinner and bottlenose dolphins, is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Basic Alternative 2. Therefore, a less than significant impact is anticipated with the implementation of Basic Alternative 2.

Non-native Species

Although temporary, increased vessel traffic under Basic Alternative 2 offers the potential for an increase in introductions of non-native species into the project area during the construction phase. Existing hull and ballast water management programs, along with the development of the MBP and implementation of interim biosecurity measures would minimize and avoid the potential introduction of non-native invasive species. Therefore, activities associated with Basic Alternative 2 are expected to have minimal impacts with respect to the introduction of non-native marine species.

Operation

Marine Flora, Invertebrates and Associated EFH

Marine flora, invertebrates and associated EFH in the project area would not be directly affected by activities (direct or indirect impacts of the military relocation) associated with Basic Alternative 2, and indirect impacts would be minimal. Operation of the potable water systems may include discharge of water to the ground involved in supporting maintenance operations, but these discharges are unlikely to reach marine waters, and if they do impacts are expected to be negligible. Basic Alternative 2 would result no impacts to marine flora and invertebrates, and would have no adverse effect on associated EFH.

Essential Fish Habitat

EFH MUS in the project area would not be directly affected by activities (direct or indirect impacts of the military relocation) associated with Basic Alternative 2, and indirect impacts would be minimal. Operation of the potable water systems may include discharge of water to the ground involved in supporting maintenance operations, but these discharges are unlikely to reach marine waters, and if they do impacts are expected to be negligible. Basic Alternative 2 would result in no impacts to fish, and would have no adverse effect on EFH.

Special-Status Species

Special-status species (sea turtles and dolphins) in the project area would not be directly affected by activities (direct or indirect impacts of the military relocation) associated with Basic Alternative 2, and indirect impacts would be minimal. Operation of the potable water systems may include discharge of water to the ground involved in supporting maintenance operations, but these discharges are unlikely to reach marine waters, and if they do impacts are expected to be negligible. Activities associated with the

Basic Alternative 2 would have no effect on ESA-listed sea turtles or any marine mammal species. Therefore, no impacts are anticipated with the implementation of Basic Alternative 2.

Non-native Species

Since potentially invasive non-native marine species are associated with vessel hulls and discharges, and vessel traffic is not associated with the operation of the potable water system, then there would be no impacts related to introduction of non-native marine species.

13.2.3.3 Summary of Impacts

Table 13.2-3 summarizes the impacts. A text summary is provided below.

Table 13.2-3. Summary of Potential Impacts to Marine Biological Resources-Potable Water

*Basic Alternative 1**	*Basic Alternative 2*
Construction Impacts (direct and indirect impacts are the same)	
LSI • General overall minor indirect impacts from increased road and barge traffic • No adverse effect on special-status species or EFH • Minimal potential for increased introduction of non-native invasive species	LSI • General overall minor indirect impacts from increased road and barge traffic • No adverse effect on special-status species or EFH • Minimal potential for increased introduction of non-native invasive species
Operation Impacts (direct and indirect impacts are the same)	
NI • Discharge to ground during maintenance activities • No adverse effect on special-status species or EFH • No potential for increased introduction of non-native invasive species	NI • Discharge to ground during maintenance activities • No adverse effect on special-status species or EFH • No potential for increased introduction of non-native invasive species

Legend: EFH = Essential Fish Habitat; LSI = Less than significant impact.
*Preferred Alternative.

Basic Alternatives 1 and 2 do not have construction or operation-related actions that are associated with the marine environment; however, there would be an associated increase in barge traffic into Apra Harbor carrying construction- and operation-related materials. There is small potential for runoff to reach the marine environment. The induced civilian population growth would have no impacts to marine biological resources since there is limited construction or change in operations. Alternatives 1 and 2 would result in less than significant impacts to marine biological resources.

13.2.4 Wastewater

13.2.4.1 Basic Alternative 1a (Preferred Alternative) and 1b

As described in Section 3.2.4.1 Basic Alternative 1 (Alternative 1a supports Main Cantonment Alternatives 1 and 2; Alternative 1b supports Main Cantonment Alternatives 3 and 8), combining upgrades to the existing primary treatment facilities and expansion to secondary treatment at the Northern District Wastewater Treatment Plant (NDWWTP). The difference between Alternatives 1a and 1b is a requirement for a new sewer line from proposed DoD housing at Barrigada to NDWWTP for Alternative

1b. For both alternatives, industrial wastewater generated on DoD properties would be pretreated in accordance with a local DoD pretreatment program that uses standard industry practices, or with a GWA pretreatment program once one is established, before discharging wastewater to the sanitary sewer system.

Basic Alternative 1a

Construction

The land-based construction has the potential for temporary increases in sediment laden stormwater, which may impact near shore waters. However, as described and evaluated in Volume 6, Chapter 6 Section 6.2.4, National Pollutant Discharge Elimination System (NPDES) permits, requiring construction Stormwater Pollution Prevention Plans (SWPPPs) and associated BMPs would reduce or eliminate discharge from the site. Special-status species (sea turtles and dolphins) and the EFH would not be directly affected by construction activities. Increased vessel traffic associated with the delivery of construction materials is not likely to disturb special-status species and EFH, as these species are highly mobile and barges are slow moving. Although temporary, increased construction-related vessel traffic offers the potential for an increase in introductions of non-native invasive species into the project area. Existing Navy hull and ballast water policies and the implementation of a MBP would avoid introducing non-native invasive species.

The Navy is developing the MBP and would implement interim biosecurity measures to reduce the likelihood of introducing and spreading invasive marine organisms. Some example BMPs may include clarifying biosecurity requirements for all Navy vessels (including chartered MSC ships), improving hull husbandry documentation, and incorporating into contractual agreements with vessels chartered to support the military-relocation specific criteria to ensure low levels of biofouling and ballast water management.

Alternative 1 construction impacts would be less than significant to marine biological resources, and would have no adverse effects on EFH.

Operation

As stated in Chapter 2, the proposed military relocation on Guam would be potentially located at Andersen AFB, NCTS Finegayan, South Finegayan, Andersen South, Barrigada, and Naval Base Guam at Apra Harbor. These areas are currently serviced by wastewater treatment plants owned by the Guam Water Authority (GWA) and the Navy. Of these plants, two are considered as alterative locations for wastewater treatment for the discharges directly associated with the military buildup, which includes wastewater from the DoD population and new facilities on DoD property. These are GWA's Northern District Wastewater Treatment Plant (NDWWTP) and Navy's Apra Harbor WWTP. Figure 2.3-1 shows the locations of these wastewater treatment plants that could receive wastewater from the direct DoD populations that would result from the military relocation.

The construction workforce was assumed to make up two-thirds of the residents in North Guam and one-third in Central Guam, while induced civilian population growth was assumed to make up 38 percent (%) of the population on North Guam, 43% of Central Guam, and 19% of South Guam, as estimated by the socioeconomic analysis., The NDWWTP and the Hagatna WWTP are expected to treat the vast majority of the increased wastewater flows that would be generated by the temporary construction workforce and the induced civilian population, based on these predictions of where these populations would reside. Other GWA wastewater treatment facilities are on Guam that are not in the proposed military relocation area, but would be indirectly affected by the relocation-induced civilian population growth. These facilities are located among scattered communities in South Guam and include Agat–Santa Rita WWTP, Baza Gardens WWTP, Umatac-Merizo WWTP, and Inarajan WWTP. Descriptions of all these wastewater systems are provided in Chapters 2 and 3 of this Volume. The United States Department of Justice (DOJ) filed a civil suit against GWA and the GovGuam in December 2002 for failure to comply with the Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA) (*U.S. versus Guam Waterworks Authority*, Civil No. 02-00035 (D. Guam)). A Stipulated Order (SO) for Preliminary Relief was entered in June 2003. Subsequently, the parties agreed to two modifications of the SO. The second amended SO was entered by the court in October 2006. The parties viewed the SO as the most appropriate way to require GWA to immediately implement short-term projects to address GWA's compliance with the CWA and SDWA. The SO indicates that the parties contemplate entering into a further stipulation to address additional compliance issues after GWA's completion of the initial planning measures set out in the SO. The SO requires the following steps:

- Construction of a new ocean outfall at the Hagatna WWTP by January 1, 2008
- Construction of a new ocean outfall at the NDWWTP by January 1, 2009
- Implementation of corrective actions to restore primary treatment to the original design operational capacity at the Hagatna WWTP and the NDWWTP by March 2, 2007
- Implementation of corrective actions to restore operational capacity at the Hagatna Main Sewage Pump Station (SPS) by March 2, 2007
- Implementation of corrective actions to stop overflows of raw sewage from the Hagatna Main SPS, including development of an implementation schedule
- Assessment of the Chaot Wastewater Pump Station and sewer collection and conveyance system, including development of an implementation schedule
- Renovation and/or Expansions of Agat, Baza Gardens, and Umatac-Merizo WWTPs

As part of compliance with the SO, the GWA submitted the WRMP in 2007. The WRMP lists the following goals:

- Institute sound asset management and capital planning.
- Develop a foundation for sound management, operations, and maintenance and financial planning.
- Engage the customer and achieve the appropriate level of service.
- Achieve long-term resource sustainability.
- Establish a road map for full regulatory compliance.

Direct Impacts

NDWWTP

The NDWWTP is a primary treatment plant that is owned by the GWA and operated by Veolia under contract with the GWA. The treatment plant treats wastewater flows from civilian populations and DoD installations that are located in North Guam. Andersen AFB, NCTS Finegayan, and South Finegayan contribute wastewater flows to the NDWWTP.

The NDWWTP could potentially receive the majority of wastewater flows from the direct DoD population that would results from the military relocation. It could also potentially receive a portion of the wastewater flows from the indirect construction workforce population and the induced civilian population. The NDWWTP is a GWA plant that services the areas where much of the direct military relocation would occur. The GWA holds an NPDES permit for the NDWWTP, which was issued by USEPA Region 9 in June 1986. The NDWWTP discharges to the Philippine Sea through an offshore ocean outfall. The ocean outfall is designed with a diffuser that has discharge ports to disperse the effluent into the ocean; however, the diffuser is currently out of service, having not been installed at the time of recent outfall upgrades due to a design deficiency.

The NPDES permit for the NDWWTP expired in 1991. Since that time USEPA Region 9 administratively extended the permit. The permit contained a variance that allows plant to utilize only primary treatment processes instead of more advanced treatment processes that are typically required for sewage treatment plants. Primary treatment refers to sewage treatment that uses physical separation of solid material from the waste stream prior to discharge to a water body. More advanced treatment, called secondary treatment, provides for removal of organic matter and pollutants in sewage beyond what can be removed in primary treatment plants, typically by using bacteria as a means to digest and remove wastes. Secondary treatment variances are allowed under Section 301(h) of the Clean Water Act. Sewage treatment facilities that are granted a 301(h) secondary treatment variance must demonstrate that their discharge does not have an adverse impact on the environment or on water quality. They must also demonstrate that they adequately control industrial wastes that could enter the plant, and they must meet minimum standards for pollutants removal efficiencies in their treatment processes.

On September 30, 2009, USEPA Region 9 made a decision to deny the secondary treatment variance for the NDWWTP, which effectively requires the GWA to install full secondary treatment at the plant. The GWA has formally challenged USEPA's decision to deny the secondary variance, so it is unclear at this time if secondary treatment would be required at the NDWWTP. However, the alternatives presented in this EIS were adjusted to recognize this secondary variance denial and reflect the potential future need for secondary treatment plant upgrades for all alternatives evaluated by providing a phased approach to upgrading the plant. This is discussed in detail in Chapter 2 and 3 of this Volume.

The Navy conducted a study to evaluate potential impacts on water quality and the marine environment from the GWA NDWWTP, a primary treatment plant. The study, *Northern District Wastewater Treatment Outfall Assessment* (NAVFAC Pacific 2009), is located in Volume 9, Appendix K, and was used to assess the magnitude and duration of potential impacts to marine resources. Pertinent data and information from the draft study was used in this Environmental Impact Statement, along with other available information, to evaluate the water quality and marine environment impacts in this chapter. The study assesses impacts to the receiving marine environment resulting from the primary and secondary treatment and disposal of wastewater, including additional wastewater loadings associated with the military relocation on Guam.

Based on current conditions of the existing primary treatment processes, the NDWWTP would need to be refurbished and upgraded to restore its original design capacity and treatment capability of 12 MGd (45 MLd) average flow to meet the projected flows shown in Chapter 2. Also, an enforcement order is being developed between the GWA and USEPA Region 9 that would include provisions to allow increased average daily flows of 12 MGd (45 MLd) and maximum daily flows of 27 MGd (102 MLd) to accommodate the projected ultimate flow from the planned Marine Corps relocation at the completion of relocation for Main Cantonment Alternatives 1 and 2. Currently the NPDES permit allows only a 6 MGd (23 MLd) flow at the plant discharge, even though the plant design flow is 12 MGd (45 MLd). The DoD, as part of the military relocation to Guam, proposes to refurbish and upgrade the NDWWTP through a Special Purpose Entity (for more detail see Volume 6, Chapter 2). The proposed refurbishment and upgrades would improve the quality of the plant effluent and assist in meeting coastal water quality standards.

According to the USEPA Clean Water Act Section 301(h) waiver denial (USEPA 2009), the existing NDWWTP primary treatment plant is removing Biochemical Oxygen Demand (BOD) and Total

Suspended Solids (TSS) at only approximately 30% efficiency, while the plant was designed for 50–75% and 40–60% removal efficiencies for TSS and BOD respectively.

Table 13.2-4 shows the existing actual end-of-pipe pollutant concentrations of the effluent from the NDWWTP primary treatment plant based on results of the Navy's outfall assessment study (NAVFAC Pacific 2009), which shows that the plant is operating at approximately 50% of its intended removal capacity as originally designed (USEPA 2009). Table 13.2-4 also shows the estimated primary treatment plant effluent pollutant concentrations after the proposed DoD refurbishment based on the original design removal efficiency and shows the predicted effluent pollutant concentrations after secondary treatment upgrades (NAVFAC Pacific 2009). Using the data and estimates of pollutant removal concentrations from the USEPA Clean Water Act Section 301(h) waiver denial (USEPA 2009), effluent pollutant concentrations for Basic Alternative 1a after plant refurbishment and upgrades would result in pollutant concentrations reduced by approximately half of the current concentrations. A more conservative 40% increase in removal efficiency versus 50% per original design was assumed when calculating these predicted pollutant concentrations. The NDWWTP plant is designed to discharge plant effluent to the marine environment through an offshore ocean diffuser; however, this diffuser is not currently in service. Were the outfall diffuser in service, concentrations in the marine environment would be even lower than shown in the table. Because the diffuser is not currently in service the pollutant concentrations in the effluent were compared directly against Guam instream marine Water Quality Standards (GWQS) in Table 13.2-4.

Table 13.2-4. Comparison of Baseline, Estimate Primary and Modeled Secondary Treatment Effluents at NDWWTP Based on Projected Flows

Constituents Regulated by the GWQS	*Units*	*Primary Treatment*		*Secondary Treatment Basic Alternative 1a (Year 2015)*
		Baseline (No-Action Alternative) Effluent	*Basic Alternative 1a (Year 2011-2012) Effluent**	*Effluent*
Enterococcus	MPN/100 ML	240,000	144,000	15
Turbidity	NTU	59	35	16
TSS	µg/L	80,000	48,000	9,000
Ortho-P	µgP/L	2,620	1,570	1,640
Ammonia	µgN/L	18,400	11,040	3,500
Total Nitrogen	µgN/L	47,600	28,560	23,950
Total Phosphorus	µgP/L	3,850	2,310	3,760

Legend: GWQS = Guam Water Quality Standards; ML = million liters; MPN = most probable number; NTU = Nephelometric Turbidity Unit; TSS = total suspended solids; µg/L = microgram per liter; N = Nitrogen; P = phosphorus; * estimated concentration values based on a conservative 40% increase in primary treatment plant removal efficiency (i.e. NDWWTP operating at designed removal rates after DoD refurbishing).

Environmental and biological impact assessments were also performed as part of the Navy's outfall assessment study (NAVFAC Pacific 2009). Parameters used to assess the environmental impacts on the receiving marine waters, aside from those in Section 13.2.1, include:

- Comparison with the GWQS
- Effects to 303(d) impaired waters
- Potential effects to the ecological life and environment of the receiving marine waters

Navy Apra Harbor WWTP

The Apra Harbor WWTP is a secondary treatment facility designed to treat an average daily flow of 4.3 MGd (16 MLd) and a peak flow of 9 MGd (34 MLd). The treatment plant currently receives an average daily flow of approximately 2.9 MGd (11 MLd). Treated effluent is discharged through an ocean outfall into Tipalao Bay under NPDES Permit No. GU0110019. This permit authorizes the Apra Harbor WWTP to discharge an average monthly flow of 4.3 MGd (16.3 MLd). The Navy-owned outfall also discharges effluent from the GWA Agat–Santa Rita WWTP (NPDES Permit No. GU0020222).

Proposed increases in the DoD population in the Apra Harbor area would increase the wastewater flow to the Apra Harbor WWTP by about 0.79 MGd (2.99 MLd), for a total projected flow of 3.69 MGd (13.96 MLd). This increase would occur when proposed transient ships would be in port, thus would not be a full time demand. This is within the design capacity and permit limits; therefore, no additional wastewater treatment capacity would be needed at the Apra Harbor WWTP, and no changes to the NPDES permit would be necessary. See Chapter 3 for additional information.

Indirect Impacts

Hagatna WWTP

The Hagatna WWTP is a primary treatment plant that is owned and operated by the GWA. The treatment plant treats wastewater flows from civilian populations and DoD lands that are located in Central Guam. Navy and Air Force Barrigada, the Naval Hospital, and DoD lands located in the Nimitz Hill area contribute wastewater flows to the Hagatna WWTP.

The Central Guam sewer collection system that conveys sewage to the Hagatna WWTP has several capacity limitations, which create periodic overflows during high flow conditions. To alleviate the problem, in 2008 the GWA issued a moratorium that limits development and new sewer connection, which was lifted in early 2009 based on planned improvements to the collection system to address sewer-line capacity issues. The Hagatna WWTP is designed to treat an average daily flow of 12.0 MGd (45.4 MLd) and a peak flow of 21 MGd (79 MLd). Communication with GWA has indicated that the current average daily flow to the Hagatna WWTP from civilian and military sources is approximately 4.4 MGd (16.6 MLd) (GWA 2008). Treated effluent is discharged from the WWTP through a newly constructed 42-inch (in) (107-centimeter [cm]) outfall into Agana Bay approximately 2,178 feet (ft) (664 meters [m]) offshore at a depth of approximately 275 ft (84 m) under a USEPA-administrated permit (NPDES Permit No. GU0020087) that expired on June 30, 1991. The permit contained a 301(h) variance allowing for less than secondary treatment and authorized the Hagatna WWTP to discharge a maximum daily flow of 12 MGd (45.4 MLd). The GWA failed to provide sufficient information for the USEPA to conclude that the GWA permit renewal application met the 301(h) criteria. As a result, USEPA issued a tentative decision on April 4, 1997, denying the reissuance of a 301(h) variance to the GWA. The GWA revised the permit renewal applications by installing a new extended outfall. The new outfall for the Hagatna WWTP was put into service in December 2008 and the Hagatna WWTP was refurbished in 2007 to restore its original designed capacity. Based on plant operation performance and data provided by the GWA on the actual effluent quality, the USEPA denied the GWA's application for a renewed variance from full secondary treatment on September 30, 2009, and concluded that the CWA 301(h) criteria have not been met at the Hagatna WWTP.

Plant effluent quality has improved since the plant was refurbished, but problems with elevated TSS in the discharge remain due to the processing of septage wastes at the plant and the need for improved operator training. Needed upgrades to the plant to alleviate the problems are not part of the DoD proposed action.

GWA Southern Wastewater Treatment Plants

Four small GWA WWTPs (i.e., Agat-Santa Rita WWTP, Baza Gardens WWTP, Umatac-Merizo WWTP, and Inarajan WWTPs) and their sewer collection systems in Southern Guam would be affected by the proposed military relocation from the indirect population growth from induced civilian growth in their service regions. Figure 13.2-3 shows the locations of these plants. Based on a socioeconomic analysis, 19% of the induced civilian population growth could locate to Southern Guam, increasing wastewater flows to these GWA southern WWTPs (see Table 13.2-5). According to the GWA, these treatment facilities do not comply with their effluent NPDES permits and/or other operational requirements due to inadequate treatment capacity, deterioration of equipments, and lack of maintenance. Also, the sewer collection systems for all of these facilities currently experience overloading, resulting in sewage overflows. See Chapter 3 in this Volume for additional information on these WWTPs.

As shown in Table 13.2-5, the induced population would result in only a slight increase to wastewater flows to the southern treatment plants. Two of the treatment plants, Umatac-Merizo WWTP and Inarajan WWTP, do not discharge to surface waters but percolate into the ground. Therefore, these plants are not expected to affect the marine environment and are not evaluated further in this Chapter.

One of the treatment plants, Agat-Santa Rita WWTP, discharges to the Philippines Sea through a combined ocean outfall shared with the Navy’s Apra Harbor WWTP. The other plant, Baza Gardens WWTP, discharges to surface waters. Although these treatment facilities in South Guam generally have inadequate treatment capacity, deterioration of equipment, bypassing of treatment processes, and lack of maintenance, the small increase of wastewater flow to these plants from the induced population is inconsequential and would not be expected to affect current plant removal efficiencies. See Volume 6, Chapter 3 for more information.

Table 13.2-5. Wastewater Treatment Plants in Southern Guam and the Associated Induced Population Growths and Waste Water Flows

			Year 2014			*Year 2019*		
WWTPs	*Discharge Method*	**Current WW Flow*	*Induced Population Growth*	**WW Flow generated by Induced growth*	*Increased WW Flows*	*Induced Population Growth)*	**WW Flow generated by Induced growth*	*Increased WW Flows*
			8,797			2,375		
Agat-Santa Rita	Ocean Outfall	1.81/6.85	1602			432		
Baza Garden	Surface River	0.5/1.89	440	0.053/0.201	11%	119	0.014/0.053	3%
Umatac-Merizo	Percolation to groundwater	0.41/1.55	362	0.043/0.162	11%	98	0.012/0.045	3%
Inarajan	Percolation to groundwater	0.07/0.26	60	0.007/0.026	10%	16	0.002/0.0075	3%

Notes:
1) Islandwide induced population = 46,300 at Year 2014 and 12,500 at year 2019.
2) Induced population in south is 19% of islandwide = 8,797 at Year 2014 (19% x 46,300) and 2,375 at Y2019 (19% x 12,500).
3) A total of 28% of induced population is sewered: 2,464 at Y2014 (28% x 8,797), and 665 at Y2019 (28% x 2,375).
4) Induced population serviced by each treatment plant is determined by its proportion of the current WW flow.
5) Wastewater generated by induced population is assumed at 120 gallons per capita per day.

Legend: WW = wastewater; WWTP = wastewater treatment plant; * Wastewater flows in million gallons per day/million liters per day.

Marine Flora, Invertebrates, and Associated EFH

Direct Impacts

Figure 13.2-2 shows the location of the existing NDWWTP offshore ocean outfall in relation to sensitive marine biological resources in the area. Figure 13.2-2 and Figure 13.2-4 shows the southern GWA WWTP locations and receiving waters and associated sensitive marine biological resources. Potential marine biological receptors of ocean outfall effluent constituents include a wide variety of marine flora and fauna living in or near coastal or marine waters, including humans (human exposures are addressed in Volume 6, Chapter 11, Recreational Resources, and Volume 6, Chapter 19, Public Health and Safety).

Marine flora, invertebrates, and associated EFH in the wastewater treatment plant outfall areas would be affected by activities associated with Basic Alternative 1a. As stated in Volume 2, Chapter 11, the three components of sewage effluent found to be most detrimental to marine life and coral reefs are nutrients, sediments, and toxic substances. Ammonia nitrogen, a nutrient and substance that is toxic to some marine life, probably has the most prominent sewage associated effect, especially with finfish. However, tropical ocean waters are typically characterized as low in nutrients and particulates. Therefore, the discharge of high levels of nutrients and particulates may have detrimental impacts to the receiving marine waters.

As stated in Volume 6, Chapters 2 and 3, the current NDWWTP and Hagatna WWTP are not operating as designed due to bypassing of treatment trains and poor maintenance. The proposed near-term refurbishment of the primary treatment system for the NDWWTP would result in a reduction of pollutant concentrations being discharged, contributing to improved receiving water quality in the long-term even with an increase in wastewater flows. Table 13.2-4 compares pollutant concentrations between current conditions at the NDWWTP (poor treatment of 6 MGd wastewater) to the proposed action at the plant, which includes repairing and upgrading the plant to provide primary treatment and increasing flows to 12 MGd, followed by upgrading the plant to provide secondary treatment and increasing flows up to 18 MGd. Table 13.2-4 shows that even with the substantial increase in flows that would result from the proposed action, effluent quality from the repaired and upgraded plant would be improved above what is discharged today. For example, TSS loading in the marine environment over the next 5 years under the no-action alternative (no repairs or upgrades to the plant and no increased flows) as compared to just the first phase of the proposed upgrades to the plant (repair and upgrade primary treatment) would result in the discharge of approximately 50,000 µg/L per day (or 91,250,000 µg/L) in 5 years more TSS into the marine environment in 5 years than the proposed action. After the proposed secondary upgrades are completed, these values would be lower. A similar analogy could be applied to the other pollutants found in wastewater discharge, including ammonia nitrogen.

Significant short-term and localized impacts may be seen while DoD performs plant refurbishment, however as discussed in Volume 6, Chapter 3, the use of chemical flocculants in the interim while the primary treatment systems are upgraded would increase solids removal prior to discharge, resulting in improved effluent quality and less than significant impacts. A net beneficial impact is anticipated when the planned DoD primary refurbishment of the NDWWTP has been completed, even with the increased flows as described above. The repair and upgrade of the NDWWTP would produce an effluent with lower concentration of pollutants than discharged today from the plant, resulting in improved water quality at the plant discharge. The secondary upgrades to NDWWTP system, if required, would be designed to meet GEPA ambient coastal water quality standards, and result in significantly decrease pollutants in the plant discharge. This would result in positive significant beneficial impact to coastal water quality.

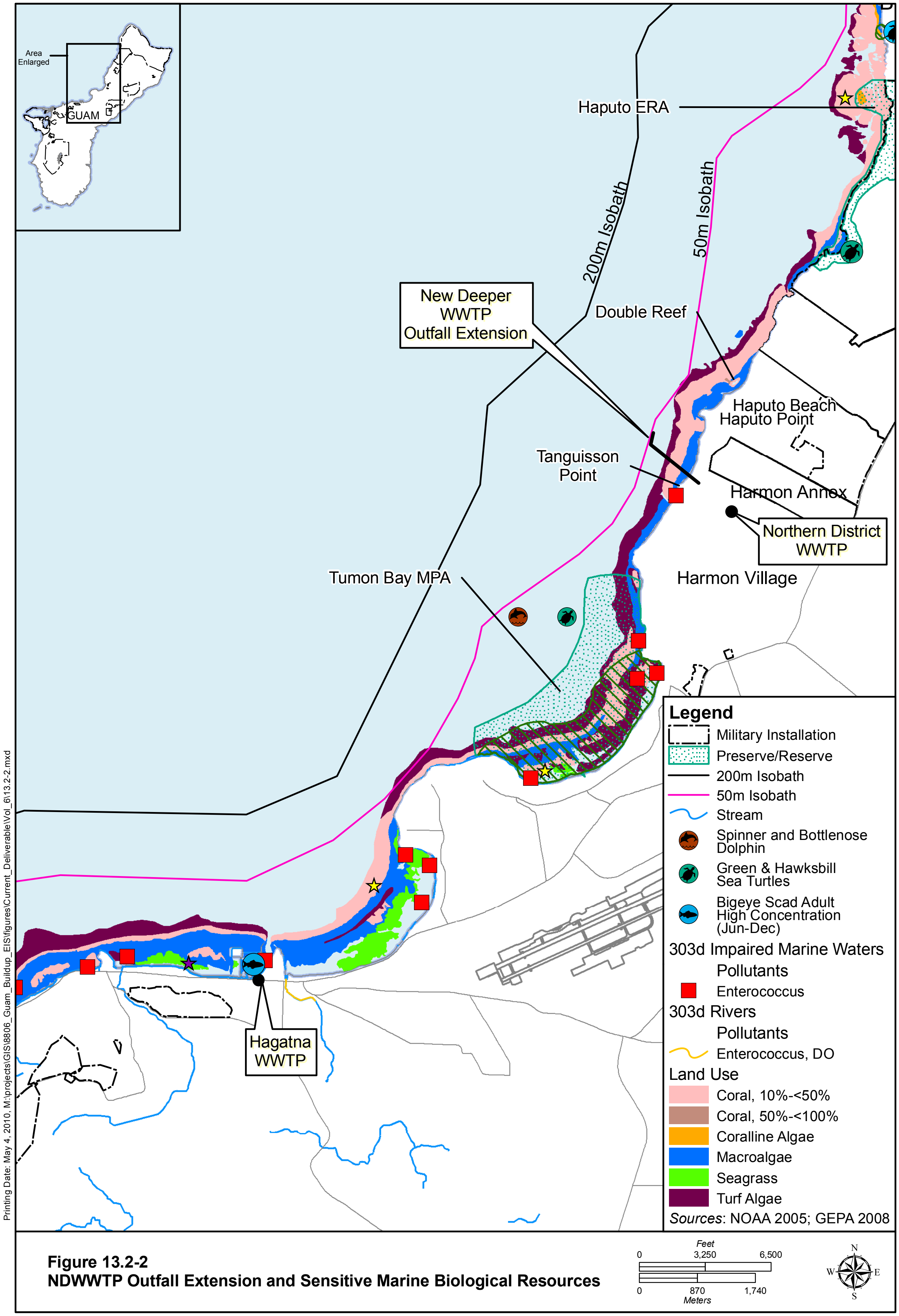
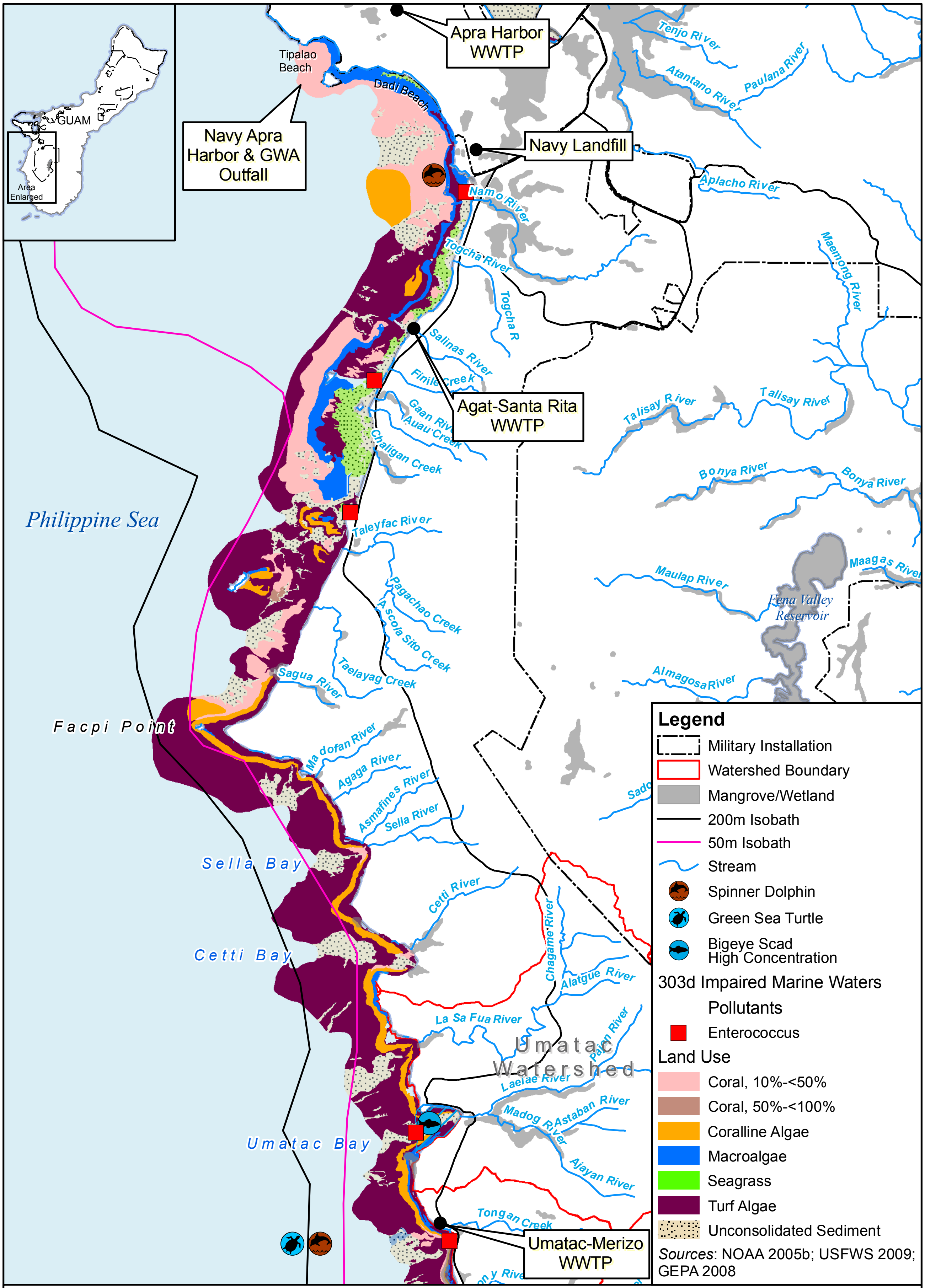


Figure 13.2-2
NDWWTP Outfall Extension and Sensitive Marine Biological Resources



Sources: NOAA 2005b; USFWS 2009; GEPA 2008

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Figure 13.2-3
Southwestern GWA WWTP Outfall Areas and Sensitive Marine Biological Resources

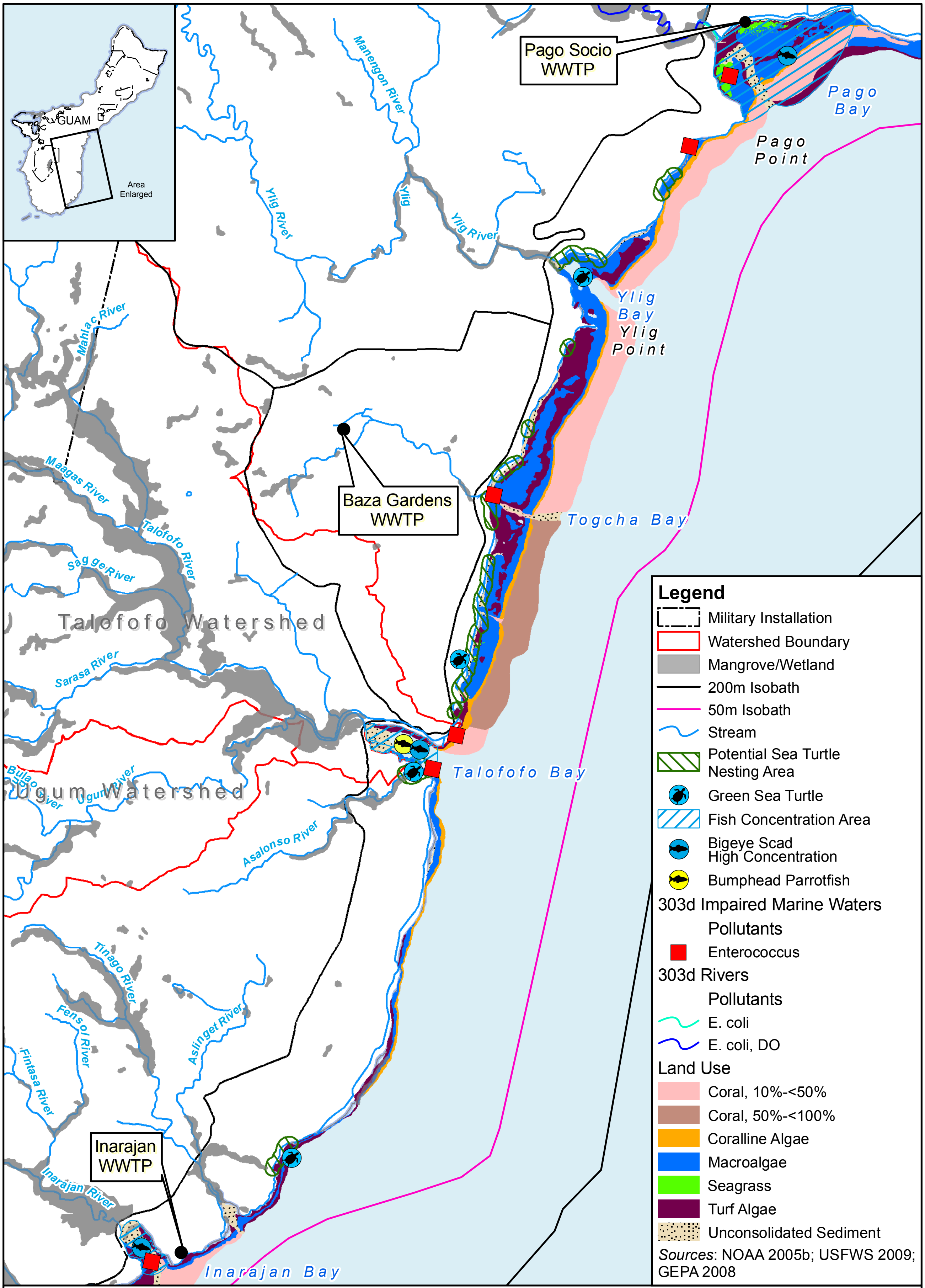

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Figure 13.2-4
Southeastern GWA WWTP Outfall Areas and Sensitive Marine Biological Resources

Feet
0 2,800 5,600
0 750 1,500
Meters
N W E S

If the DoD should fail to secure necessary financing to repair and upgrade the primary treatment capability of the NDWWTP from the Government of Japan (GoJ), significant environmental impacts would occur. These include increased flows from an already noncompliant treatment plant, resulting in further impacts on receiving waters caused by poorly treated wastewater. Consistent with the Navy's commitment to keep from significantly degrading utilities on Guam, the DoD would apply force flow reductions and/or adaptive program management of construction as explained in Volume 7, Chapter 2. Failure to secure funding for secondary treatment capability would result in failure to meet an impending enforcement order regarding secondary treatment requirements. Failure to secure necessary funding for secondary treatment may require that DoD delay or not issue construction contracts or task orders until such time as the financing is received from the GoJ and the necessary improvements to the NDWWTP primary treatment capability are implemented. Such action would severely affect the construction pace and the ability of Navy to complete required construction to support the Marine Corps relocation.

As reported in Volume 2, Chapter 11, Section 11.1.4, the nearfield plume at the deep NDWWTP outfall rises quickly with minimal horizontal dispersion before reaching the surface; therefore, minimal interaction occurs with the extant assemblages of organisms in the water column. Phytoplankton may assimilate some of the nutrients present in the near and farfield plume; however, phytoplankton requires several days to replicate, and the plume would likely disperse over a wide area in a matter of hours. The increase in biomass is not likely to be a concern, considering the low phytoplankton biomass around Guam and the vicinity (based on the low levels of chlorophyll), any increase resulting from phytoplankton productivity would be rapidly grazed by herbivorous zooplankton and fish. Detectable changes in phytoplankton or herbivorous zooplankton biomass are not anticipated, but should be monitored (Navy 2005, 2009). As a result, valuable EFH, including planktonic organisms in the water column, coral reef, and macro/turf algae habitats (700 feet [ft] [200 meters (m)]) toward the shore, are not likely to be negatively affected by the increased loading to the environment.

Considering that flora and invertebrates are generally more resistant to ammonia toxicity than fish (Ankley et al. 1996), and there are no heavy metals issues with NDWWTP, and the planned refurbishment and upgrades would considerably improve water quality, the impacts would be negligible.

Therefore, Basic Alternative 1a would result in less than significant impacts to marine flora and invertebrates, mitigated to temporary and minimal, in the NDWWTP outfall ROI. A beneficial short-term (in 2 years) and long-term impact to these resources would be expected when primary treatment system refurbishing and secondary upgrades are online, respectively. Therefore, the proposed action would have no adverse effect on associated EFH.

As described above, the Navy Apra Harbor WWTP is out of compliance for BOD, TSS, aluminum, copper, nickel, and total residual chlorine. There is a compliance strategy for all these constituents, but metals (copper in particular) would still be a problem because of the low ambient water quality standard. It is anticipated that all compliance issues would be addressed except copper. For copper, the Navy is working with the GEPA and USEPA Region 9 to obtain approval for a modified mixing zone at the ocean outfall to bring the discharge into compliance. The Navy Apra Harbor WWTP shares a deepwater outfall with the Agat-Santa Rita WWTP, discharging into the Philippine Sea outside Tipalao Bay. This water body is currently not impaired water; however the larger body (Agat Bay and associated coastal areas) are impaired waters with low priority ranking for polychlorinated biphenyls, chlordane, and dioxin in fish tissue. Therefore, with anticipated implementation of the Navy Apra Harbor WWTP compliance strategy and the GWA’s implementation of upgrades to the plant as identified in the GWA Water Resources Management Plan (WRMP), a less than significant impact on this resource is expected. Basic Alternative

1a would result in less than significant impacts on marine flora, invertebrates, and no adverse effects on associated EFH from the combined effluent at the ocean outfall for the Apra Harbor WWTP and Santa-Rita WWTP ROI.

Indirect Impacts

The increased construction workforce and induced population in Central Guam would result in increased flows to the Hagatna WWTP. Increased discharges would have the potential to decrease water quality and affect marine resources if final improvements to the plant are not made and operations are not improved. The GWA has indicated that plant operational improvements will continue as directed by the USEPA Region 9, particularly in how septage is handled at the plant. Additionally, improved plant operator training will be implemented by the GWA to maximize plant operations. This is expected to result in continued improvements to plant effluent quality. Increased effluent from this plant under Basic Alternative 1a would be expected to result in short-term and localized impacts with potential long-term beneficial impacts even with increased flows. Thus, less than significant impacts on marine flora and invertebrates and no adverse effects on associated EFH would occur in the Hagatna WWTP ROI.

Although DoD is not proposing to repair the Hagatna WWTP or upgrade it to secondary treatment as part of the proposed action, DoD is seeking funding from the GoJ to finance these upgrades. If the DoD should fail to secure necessary financing from the GoJ to repair and upgrade the NDWWTP, significant environmental impacts would occur. These impacts include increased flows from already non-compliant treatment plant, resulting in further impacts on receiving waters caused by poorly treated wastewater. Consistent with the Navy's commitment to keep from significantly affecting utilities on Guam, the DoD would apply force flow reductions and/or adaptive program management of construction as explained in Volume 7, Chapter 2. Failure to secure necessary funding may require that DoD delay or not issue construction contracts or task orders until such time as the financing is received from the GoJ and the necessary improvements to the Hagatna WWTP treatment capability are implemented. Such action would severely affect the construction pace and the ability of the Navy to complete required construction to support the Marine Corps relocation.

The two GWA southern wastewater treatment plants that directly or indirectly discharge to the marine environment, Agat-Santa Rita and Baza Gardens, would likely receive wastewater from the indirect induced population resulting from the military relocation, but are not expected to receive wastewater from the indirect construction workforce.

The Agat-Santa Rita WWTP discharges to Tipalao Bay in the Philippines Sea through a combined ocean outfall shared with the Navy’s Apra Harbor WWTP. The majority of the treatment processes and equipment are either not functioning at all or are bypassed, or are not operating within their design parameters because of deterioration or a lack of maintenance, resulting in 100% non-compliance. Another major factor in the plant's non-compliance is that the average wastewater flow to the plant is well in excess of the plant design. Unless the plant capacity is upgraded significantly or flow to this plant is diverted, permit violations will continue. However, the small increase of wastewater flows to the Agat-Santa Rita WWTP from the induced population would not contribute significant impacts to the plant in terms of plant performance and capacity. See Chapter 3 for more information. A less than significant impact on this resource is therefore expected. Basic Alternative 1a would result in less than significant impacts on marine flora and invertebrates, and no adverse effects on associated EFH in the Agat-Santa Rita WWTP ROI.

The Baza Gardens WWTP discharges effluent through a rock infiltrator to the Togcha River, which in turn flows into the Togcha Bay and Pacific Ocean. Because the treated effluent flows indirectly to a water body (river), the NPDES permit requirements are extremely strict.

The Togcha River flows to the ocean at Togcha Beach. Togcha Beach and adjacent beaches are impaired waters with high priority ranking on the Impaired Waters 303(d) list for the bacteria *Enteroccocus*, exceeding GWQS >10% of the samples. The anticipated 11% increase in wastewater flows to Baza Gardens WWTP (see Table 13.2-5) represents only a small percentage increase in flow to the plant, is within the designed treatment capacity of the plant, and is not expected to affect current plant removal efficiencies.

Therefore, Basic Alternative 1a would result in less than significant indirect impacts on Marine Flora and Invertebrates and no adverse effects on associated EFH associated with the Baza Gardens WWTP outfall ROI.

Essential Fish Habitat

The biological impacts associated with the increase in effluent discharge, especially ammonia nitrogen and sedimentation, may be significant to finfish species and corals. Combined effects of ammonia and other stressors, such as low dissolved oxygen and high temperature, are highly complex, and can be difficult to separate from the toxic effects caused by ammonia alone, especially in sensitive finfish species (Ankley et al. 1996).

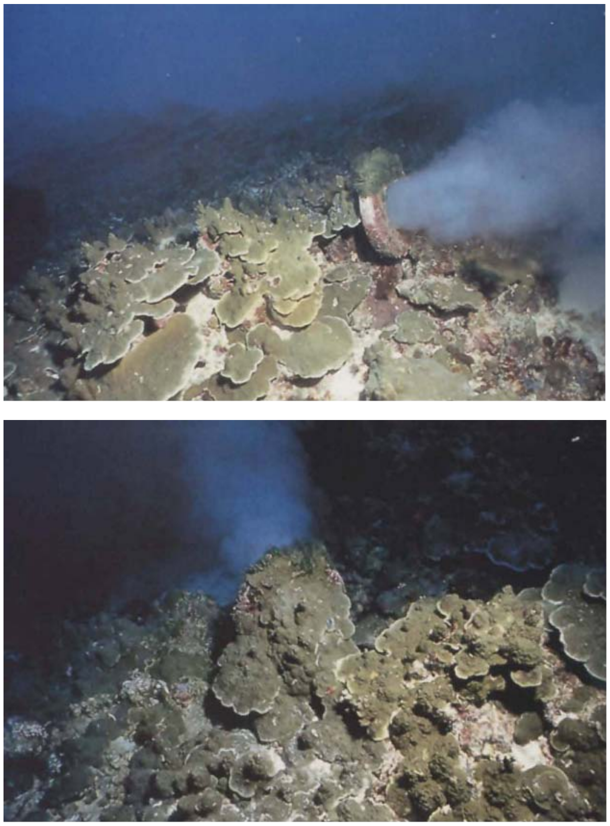

Photo credit: Dollar, S. SOAEST, UH 1994.

Figure 13.2-5. Former Tanguisson Point Primary WWTP Outfall and Coral Growth

Detrimental impacts to the coral reef ecosystems associated with excessive nutrient-loading, bacteria, and sediment abrasion have been documented in various studies (Johannes 1975, Smith et al. 1981, Pastorok and Bilyard 1985). Long-term potential impacts to finfish from elevated ammonia levels may be detrimental. Coral impacts may include increased turbidity, decreased water quality, and sedimentation in an undefined area adjacent to the diffuser. However, these impacts are dependent on the flushing properties of the receiving waters and characteristics of the sediments (NAVFAC Pacific 2009). Pastorok and Bilyard (1985) studied the impacts of sewage effluent on the coral reef ecosystem. The findings of this study indicated that the discharge of sewage had little or no impact on the coral reef ecosystems in well-flushed waters along open coasts (NAVFAC Pacific 2009). Most of the literature describing negative impacts of sewage discharge on coral reefs is limited to studies of lagoons or embayment environments with relatively long residence times that can result in buildup of nutrients and sediments to detrimental levels (Johannes 1975, Smith et al. 1981, Pastorok and Bilyard

1985). In coastal areas, discharge of treated sewage effluent may have no negative effect on coral community structure and may in fact enhance coral growth and benefit coral reef community by providing nutrient subsidies and additional surface area that is suitable for settlement and growth.

Figure 13.2-5 shows two photographs taken off Tanguisson Point in 1994 that are associated with the two diffuser ports of the Tanguisson sewage outfall (NDWWTP outfall). The outfall diffuser that was made up of 17 elevated diffuser ports (with 33-ft [10-m] separation) was aligned parallel to shore at a depth of about 66 ft (20 m). At this time period, the NDWWTP was reportedly discharging 3 to 4 MGd (11 to 15 MLd) of primary treated domestic effluent. Coral colonies, predominantly *Porities* (*Synaraea*) *rus*, have covered the discharge ports and adjacent reef areas that were excavated for placement of the diffuser pipe in the 10 years since the outfall was constructed. Effective engineering design of diffusers that maximizes dispersion, mixing, and dilution of treated plumes, and placement of outfalls in open coastal areas with high rates of water exchange appear to be important factors in preventing negative impacts to coral reef communities (Dollar 1994).

Considering the information provided above, EFH MUS (including NMFS species of concern Napoleon wrasse and Candidate Species bumphead parrotfish) found in the NDWWTP outfall ROI would experience short-term and localized negative impacts. Beneficial impacts are anticipated in the near-term (in 2 years) with the proposed primary treatment system refurbishment to the NDWWTP and with long-term loading (2010-2014) having a net beneficial impact over no-action alternative in this time period. Therefore, Basic Alternative 1a would result in more than minimal negative impacts to finfish, however temporary and localized. Thus, no adverse effect on EFH in the NDWWTP outfall ROI would occur. The implementation of Basic Alternative 1a is anticipated to result in a less than significant impact in the short-term and a beneficial impact in the long-term.

Increased wastewater treatment flows from the Hagatna WWTP outfall, the joint Navy Apra Harbor and Agat-Santa Rita WWTP outfall, and the South Guam WWTPs would be long-term impacts. However associated-effects to marine resources would be short-term impacts and localized within the ROI of the outfall. The Navy anticipates a long-term beneficial impact to the receiving water quality as the GWA brings their WWTPs into compliance in accordance with the GWA WRMP. Therefore, Basic Alternative 1a would result in no adverse effects on EFH associated with the WWTP outfalls. A less than significant impact to EFH is anticipated from the implementation of Basic Alternative 1a.

If the DoD should fail to secure necessary financing from the GoJ to repair and upgrade the primary treatment capability of the NDWWTP, significant environmental impacts would occur. These include increased flows from already non-compliant treatment plants, resulting in further impacts to receiving waters due to poorly treated wastewater. Consistent with the Navy's commitment to keep from significantly affecting utilities on Guam, the DoD would apply force flow reductions and/or adaptive program management of construction as explained in Volume 7, Chapter 2. Failure to secure funding for secondary treatment capability would result in failure to meet an impending enforcement order regarding secondary treatment requirements. Failure to secure necessary funding for secondary treatment may require that DoD delay or not issue construction contracts or task orders until such time as the financing is received from the GoJ and the necessary improvements to the NDWWTP primary treatment capability are implemented. Such action would severely affect the construction pace and the ability of Navy to complete required construction to support the Marine Corps relocation.

Although DoD is not proposing to repair the Hagatna WWTP or upgrade it to secondary treatment as part of the proposed action, DoD is seeking funding from the GoJ to finance these upgrades. If the DoD should fail to secure necessary financing from the GoJ to repair and upgrade the NDWWTP, significant environmental impacts would occur. These impacts include increased flows from an already non-compliant treatment plants, resulting in further impacts on receiving waters caused by poorly treated wastewater. Consistent with the Navy's commitment to keep from significantly affecting utilities on Guam, the DoD would apply force flow reductions and/or adaptive program management of construction as explained in Volume 7, Chapter 2. Failure to secure necessary funding may require that DoD delay or not issue construction contracts or task orders until such time as the financing is received from the GoJ and the necessary improvements to the NDWWTP primary treatment capability are implemented. Such action would have a severe impact on the construction pace and the ability of Navy to complete required construction to support the Marine Corps relocation.

Special-Status Species

The four special-status species identified in Volume 2 (green and hawksbill sea turtles, and spinner and bottlenose dolphins) are anticipated to occur in the area and may be affected by decreased water quality in the ROI of the WWTPI. Since these species are air breathing, increased turbidity should not adversely impact their respiration or biological functions (NOAA 2007). Sea turtles may forage in shallower waters in or near the project area, but are not likely to forage near the new deeper NDWWTP and Hagatna outfalls. Marine mammals (spinner dolphins) are highly mobile, and are not known to use the project areas regularly. No evidence has been shown that special-status species would be significantly affected from actions under Basic Alternative 1a. Water quality may be decreased in the nearshore habitat where these animals typical reside; however, foraging and resting habitat would not be affected nor is it limited, no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Basic Alternative 1a.

Based on the information provided previously, any impacts would be mitigated to minimal in the short-term and beneficial in the interim-term with the planned DoD primary refurbishment and subsequent upgrade to secondary treatment at the NDWWTP. Therefore, any negative impacts to sea turtles would be short-term, localized, and minimal impacts as the sea turtles pass through the WWTP ROI. The potentially significant impacts associated with Basic Alternative 1a actions are likely to affect, but are not likely to adversely affect ESA-listed sea turtles. No serious injury or mortality of any marine mammal species (spinner dolphins) is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Basic Alternative 1a.

As stated, a long-term beneficial impact would be expected after completion of the NDWWTTP primary refurbishment. Long-term beneficial impacts would also be expected concerning the Navy Apra Harbor, Hagatna, and associated ROIs of the southern WWTP outfalls when the GWA successfully brings these plants into compliance.

Therefore, activities associated with Basic Alternative 1a would result in short-term, localized, and minimal indirect impacts to special-status species.

If the DoD should fail to secure necessary financing from the GoJ to repair and upgrade the primary treatment capability of the NDWWTP, significant environmental impacts would occur. These include increased flows from an already non-compliant treatment plants, resulting in further impacts on receiving waters due to poorly treated wastewater. Consistent with the Navy's commitment to keep from significantly affecting utilities on Guam, the DoD would apply force flow reductions and/or adaptive program management of construction as explained in Volume 7, Chapter 2. Failure to secure funding for secondary treatment capability would result in failure to meet an impending enforcement order regarding secondary treatment requirements. Failure to secure necessary funding for secondary treatment may require that the DoD delay or not issue construction contracts or task orders until such time as the financing is received from the GoJ and the necessary improvements to the NDWWTP primary treatment capability are implemented. Such action would severely affect the construction pace and the ability of Navy to complete required construction to support the Marine Corps relocation.

Although the DoD is not proposing to repair the Hagatna WWTP or upgrade it to secondary treatment as part of the proposed action, the DoD is seeking funding from the GoJ to finance these upgrades. If the DoD should fail to secure necessary financing from the GoJ to repair and upgrade the NDWWTP, significant environmental impacts would occur. These include increased flows from an already non-compliant treatment plants, resulting in further impacts on receiving waters caused by poorly treated wastewater. Consistent with the Navy's commitment to keep from significantly affecting utilities on Guam, the DoD would apply force flow reductions and/or adaptive program management of construction as explained in Volume 7, Chapter 2. Failure to secure necessary funding may require that the DoD delay or not issue construction contracts or task orders until such time as the financing is received from the GoJ and the necessary improvements to the NDWWTP primary treatment capability are implemented. Such action would have a severe impact on the construction pace and the ability of Navy to complete required construction to support the Marine Corps relocation.

Non-native Species

WWTP outfalls are not a known pathway for the introduction of potentially invasive non-native invasive species. Therefore, activities associated with Basic Alternative 1a are expected to have minimal impacts with respect to the introduction of non-native marine species.

Proposed Mitigation Measures

- To minimize adverse impacts associated with the proposed military relocation program on these wastewater treatment facilities, the DoD would assist GWA in identifying where the impacts are in South Guam and work with GWA to prioritize the improvement projects, and DoD is also leading a federal inter-agency effort to identify other federal programs and funding sources that could benefit the people of Guam.
- To offset negative impacts to marine biological resources from the increased volume of effluent released and coral impacts from dredging (Volume 4 compensatory mitigation), the DoD has developed short-term and long-term upgrades to the wastewater treatment system. For the short-term, upgrades to the current primary wastewater treatment system would take place in the 2011-2012 timeframe. For the long-term, upgrades to the system would be made resulting in secondary wastewater treatment by 2015. These upgrades would significantly improve the effluent water quality, resulting in conditions that are more favorable than the no-action alternative in the short- and long-term.
- Additional mitigation measures would include use of chemical flocculants at the NDWWTP as an interim measure while the primary upgrades are being done to increase solids removal prior to discharge.

See Volume 7 for a comprehensive list of BMPs and mitigation measures for in-water construction activities and for vessels underway, and Volume 2, Chapter 11 for a detailed description of general maritime measures in place by the military.

The implementation of appropriate resource agency (USFWS/NOAA/NMFS) BMPs, construction and industrial permit BMPs, Navy LID concept plans and Industrial Management Practices, USACE permit conditions, and general maritime measures in place by the military and USCG is assumed for each resource and anticipated to reduce any construction- and operation-related impacts to marine biological resources. With respect to possible construction impacts on the nearshore marine environment, the implementation and management of such plans would reduce/eliminate any construction-related stormwater runoff into the nearshore environment. The LID concept plan would support master planning activities, and through these joint efforts, a sustainable development strategy would be implemented where pre-construction site hydrology would be equal or nearly equal to post-construction hydrology. Stormwater would be treated for pollutants prior to discharge to the porous ground surface.

Basic Alternative 1b

The difference between Alternatives 1a and 1b is a requirement for a new sewer line from Barrigada housing to NDWWTP for Alternative 1b. For both alternatives, industrial wastewater generated on the DoD land would be pretreated in accordance with GWA pretreatment program before discharging wastewater to the sanitary sewer system.

Construction

Impacts from activities associated Basic Alternative 1b would be the similar to those described under Basic Alternative 1a. Alternative 1b impacts would be less than significant to marine biological resources, and would have no adverse effects on EFH.

Operation

Impacts from activities associated with Basic Alternative 1b would be the same to those described under Basic Alternative 1a.

13.2.4.2 Summary of Impacts

Table 13.2-6 summarizes the impacts from wastewater. A text summary is provided below.

The proposed action, even with increased flow, would improve water quality in the marine environment within the NDWWTP ROI, providing beneficial impacts to marine biological resources associated with outfall waters. Any WWTP-related long-term, chronic, or cumulative adverse effect on marine organisms would be significantly reduced over the no-action alternative at the site.

Basic Alternative 1a and 1b would result in no adverse effects on EFH. Finfish may experience short-term and localized elevated concentration levels of nutrients (e.g., ammonia nitrogen), sediments, and toxic substances found within sewage discharges within the near and farfield plume exceeding GWQS. This issue is of particular concern at the southern GWA WWTPs, which already are not meeting discharge criteria in their associated impaired water bodies. The receiving waters (and WWTP) and EFH affected areas include: Philippine Sea off Tanguisson Point (NDWWTP); Philippine Sea/Agana Bay (Hagatna WWTP); Philippine Sea/Tipalao Bay/Agat Bay, Philippine Sea/Umatac Bay, Pacific Ocean/Inarajan Bay, and Pacific Ocean/Togcha Bay. However, these impacts are expected to be short-term, localized, and minimal. Long-term beneficial impacts are anticipated when the GWA brings their WWTPs into compliance as directed by the USEPA stipulated order and subsequently prepared Guam WRMP.

Basic Alternative 1a actions are likely to affect, but are not likely to adversely affect ESA-listed sea turtles. No serious injury or mortality of any marine mammal species (spinner dolphins) is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Basic Alternative 1a.

Table 13.2-6. Summary of Potential Impacts to Marine Biological Resources-Wastewater

*Basic Alternative 1a**	*Basic Alternative 1b*
Construction Impacts (no direct or indirect impacts)	
Marine Biological Resources	
LSI • Potential for temporary, minimal increases in sediment laden stormwater impacting marine flora, invertebrates, and special-status species. No adverse effect on EFH. • Minimal opportunity for non-native invasive species introduction.	LSI • Similar to Alternative 1a.
Operation Impacts (direct and indirect are the same)	
Marine Flora, Invertebrates and Associated EFH	
LSI/BI • NDWWTP: Short-term and localized impacts in the interim until primary refurbishment and upgrades are completed, then less than significant impacts once primary upgrades are completed. Long term beneficial impacts once secondary upgrades are completed. No adverse effects on EFH. • Hagatna WWTP: Short-term and localized impacts with current operations at the plant, then long term beneficial impacts once anticipated secondary upgrades are completed. No adverse effect on EFH. • Apra Harbor WWTP: Short-term and localized impacts with current operations at the plant, then less than significant once changes to plant operations are implemented. No adverse effects on EFH. • Agat-Santa Rita WWTP and Baza Gardens WWWTP: Less than significant impact with current operations at the plants. No adverse effect on EFH.	LSI/BI • Same as Alternative 1a.
Essential Fish Habitat	
LSI /BI • NDWWTP: Significant short term and localized impacts in the interim until primary refurbishment and upgrades are completed especially increased ammonia level effects on finfish. Less than significant impacts once primary upgrades are completed. Long term beneficial impacts once secondary upgrades are completed. No adverse effect on EFH. • Hagatna WWTP: Significant short-term and localized with current plant operation. Long term beneficial impact once anticipated secondary are completed. No adverse effect on EFH. • Apra Harbor WWTP: Short-term and localized impacts with current plant operations, and less than significant impact once changes to operations are implemented. No adverse effect on EFH. • Agat-Santa Rita WWTP and Baza Gardens WWTP: Less than significant impact with current plant operations.	LSI /BI • Same as 1a.

*Basic Alternative 1a**	*Basic Alternative 1b*
Special-Status Species	
LSI/BI • Temporary minimal impacts from increased flows and subsequent decreased water quality and increased siltation at NDWWTP and Hagatna WWTP. Short-term and long-term beneficial impact to water quality over no-action alternative from staggered primary refurbishment and secondary upgrades to NDWWTP in 2011-2012 and 2015 timeframe, respectively. • Short-term localized impacts from increased flows and subsequent water quality degradation from the Navy Apra Harbor WWTP, Agat-Santa Rita WWTP and the Baza Gardens WWTP discharges. May affect, but are not likely to adversely affect, sea turtle habitat. Basic Alternative 1a actions are likely to affect, but are not likely to adversely affect ESA-listed sea turtles. No serious injury or mortality of any marine mammal species (spinner dolphins) is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Basic Alternative 1a. • A beneficial impact is anticipated after the GWA upgrades to this plant to secondary treatment.	LSI/BI • Same as 1a.
Non-native Species	
LSI • Minimal chance of non-native invasive introduction from proposed action.	LSI • Same as 1a.

Legend: BI = Beneficial impact; EFH = Essential Fish Habitat; GWA = Guam Waterworks Authority; LSI = Less than significant impact; NDWWTP = Northern District Wastewater Treatment Plant; SI = Significant impact; WWTP = Wastewater Treatment Plant. *Preferred Alternative.

13.2.5 Solid Waste

13.2.5.1 Basic Alternative 1 (Preferred Alternative)

The Preferred Alternative would be to continue to use the Navy Landfill at Apra Harbor for municipal solid waste (MSW) until the new GovGuam Layon Landfill at Dandan is available for use. Disposal of other waste streams excluded from Layon Landfill would continue at the Navy Landfill. Construction and demolition (C&D) debris would continue to be disposed at the Navy hardfill.

Construction

No construction or changes in current operations would occur besides an increase in the volume of construction and disposal hardfill solid waste in the short-term.

Operation

The Navy Landfill has groundwater monitoring wells that monitor potential leachate infiltration. If future samples show contamination, further action may take place to avoid such infiltration to protect the nearby marine environment. Considering that the Navy Landfill would be receiving mainly Construction Debris, an increase in leachate is not anticipated. Potential indirect impacts to marine resources are described below for each marine resource category.

Marine Flora, Invertebrates and Associated EFH

Marine flora, invertebrates and associated EFH in the project area would not be directly affected by activities (direct or indirect impacts of the military relocation) associated with Basic Alternative 1, and indirect impacts would be minimal. Increased use of landfills would lead to more trips to the landfills by vehicles, which may lead to runoff that could decrease marine water quality. These impacts are expected to be minimal, and prevented by the use of BMPs. Other potential indirect impacts may occur from increased barge traffic during construction of the new landfill. These activities would be temporary, and any negative impacts to marine resources in the area would be short-term and limited to the duration of project activities. Increased barge traffic is not likely to disturb flora or invertebrates. Activities associated with Basic Alternative 1 would result in temporary and minimal impacts to marine flora and invertebrates, and would have no adverse effect on associated EFH. Therefore, a less than significant impact would result with the implementation of Basic Alternative 1.

Fish and Associated EFH

Fish and associated EFH in the project area would not be directly affected by activities (direct or indirect impacts of the military relocation) associated with Basic Alternative 1, and indirect impacts would be minimal. Increased use of landfills would lead to more trips to the landfills by vehicles, which may lead to runoff that could decrease marine water quality. These impacts are expected to be minimal, and prevented by the use of BMPs. Other potential indirect impacts may occur from increased barge traffic during construction of the new landfill. These activities would be temporary, and any negative impacts to marine resources in the area would be short-term and limited to the duration of project activities. Increased barge traffic is not likely to disturb fish and associated EFH. If disturbed by vessel traffic, fish would likely avoid or leave the area for the duration of the disturbance, and return once the disturbance ceases. The sensitive months for seasonally sensitive species identified by NMFS to occur in nearby Agat Bay would be taken into account for project activities as permit conditions require. EFH would not be disturbed by vessel traffic. Activities associated with Basic Alternative 1 would result in temporary and minimal impacts to fish, and would have no adverse effect on associated EFH. Therefore, a less than significant impact would result with the implementation of Basic Alternative 1.

Special-Status Species

Special-Status species (sea turtles and dolphins) in the project area would not be directly affected by activities (direct or indirect impacts of the military relocation) associated with Basic Alternative 1, and indirect impacts would be minimal. Increased use of landfills would lead to more trips to the landfills by vehicles, which may lead to runoff that could decrease marine water quality. These impacts are expected to be minimal, and prevented by the use of BMPs. Other potential indirect impacts may occur from increased barge traffic during construction of the new landfill. These activities would be temporary, and any negative impacts to marine resources in the area would be short-term and limited to the duration of project activities. Increased barge traffic is not likely to disturb special-status species, as these species are highly mobile. If disturbed by vessel traffic, sea turtles and dolphins would likely avoid or leave the area for the duration of the disturbance, and return once the disturbance ceases. Activities associated with Basic Alternative 1 may affect, but are not likely to adversely affect sea turtles. No serious injury or mortality of any marine mammal species, specifically spinner and bottlenose dolphins, is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Basic Alternative 1. Therefore, a less than significant impact would result with the implementation of Basic Alternative 1.

Non-native Species

Solid waste transported and stored in upland landfills is not a known pathway for the introduction of potentially invasive non-native marine species. Therefore, activities associated with Basic Alternative 1a are expected to have minimal impacts with respect to the introduction of non-native marine species.

Proposed Mitigation Measures

BMPs, as described in Volume 7, would be implemented to minimize risks of potential indirect impacts from increased barge traffic, surface runoff, and infiltration of groundwater from landfills.

13.2.5.2 Summary of Impacts

Table 13.2-7 summarizes the potential impacts of Basic Alternative 1. A text summary is provided below.

Table 13.2-7. Summary of Potential Impacts to Marine Biological Resources-Solid Waste

Basic Alternative 1
Construction Impacts (direct and indirect are the same)
NI • No construction actives
Operation Impacts (no direct)
LSI • General overall minor indirect impacts from increased road and barge traffic • Minor indirect impacts from runoff and/or infiltration potentially decreasing nearshore water quality • No adverse effect on special-status species or EFH • Minimal potential for increased introduction of non-native species

Legend: EFH = Essential Fish Habitat; LSI = Less than significant impact; NI = no impact. *Preferred Alternative.

Basic Alternative 1 would have less than significant impacts to marine biological resources.

13.2.6 Off Base Roadways

As discussed in Volume 6, Chapter 2.5, some Guam Road Network (GRN) projects involve road widening, bridge/culvert replacements, new road construction or roadway realignment, and pavement strengthening projects (including some pavement strengthening projects that can include widening). This section addresses the potential indirect impacts of the proposed GRN projects to marine biological resources. As discussed in Volume 6, Chapter 6, all proposed roadway improvements would occur above an elevation of 3.5 ft (1.1 m) mean lower low water (GUVD04 vertical datum). The high tide line has been estimated at 2.7 ft (0.8 m) above mean lower low water; therefore, no direct impacts to marine environments are anticipated for any proposed improvement project in any of the four regions. Based on the criteria described in the Methodology Section, no projects within the North Region would have the potential to affect marine biological resources; therefore, no analysis is required. Table 13.2-8 describes the direct and indirect impacts for each type of roadway project (non-widening pavement strengthening, intersection improvements, projects that require vegetation removal [e.g. roadway widening, new road construction, and roadway realignment projects], military access point modification or construction, and bridge and culvert replacements). Figure 13.2-6, Table 13.2-8, Table 13.2-9, Table 13.2-10, and Table 13.2-11 list the roadway projects and potential indirect and/or direct impacts on marine biological resources for the Central, Apra Harbor, and South regions, respectively.

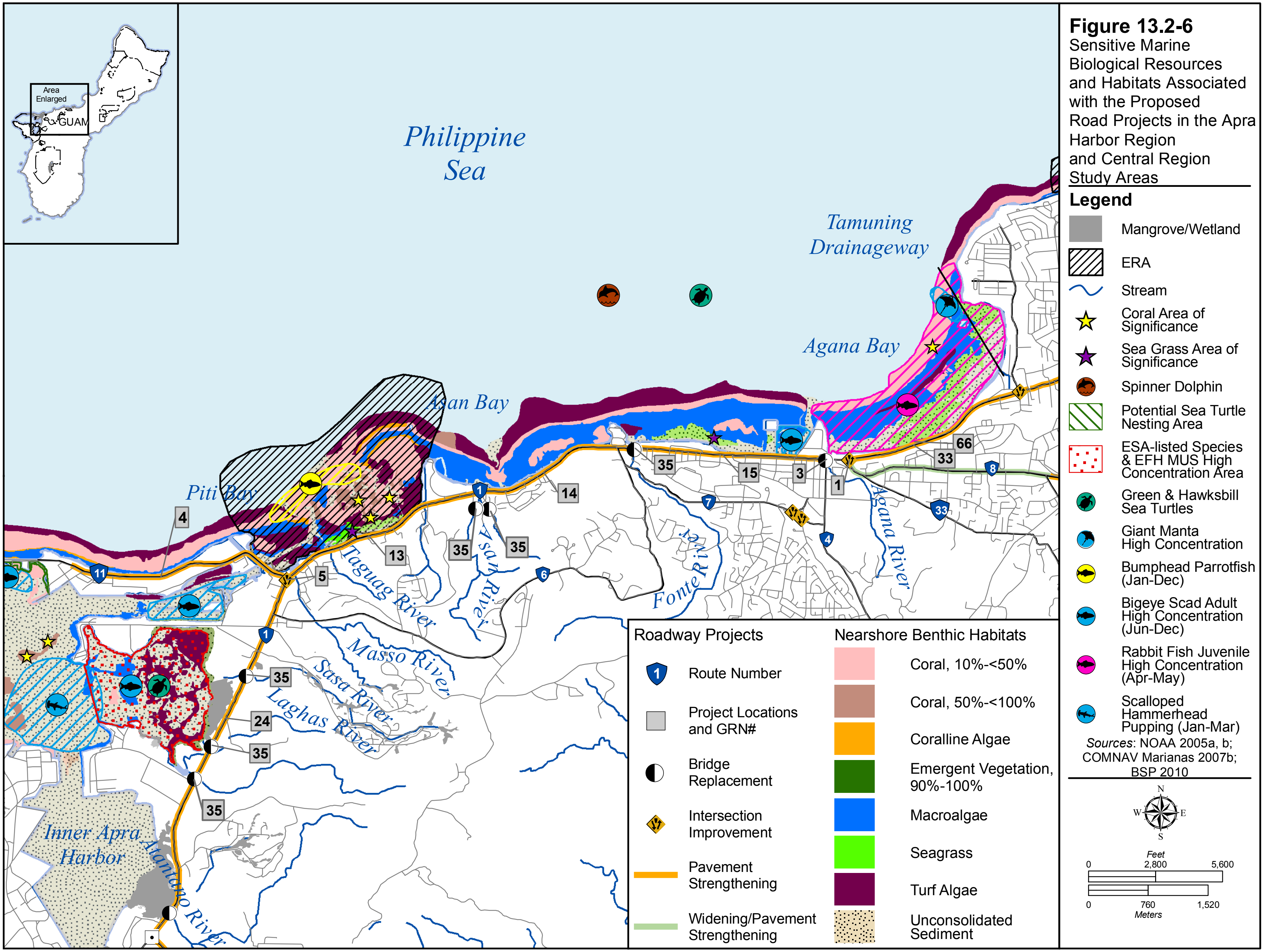
Figure 13.2-6
Sensitive Marine Biological Resources and Habitats Associated with the Proposed Road Projects in the Apra Harbor Region and Central Region Study Areas

Sources: NOAA 2005a, b; COMNAV Marianas 2007b; BSP 2010

Printing Date: May 19, 2010, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\13.2-6.mxd

Table 13.2-8. GRN Project Type and Potential Impacts to Marine Biological Resources

Project Type[1]	*Type of Impact Evaluated*	*Potential Impact Description*[2]
Pavement Strengthening	Indirect impacts – construction phase	No impact in areas without an impervious surface and/or drainage connection with marine environments (e.g. North Guam). Uncontrolled runoff in other areas (Central, Apra Harbor, and South regions) may impact marine communities downstream or downgradient during the construction phase. Sedimentation and non-point pollution inputs into marine waters, particularly near termini of rivers and stormwater outflows have the potential to stress marine resources (e.g. corals).
Intersection Improvements		
	Indirect impacts – operational phase	Additional traffic would increase loading of various potential non-point source pollutants (e.g. sediments, hydrocarbons) above current levels and have the potential for runoff and stress to marine resources (e.g. corals).
Roadway Widening, New Road Construction (Finegayan Connection), Military Access Point Modifications / Construction, & Road Realignment (Route 15)	Direct impacts	None: New road construction (Finegayan Connection) and Route 15 realignment would occur in upland areas with no direct removal or disturbance of marine communities.
	Indirect impacts – construction phase	None: New road construction (Finegayan Connection) and Route 15 realignment would occur in upland areas of North Guam with no impervious surface and/or drainage connection with marine environments.
	Indirect impacts – operational phase	
Bridge and Culvert Replacements (Aguada, Agana, Asan # 1, Asan # 2 Atantano, Fonte, Laguas, and Sasa Bridges)	Direct impacts	None: Bridge proposed for replacement span riverine habitats with no direct removal or disturbance of marine communities.
	Indirect impacts – construction phase	Uncontrolled runoff may impact marine communities downstream during the construction phase. Sedimentation and non-point pollution inputs into marine waters, particularly near termini of rivers and stormwater outflows have the potential to stress marine resources (e.g. corals).
	Indirect impacts – operational phase	Alteration of the hydraulic conveyance due to the new bridge design may impact downstream marine communities.

Notes:

[1] The GRN project descriptions are included in Volume 6, Chapter 2.

[2] Mitigation measures are included later in this chapter that minimize or avoid potential direct or indirect impacts.

Table 13.2-9. Central Region GRN Projects, Alternatives, and Potential Impacts

GRN #	*Alternatives*[1]				*Potential Impact Type and Description*[2]	
	1	*2*	*3*	*8*	*Indirect*	*Direct*
1	x	x	x	x	Potential for uncontrolled runoff during the construction phase, non point-source pollutants and/or sedimentation inputs into marine communities of East Hagatna Bay.	None: The proposed road and intersection improvements in the Central region are all proposed to occur in upland non-marine environments. Therefore, no direct effects to marine environments are anticipated.
2	x	x	x	x		
3	x	x	x	x		
6	x	x	x	x	Potential for uncontrolled runoff during the construction phase, non point-source pollutants and/or sedimentation inputs into marine communities of Tumon Bay via stormwater drainages.	
7	x	x	x	x		
11	x	x	x	x	The proposed roadway improvement along Chalan Lujuna would occur over pervious limestone substrates and limited potential for non-point source pollutant inputs into marine communities.	
12	x	x	x	x	The proposed roadway improvement along Route 15 would occur over pervious limestone substrates and limited potential for non-point source pollutant inputs into marine communities.	
13	x	x	x	x	Potential for uncontrolled runoff during the construction phase, non point-source pollutants and/or sedimentation inputs into marine communities of Asan Bay and Piti Bay, including Piti Bomb Holes Marine Preserve.	
14	x	x	x	x		
15	x	x	x	x		
16	x	x	x	x	Potential for uncontrolled runoff during the construction phase, non point-source pollutants and/or sedimentation inputs into marine communities of Hagatna Bay via stormwater drainages.	
17	x	x	x	x		
18	x	x	x	x	Potential for uncontrolled runoff during the construction phase, non point-source pollutants and/or sedimentation inputs into marine communities of Tumon Bay via stormwater drainages.	
19	x	x	x	x		
20	x	x		x		
21	x	x	x	x		
28	x	x	x	x		
29	x	x	x	x		
30	x	x	x	x	The proposed roadway improvement along Route 10 would occur over pervious limestone substrates and limited potential for non-point source pollutant inputs into marine communities.	
31	x	x		x		
32	x	x	x	x	The proposed roadway improvement along Route 15 would occur over pervious limestone substrates and limited potential for non-point source pollutant inputs into marine communities.	

GRN #	*Alternatives*[1]				*Potential Impact Type and Description*[2]	
	1	*2*	*3*	*8*	*Indirect*	*Direct*
33	x	x	x	x	Potential for uncontrolled runoff during the construction phase, non point-source pollutants and/or sedimentation inputs into marine communities of Tumon Bay via impervious surfaces, stormwater drainages, and/or Agana River drainages that terminate at Tumon Bay and Tumon Bay Marine Preserve.	None: The proposed road and intersection improvements in the Central region are all proposed to occur in upland non-marine environments. Therefore, no direct effects to marine environments are anticipated.
35	x	x	x	x	Potential for uncontrolled runoff during the construction phase, non point-source pollutants and/or sedimentation inputs into marine communities of Sasa Bay Marine Preserve (via Aguada, Laguas, Sasa Rivers), Inner Apra Harbor (via Fonte and Atantano Rivers), and Asan Bay (via the two crossings along the Asan River and adjacent drainage).	None: The proposed bridge replacements occur over riverine (non-marine) environments; therefore, no direct effects to marine environments are anticipated.
36	x	x	x	x	Potential for uncontrolled runoff from the Route 15 realignment; however, runoff would attenuate due to thick vegetation and highly pervious limestone. No surface stormwater drainage connection to marine communities around Pagat Point.	None: The proposed road and intersection improvements in the Central region are all proposed to occur in upland non-marine environments. Therefore, no direct effects to marine environments are anticipated.
44	x	x	x	x	Potential for uncontrolled runoff; however, runoff from the access gate construction area would attenuate due to thick vegetation and highly pervious limestone. No surface stormwater drainage connection to marine communities around Pagat Point.	
46	x	x	x	x		
47			x		The access gate at Barrigada (Navy) would occur over pervious limestone substrates and limited potential for non-point source pollutant inputs into marine communities.	
48			x			
49			x		The access gate at Barrigada (Air Force) would occur over pervious limestone substrates and limited potential for non-point source pollutant inputs into marine communities.	
49A			x			
63			x			
74			x			
113	x	x	x	x		

Note:

[1] The GRN project descriptions and alternatives are described in detail in Volume 6, Chapter 2.

[2] Mitigation measures are included later in this chapter that minimize or avoid potential direct or indirect impacts.

Legend: GRN = Guam Road Network.

Table 13.2-10. Apra Harbor GRN Projects, Alternatives, and Potential Impacts

GRN #	*Alternatives*[1]				*Potential Impact Type and Description*[2]	
	1	*2*	*3*	*8*	*Indirect*	*Direct*
4	x	x	x	x	Potential for uncontrolled runoff during the construction phase, non point-source pollutants and/or sedimentation inputs into marine communities of Outer Apra Harbor (to the south) and outside the breakwater.	None: The proposed road and intersection improvements in the Apra Harbor region are all proposed to occur in upland non-marine environments. The addition of the weigh station associated with GRN #4) would also occur in upland non-marine environments. Therefore, no direct effects to marine environments are anticipated.
5	x	x	x	x		
24	x	x	x	x	Portions of the proposed roadway improvements along Route 1 are adjacent to Sasa Bay Marine Preserve (on the west side of Route 1) and freshwater wetlands (on the east side of Route 1) Potential for runoff during the construction phase into Sasa Bay and Sasa River, Laguas River, Aguada River, and Atantano River, which terminate at Sasa Bay or Inner Apra Harbor. Potential for uncontrolled runoff during the construction phase, non point-source pollutants and/or sedimentation.	
26	x	x	x	x	Portions of the proposed roadway improvements along Route 2A are adjacent freshwater wetlands formed by the Atantano River. Potential for runoff during the construction phase into the wetlands and other stormwater drainages that terminate at Inner Apra Harbor. Potential for uncontrolled runoff during the construction phase, non point-source pollutants and/or sedimentation.	
50	x	x	x	x	Potential for uncontrolled runoff during the construction phase, non point-source pollutants and/or sedimentation into marine communities of Inner Apra Harbor.	

Note:

[1] The GRN project descriptions and alternatives are described in detail in Volume 6, Chapter 2.

[2] Mitigation measures are included later in this chapter that minimize or avoid potential direct or indirect impacts.

Legend: GRN = Guam Road Network.

Table 13.2-11. South Region GRN Projects, Alternatives, and Potential Impacts

GRN #	*Alternatives*[1]				*Potential Impact Type and Description*[2]	
	1	*2*	*3*	*8*	*Indirect*	*Direct*
25	x	x	x	x	Although most of the portions of the proposed roadway improvements along Route 5 are adjacent residential areas (e.g., Apra Heights), some portions have potential for construction runoff into freshwater wetlands formed by the Namo River near the Agat Commercial Center. The Namo River terminates at Agat Bay.	None: The proposed road and intersection improvements in the South region are all proposed to occur in upland non-marine environments. Therefore, no direct effects to marine environments are anticipated.
27	x	x	x	x		
52	x	x	x	x	Potential for runoff during the construction phase into upper reaches of the Namo River.	
110	x	x	x	x	The proposed intersection improvement for Route 2 and 12 would occur near commercial and light industrial areas (e.g., Agat Commercial Center). Runoff or noise during the construction phase would not impact terrestrial biological resources.	

Note:

[1] The GRN project descriptions and alternatives are described in detail in Volume 6, Chapter 2.

[2] Mitigation measures are included later in this chapter that minimize or avoid potential direct or indirect impacts.

Legend: GRN = Guam Road Network.

13.2.6.1 Alternative 1

Year 2014 (Peak Construction and Population)

North

None of the proposed roadway projects within the North Region would have the potential to directly or indirectly impact marine biological resources (i.e., marine flora and invertebrates, fish and EFH, special-status species, and non-native invasive species introductions). Runoff from these projects would attenuate due to thick vegetation and highly pervious limestone and none of the projects are proposed to occur within the marine environment.

Central

Because no GRN project is proposed to occur within marine environments in the Central Region, no direct impacts would occur to marine biological resources. The proposed road improvement projects for Alternative 1 in the Central Region that have the potential to indirectly impact marine biological resources include GRN #s 1, 2, 3, 6, 7, 13 - 21, 28, 29, 33, and 35. Impacts from construction activities may include loss of sediment into coastal waters and non-point source inputs into marine environments. Indirect impacts to marine resources include the potential for increased pollutant loading on road surfaces (e.g. substances containing hydrocarbon residues, sediments, and debris) relative to levels currently produced by existing traffic intensity. This increased potential for non-point source pollution may stress coral communities in marine environments along Route 1. Particular areas of concern are designated marine preserve areas, such as Sasa Bay Marine Preserve, Piti Bomb Holes Marine Preserve, and Tumon Bay Marine Preserve, although non-designated bays are also important marine environments. As discussed within this chapter, the downstream termini of drainages and rivers that would potentially carry pollutants and sediments into marine environments are important, although degraded, marine communities.

Apra Harbor

Because no Apra Harbor Region GRN projects are proposed to occur associated with the marine environment, no direct impacts to marine biological resources would occur; all proposed projects (GRN #s 4, 5, 24, 26, and 50) within the Apra Harbor Region have the potential to indirectly impact marine biological resources through runoff or pollutants carried downstream. Portions of the proposed roadway improvements along Route 1 are adjacent to Sasa Bay Marine Preserve (on the west side of Route 1) and freshwater wetlands (on the east side of Route 1). These projects have the potential for runoff during the construction phase into Sasa Bay and Sasa River, Laguas River, Aguada River, and Atantano River, which terminate at Sasa Bay or Inner Apra Harbor. Other areas of concern include Outer Apra Harbor (south side of Route 11), and open water to the north of Route 11).

South

Because no South Region GRN projects are proposed to occur within marine environments, no direct impacts to marine biological resources would occur; projects (GRN #s 25, 27, and 52) within the South Region have the potential to indirectly impact marine biological resources. Although most of the portions of the proposed roadway improvements along Route 5 are adjacent residential areas (e.g., Apra Heights subdivision), some portions have potential for construction runoff into freshwater wetlands formed by the Namo River near the Agat Commercial Center. The Namo River terminates at Agat Bay, which would be considered a pathway for inputs into Agat Bay.

Year 2030

North

None of the proposed roadway projects within the North Region would have the potential to impact marine biological resources.

Central

In the long-term, none of the proposed roadway projects within the Central Region would have the potential to impact marine biological resources because there would be no net increase in impervious cover over existing conditions after the construction is complete.

Apra Harbor

In the long-term, none of the proposed roadway projects within the Apra Harbor Region would have the potential to impact marine biological resources because there would be no net increase in impervious cover over existing conditions after the construction is complete.

South

In the long-term, none of the proposed roadway projects within the South Region would have the potential to impact marine biological resources because there would be no net increase in impervious cover over existing conditions after the construction is complete.

In conclusion, implementation of Alternative 1 would not substantially impact marine biological resources within the North, Central, Apra Harbor, or South regions. Any potential affects from construction.

Proposed Mitigation Measures

As impacts to marine resources (i.e., marine flora, invertebrates and associated EFH, fish and EFH, special-status species, and non-native invasive species introductions) are indirect and temporary (during the construction phase of the bridge and culvert replacements), no mitigation measures are identified at this time. The use of BMPs as described in Volume 7 would be implemented as appropriate to avoid and minimize negative impacts to marine resources. The Navy is developing the MBP and is implementing interim biosecurity measures to minimize impacts from non-native invasive species associated with the construction phase of the road improvements and bridge and culvert replacements. Because the eight bridge and culvert replacements occur within potential waters of the U.S., the FHWA would be engaging the USACE Honolulu District Office in the Section 404 CWA permitting process. During this process, additional BMPs or mitigations may be required as part of the permit conditions.

13.2.6.2 Alternative 2 (Preferred Alternative)

Proposed road projects under Alternative 2 are the same as the proposed road projects under Alternative 1, with the exception of military access point locations at NCTS Finegayan. The difference in locations of these access gates does not vary the potential impact of Alternative 2 relative to Alternative 1. Therefore, impacts to marine biological resources for Alternative 2 are the same as those for Alternative 1 for each region.

Proposed Mitigation Measures

The mitigation measures for Alternative 2 are the same as those for Alternative 1.

13.2.6.3 Alternative 3

The proposed road projects under Alternative 3 are the same as the proposed road projects under Alternative 1, except that Alternative 3 includes GRN #s 38, 39, 47, 48, 49, 63, and 74, and it excludes GRN #s 20, 31, 38A, 39A, 41, 41A and 124. GRN #s 47 and 48 are associated with new access to Barrigada (Navy); however, these projects would occur in upland areas where stormwater runoff would be expected to attenuate before reaching marine habitats. Gate locations for Alternative 3 are the same for Alternative 1, except that NCTS Finegayan Main Gate and commercial gate locations (GRN #s 38 and 39) are in different locations than the Main Gate and commercial gate locations in Alternative 1 (GRN # 38A and 39A). Again, these gate locations are within upland areas where stormwater runoff would be expected to attenuate before reaching marine habitats. Therefore, impacts to marine biological resources of Alternative 3 are similar to Alternative 1 for each region.

Proposed Mitigation Measures

The mitigation measures for Alternative 3 are the same as those for Alternative 1.

13.2.6.4 Alternative 8

The proposed road projects under Alternative 8 are the same as those under Alternative 1 with the exception of the military access gate location at Barrigada (Air Force). The impact conclusion for this gate location project included as part of Alternative 8 (GRN # 49A) is the same for the access gate project included as part of Alternative 3 (GRN # 49); therefore, impacts to marine biological resources of Alternative 8 are similar to Alternative 1 and Alternative 3 for each region.

Proposed Mitigation Measures

The mitigation measures for Alternative 8 are the same as those for Alternative 1.

13.2.6.5 Firing Range Options

The alternatives described in Volume 2, Chapter 2, for the relocation include the Main Cantonment action alternatives with either a Firing Range Option A or B. Option A would require the realignment of Route 15 (GRN #36), while Option B does not require realignment of Route 15. Neither option would impact marine biological resources.

13.2.6.6 Summary of Impacts

Table 13.2-12 summarizes the potential impacts of each alternative. The proposed road projects in the North and South regions would not directly or indirectly impact marine biological resources. Only projects within the Apra Harbor and Central regions were assessed for potential impacts to marine biological resources, and the projects within these study areas do not require construction within coastal waters.

13.2.6.7 Summary of Proposed Mitigation Measures

No mitigation measures are required for roadway projects impacts to marine biological resources.

Table 13.2-12. Summary of Potential Impacts

Potentially Affected Resource	*Alternative 1*	*Alternative 2**	*Alternative 3*	*Alternative 8*
Marine Flora, Invertebrates and Associated EFH	LSI	LSI	LSI	LSI
Fish and Associated EFH	LSI	LSI	LSI	LSI
Special-Status Species	LSI	LSI	LSI	LSI
Non-native Species Introductions	LSI	LSI	LSI	LSI

Legend: EFH = Essential Fish Habitat; LSI = Less than significant impact.* Preferred Alternative.

CHAPTER 14.
CULTURAL RESOURCES

14.1 INTRODUCTION

This chapter describes the potential environmental consequences to cultural resources associated with implementing the alternatives within the region of influence. For a description of the affected environment for all resources, refer to the respective chapter of Volume 2. The locations described in Volume 2 include the region of influence for the utilities and roadway related project components of the proposed action. The chapters are presented in the same order as the resource areas contained in Volume 6.

14.2 ENVIRONMENTAL CONSEQUENCES

14.2.1 Approach to Analysis

14.2.1.1 Methodology

Utilities

The methodology for identifying, evaluating, and mitigating impacts to cultural resources has been established through federal laws and regulations including the National Historic Preservation Act (NHPA) and the Archaeological Resource Protection Act.

Under the NHPA, a significant resource is a cultural resource listed or eligible for listing on the National Historic Places (NRHP) or is a historic property. A project affects a historic property when it alters the resource’s characteristics, including relevant features of its environment or features that qualify it for inclusion on the NRHP. Adverse effects may include the following: physical destruction, damage, or alteration of all or part of the resources; alteration of the character of the surrounding environment that contributes to the resource’s qualifications for the NRHP; introduction of visual, audible, or atmospheric elements that are out of character with the resource; neglect of the resource resulting in its deterioration or destruction; and transfer, lease, or sale of the property (36 Code of Federal Regulations [CFR] § 800.5(a)(2)) without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property’s historic significance.

Analysis of potential impacts to historic properties considers both direct and indirect impacts. Direct impacts are impacts that “may occur from the project, such as the destruction of the property” (National Park Service [NPS] 1997:1). Indirect impacts “may be visual, audible, or atmospheric changes which effect the setting of the property” (NPS 1997:1). Cumulative impacts on historic properties under NEPA result from the incremental impact of the action when added to other past, present, and future actions. Cumulative impacts are discussed in Volume 7.

Vandalism is considered a significant impact because it damages the integrity of the site, which is a major determinant of NRHP-eligibility. Physical evidence left in historic properties is finite and cannot renew itself once it has been disturbed. For this reason, federal activities that open up areas to the public or that involve personnel traveling through an area may have an adverse impact, especially if vandalism to historic properties in the vicinity occurs.

Roadway Projects

All project Areas of Potential Effect (APE) were inspected by cultural resources experts and Guam State Historic Preservation Office (Guam SHPO) personnel. In some cases, it was determined that more fieldwork would be required, as described below. NHPA Section 106 allows for projects to result in a finding of “no historic properties affected” (sometimes listed as “no effect”), “no adverse effect,” or “adverse effect,” as defined below.

- **No Historic Properties Affected (No Effect):** There are either no historic properties present in the APE, or there are historic properties present in the APE, but the undertaking would have no effect on them as defined in 36 CFR § 800.16(i).
- **No Adverse Effect:** There could be an effect on a historic property, but the effect would not be harmful to those characteristics that qualify the property for inclusion in or eligibility for the NRHP.
- **Adverse Effect:** Project impacts may directly or indirectly alter any of the characteristics that qualify the property for inclusion in the NRHP in a manner that would diminish the integrity of the property’s location, design, setting, materials, workmanship, feeling, or association, or a property’s ability to offer research potential.

The criteria of adverse effect described in the guidelines for NHPA Section 106 (36 CFR § 800.5) define adverse effects to significant cultural resources as any of the following actions, regardless of whether they occur singly or in combination with one another:

- Physical destruction of or damage to all or part of the resource
- Alteration of a resource, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation, and provision of handicapped access that is not consistent with the Secretary’s standards for the treatment of historic properties (36 CFR 68) and applicable guidelines
- Removal of the resource from its historic location
- Change of the character of the resource’s use or of physical features within the setting that contribute to its historic significance
- Introduction of visual, atmospheric, or audible elements that diminish the integrity of the property’s significant historic features
- Neglect of a property that causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe

The Federal Highway Administration (FHWA) understands that there may be undocumented properties in some locations, such as subsurface archaeological sites, or properties hidden in dense vegetation. For this reason, ongoing consultation is contributing to development of a plan to test and monitor areas where FHWA found the potential for undocumented historic properties is higher.

14.2.1.2 Determination of Significance under NEPA

In this document, a historic property is a property that is listed on or eligible for listing on the NRHP. For cultural resources a significant adverse impact is one that disturbs the integrity of a historic property. If a project disturbs the characteristics that make the property listed or eligible for listing on the NRHP, then it is also considered to be a significant adverse impact.

The Regional Integrated Cultural Resources Management Plan (ICRMP) for Navy property on Guam has established Standard Operating Procedures (SOPs) to protect known historic properties; procedures for managing the inadvertent discovery of archaeological resources, inadvertent discovery of human remains, inadvertent disturbance to historic properties; and distributing permits for archaeological investigations (Tomonari-Tuggle et al. 2005). In addition, agreements on limitations in training have been made as part of the Mariana Islands Training Range Complex Environmental Impact Statement Programmatic Agreement (PA) (Navy 2009). Areas with limited or no training stipulations at Apra Harbor and the Naval Munitions Site are presented in Volume 2, Chapter 12, Cultural Resources (Figure 12.1-1 for Apra Harbor and Figure 12.1-2 for the Naval Munitions Site). Lands managed by the Marine Corps would comply with all cultural resources requirements in accordance with MCO P5090.2A, Chapter 2, Chapter 8: Cultural Resource Management on both federal and leased lands.

As part of the Section 106 consultation process for the Joint Guam relocation, a PA for all military training activities, construction, and operations proposed under the proposed action, preferred alternative that includes additional mitigation measures and procedures is being prepared. Current signatories to this proposed PA are: the Department of Defense (DoD) (Joint Region Marianas; DoD Representative Guam, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, and Republic of Palau; Marines; Navy; Army; Air Force), other federal agencies (Advisory Council for Historic Preservation (ACHP), and the NPS), and local government agencies (Guam SHPO, Commonwealth of the Northern Mariana Islands HPO). Stipulations in the proposed PA include the following:

- The DoD would ensure that the identification and evaluation of historic properties within the APE for the project is completed prior to the initiation of any part of the project with the potential to affect historic properties. Newly discovered properties would be avoided where possible.
- For areas or properties that have not been inventoried for historic properties, the DoD would record surface sites and, when possible, areas would also be archaeologically sampled for subsurface sites when easily obtainable (i.e., without having to demolish existing facilities or infrastructure) unless this demolition is required for the project.
- Any properties not evaluated shall be assessed for NRHP eligibility. These historic properties would be incorporated into existing ICRMPs as they are revised or updated or if a new ICRMP is developed in consultation with the appropriate SHPO.

In recognition of the significance that many historic properties within the APE of the proposed action has to various cultural groups, the DoD would generally look favorably on affording access to archaeological sites to individuals and organizations that attach significance to these historic properties where security requirements are not prohibitive. The proposed PA also provides stipulations for treatment in case of emergencies, inadvertent discoveries, the review process, and report requirements. The SOPs in the current regional ICRMP would be updated, revised, and attached to the proposed PA.

Off Base Roadway Projects

The off base roadway projects are not included in the proposed PA discussed above. FHWA is consulting with Guam SHPO and various consulting parties on each roadway project individually. Recognizing that some historic properties may not be identified during the Section 106 process, this ongoing consultation is contributing to development of a plan to test and monitor areas where the potential for undocumented properties is higher.

For off base roadway projects, a significant adverse impact is one that disturbs the integrity of a historic property. An impact would also be significant and adverse if a project would alter the characteristics that make a property eligible for listing on the NRHP. For the purposes of this document, impacts may be mitigated to less than significant.

14.2.1.3 Issues Identified during the Public Scoping Process

The following analysis focuses on possible impacts to cultural resources; archaeological, architectural, and traditional cultural properties that could be affected by the proposal. As part of the analysis, concerns relating to cultural resources that were mentioned by the public, including regulatory stakeholders, during the public scoping meetings were addressed. A general account of these comments, including issues other than cultural resources is as follows:

- Access to cultural sites
- Construction impacts to cultural resources
- The need to conduct thorough and adequate data collection
- Public participation in the planning process relating to cultural resources

Other cultural issues indentified included:

- Access to traditional plant and fishing areas
- Curation of artifacts off island and storage issues associated with the Guam Museum

Public outreach for the military relocation as a whole has included roadway projects. Augmenting this effort, FHWA is furthering consultation on roadway projects, pursuant to 36 CFR 800.2 and 800.3. Consultation with Guam SHPO is ongoing, but formal consultation to date (including meetings, field visits, and submittals) has occurred on December 5, 2008; February 26, 2009; October 22, 2009; February 23, 2010; February 26, 2010; April 15, 2010; and June 2010. Additional consultation via phone or e-mail occurs frequently.

Initial consultation discussed the off base roadway projects, the APE, the level of work effort, and the expectations for each project. It included outlining the number of types of projects associated with the roadway projects and summarizing them by project type and by those that do and do not exceed existing rights-of-way.

Subsequent consultation included touring project locations with project staff and staff from Guam SHPO. These visits indicated areas where findings of No Historic Properties Affect may be appropriate and historic properties along project roadways and the potential for undocumented properties were discussed. Hagatna (Agana) Bridge (Guam Road Network [GRN] project #4) was visited, discussed, and photographed. Field trips included discussing potential adverse effects and mitigation for to the Hagatna (Agana) Bridge.

Pursuant to 36 CFR 800.3, 15 invitations to consulting parties have been extended, and consulting party meetings have been initiated. Discussions with consulting parties include each project, possible impacts to historic properties of all sorts, and the presence of possible traditional cultural properties.

14.2.2 Power

14.2.2.1 Basic Alternative 1: Recondition up to Five Existing Guam Power Authority–Permitted Facilities to Provide Peaking Power/Reserve Capacity

Basic Alternative 1 would recondition existing Combustion Turbines (CTs) and upgrade Transmission and Distribution (T&D) systems and would not require new construction or enlargement of the existing footprint of the facility. This work would be undertaken by the Guam Power Authority on its existing permitted facilities. Reconditioning would be made to existing permitted facilities at the Marbo, Yigo, Dededo (two units), and Macheche CTs. These CTs are not currently being used up to permit limits. T&D system upgrades would be on existing above ground and underground transmission lines. This alternative supports Main Cantonment Alternatives 1 and 2 and Main Cantonment Alternatives 3 and 8 would require additional upgrades to the T&D system.

It is anticipated that these facilities would require general overhaul, capability testing, and controlled startup that could take up to 12 months. The amount of improvements needed would not be known until the units are inspected and tested. The NRHP eligibility of the Guam Power Authority power plants is unknown; however, most are between 15 to 20 years old.

Basic Alternative 1 would also involve T&D upgrades both above ground and below ground. Approximately 90% of the APE have been surveyed for archaeological resources (Dixon et al. 2010). Most of the utilities would be placed in previously disturbed areas. Two historic properties would be directly affected by construction of power lines (T-U-4 and T-U-11). The locations of the utilities in relation to archaeological probability areas are shown in Figure 14.2-1 through Figure 14.2-4. No historic properties were found at the Marbo Power Plant. Other underground power lines would be constructed in the roadways along Routes 1 and 3. These utility lines would be placed in previously disturbed areas adjacent to the roads. However, one site, 08-1350 (a water catchment site of the early American period), is very near a proposed powerline and could be inadvertently damaged during construction.

Operations associated with Basic Alternative 1 would not have significant direct or indirect impacts on historic properties, as operations would not bring an influx of people into the area and operational activities are unlikely to cause erosion. Because it is an existing activity, operations would not change the visual or audible setting near historic properties that are important for these reasons.

Best Management Practices (BMPs) implemented to protect cultural resources include:

- Archaeological monitoring of medium archaeological probability areas during construction in consultation with the Historic Preservation Officer.
- For post review discoveries, an assessment would be made for NRHP eligibility in consultation with the Historic Preservation Office.
- For areas or properties that have not been inventoried for historic properties, the DoD would follow SOPs as outlined in the ICRMP and any existing agreements.

Proposed Mitigation Measures

Basic Alternative 1 would have significant adverse direct impacts to two historic properties (T-U-4 and T-U-11). Impacts to these two historic properties would be mitigated through data recovery as these sites are eligible under Criterion D and recovery efforts would follow the ACHP guidance, Resolving Adverse Effects through Recovery of Significant Information from Archeological Sites (ACHP 1999). Through data recovery these impacts would be reduced to a less than significant level. A table with the area, site number, impact, NRHP criteria of significance, and potential mitigation measures for each resource is included in Volume 9, Appendix G.

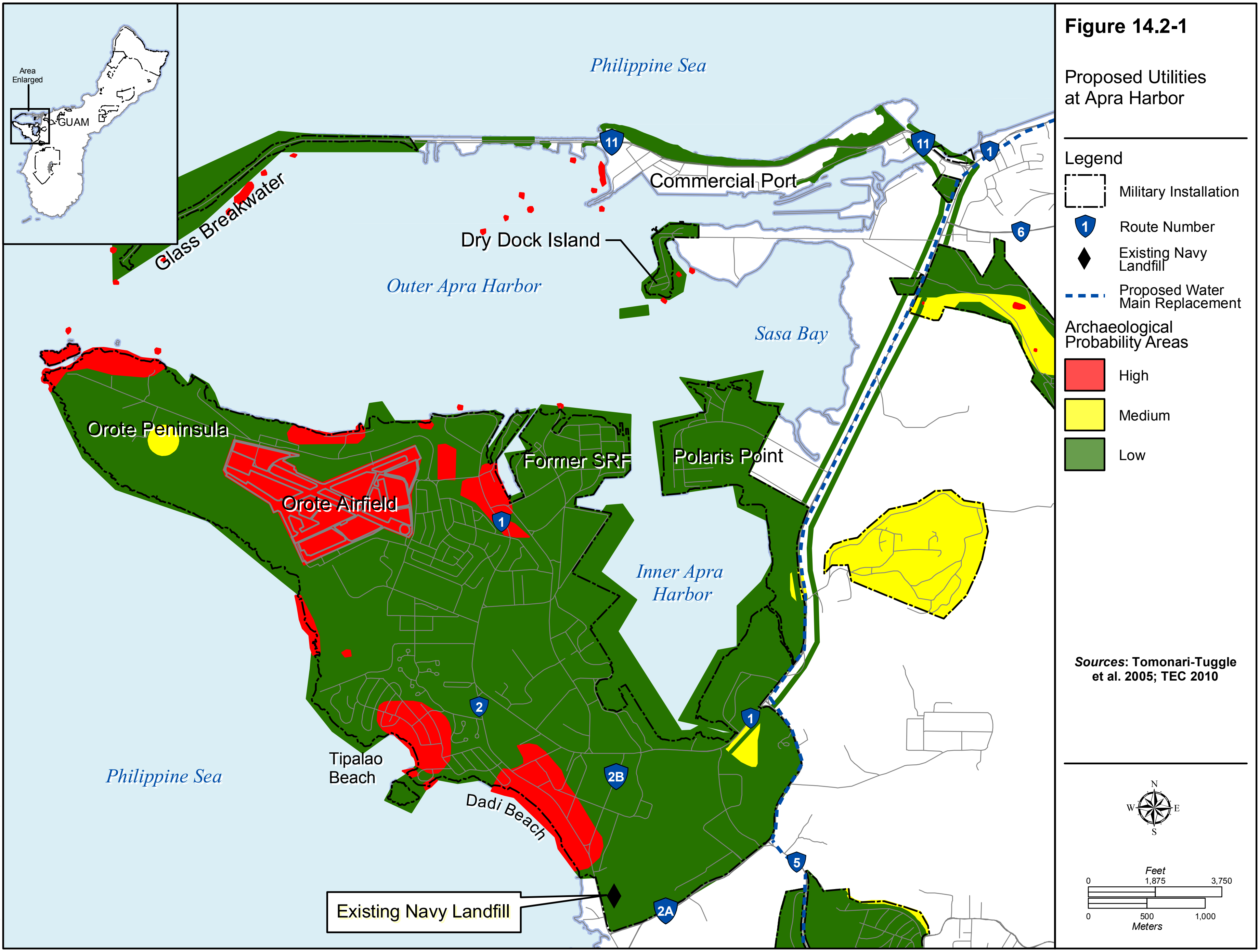

Figure 14.2-1

Proposed Utilities at Apra Harbor

***Sources*: Tomonari-Tuggle et al. 2005; TEC 2010**

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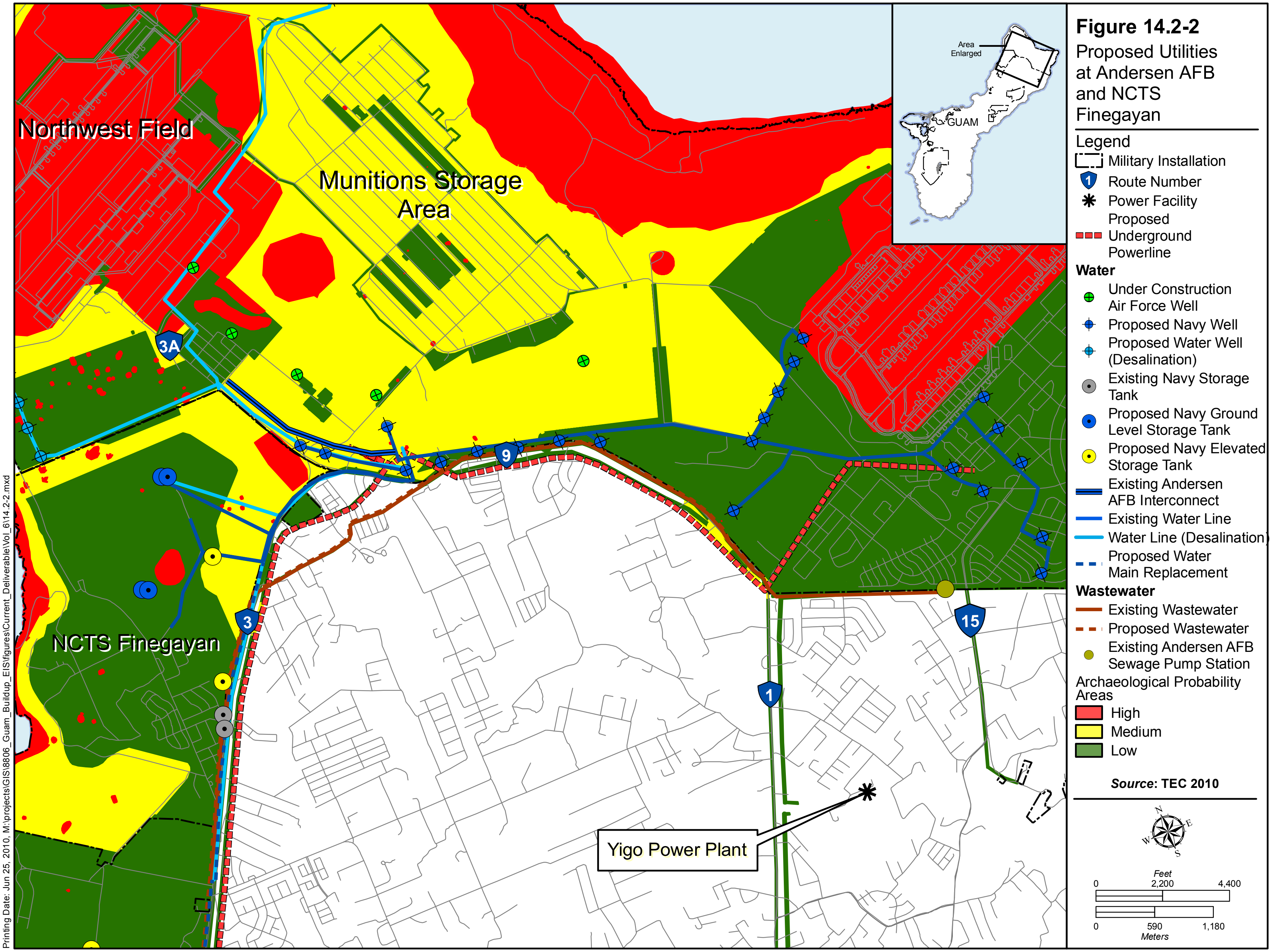

Figure 14.2-2
Proposed Utilities at Andersen AFB and NCTS Finegayan

Source: TEC 2010

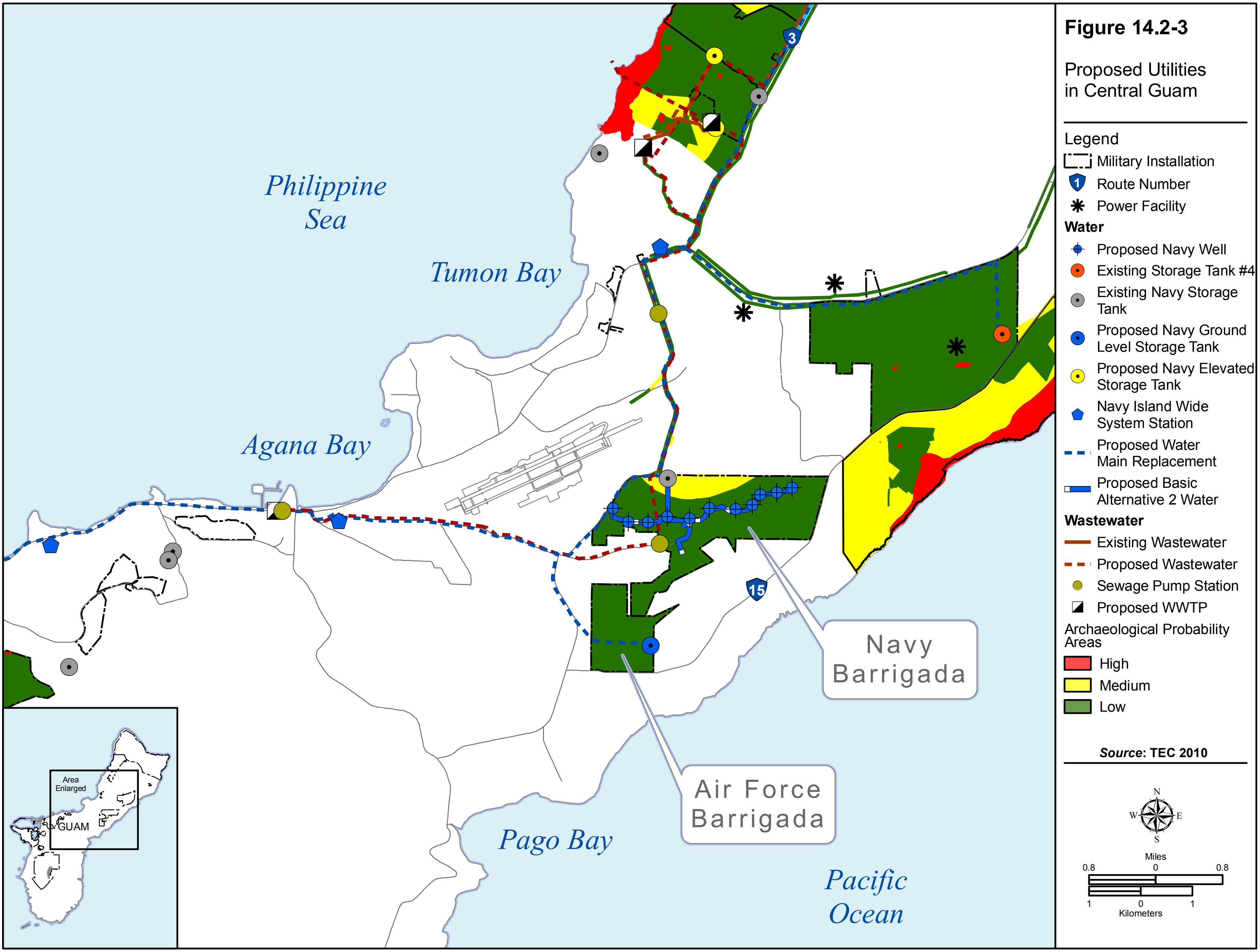

Figure 14.2-3

Proposed Utilities in Central Guam

Source: TEC 2010

Printing Date: Jun 25, 2010; M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_6\14.2-3.mxd

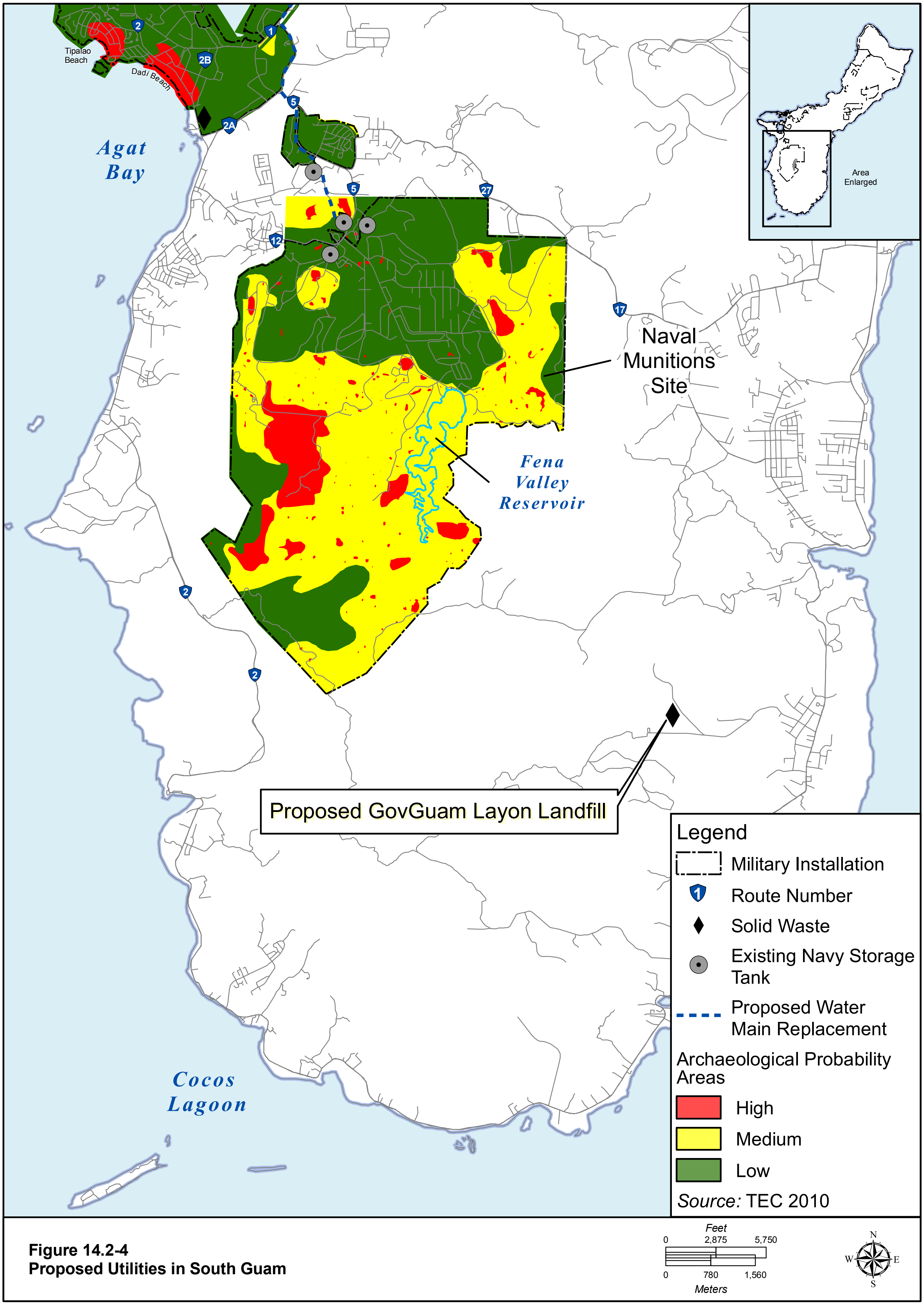

Figure 14.2-4
Proposed Utilities in South Guam

DoD recognizes that mitigation associated with data recovery efforts for archaeological sites impacted by the undertaking would result in increased archaeological materials that need to be curated. This increase in archaeological materials will require appropriate curatorial facilities as well as clearly defined procedures for the disposition of artifacts and, if encountered, the respectful and proper handling of human remains. DoD is committed to working with local, state, and federal partners to maintain DoD archeological material collections on CNMI in facilities that meet federal standards and have appropriate capacity. Further, DoD is committed to ensuring the proper handling and disposition of human remains in accordance with federal statutes. For non-DoD archaeological material collections, DoD would follow local regulations regarding the handling and repatriation of cultural materials or human remains to the extent such local regulations are consistent with federal law and regulations on the subject. DoD is currently working on a capacity analysis of its current collections in Guam and CNMI and will use that information to develop a plan for the initial and long-term curation needs associated with the undertaking.

One site, 08-1350 (a water catchment site of the early American period), is very near a proposed powerline. This site would be marked and avoided during construction. With the BMPs implemented above, no further mitigated measures would be required.

Summary of Impacts

Table 14.2-1 summarizes the potential impacts of the basic alternative.

Table 14.2-1. Summary of Potential Impacts on Cultural Resources – Power

*Basic Alternative 1**
Construction Impacts (direct with indirect in parentheses)
Archaeological Resources
SI-M • Adverse impacts to two archaeological sites, T-U-4, and T-U-11(Adverse impacts to archaeological sites from erosion or construction personnel during the construction process). Possible impacts to site 08-1350 during construction.
Architectural Resources
NI • No adverse impacts to architectural resources at North, South, or Central Guam (no adverse impacts).
Submerged Resources
NI • No adverse impacts to submerged resources or objects (no adverse impacts).
Traditional Cultural Properties
NI • No adverse impacts to Traditional Cultural Properties (no adverse impacts).
Operation Impacts (direct and indirect are the same)
Archaeological Resources
NI • No adverse impacts to archaeological sites at North, South, or Central Guam.
Architectural Resources
NI • No adverse impacts to architectural resources at North, South, or Central Guam.
Submerged Resources
NI • No adverse impacts to submerged resources or objects.
Traditional Cultural Properties
NI • No adverse impacts to Traditional Cultural Properties.

Legend: NI = No impact; SI-M = Significant impact mitigable to less than significant. *Preferred Alternative.

14.2.3 Potable Water

14.2.3.1 Basic Alternative 1 (Preferred Alternative)

Basic Alternative 1 would provide additional water capacity of 11.3 MGd (42.8 MLd), which is anticipated to be met by an estimated 22 new wells at Andersen Air Force Base (AFB), rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 2.5 MG (9.5 ML) water storage tanks would be constructed at ground level at NCTS Finegayan. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint. The elevated tanks would be in different locations depending upon the Main Cantonment alternative.

Impacts to the areas include subgrade construction, cut and fill activities, and brush clearing. No structures would be modified or demolished for this action.

Figure 14.2-2 shows the proposed project locations at Andersen AFB. All of the APE on Andersen AFB were surveyed for archaeological resources (Dixon et al. 2010). Two well locations would cause significant direct adverse impacts to two historic propertiesT-W-4 (WWII *lancho*) and T-W-7 (a pre-contact ceramic scatter). These sites could also be indirectly affected by erosion or construction personnel working in the area during the construction process. There are many new water storage components in Alternative 1. These components include installing two treated water transmission mains (including a connection to the GWA system), constructing a network of water distribution pipes on both DoD and non-DoD lands, one ground level water storage tank at Finegayan, and two elevated water storage tanks at Finegayan). Impacts to the areas include tree removal, cut and fill activities, and subgrade construction.

Figure 14.2-2 and Figure 14.2-3 show the proposed project locations in relation to archaeological probability areas on Andersen AFB and Finegayan. Waterline construction at Andersen AFB has the potential to cause significant direct adverse impacts to one historic property, T-U-8 (WWII artifact scatter). This site could also be indirectly affected by erosion or construction personnel working in the area during the construction process. All water distribution elements on non-DoD land are replacements of existing lines and are therefore already disturbed and assumed not to contain intact historic properties. Construction at Finegayan has the potential to require the removal of natural resources of cultural concern. A water main that runs along the northern boundary of Andersen South would be replaced. The water main along the eastern border would also be replaced. A traditional cultural property (Latte Stone Park, Site 08-0414) is located approximately 0.5 mile (0.8 kilometer) away in South Finegayan and would not be impacted by construction of the new water distribution pipes.

No direct or indirect impacts from operations of the new water supply and water storage facilities are expected.

BMPs implemented to protect cultural resources include:

- Archaeologists would monitor medium archaeological probability areas during construction in consultation with the SHPO.
- For post review discoveries, an assessment would be made for NRHP eligibility in consultation with the SHPO.
- For areas or properties that have not been inventoried for historic properties, the DoD would follow SOPs as outlined in the ICRMP and any existing agreements.

Possible Proposed Mitigation Measures

Basic Alternative 1 would have significant adverse impacts on three historic properties (T-W-4, T-W-7, and T-U-8). Mitigation of impacts on the three NRHP-eligible sites would be resolved through data recovery because these sites are eligible under Criterion D and recovery efforts would follow the ACHP guidance, Resolving Adverse Effects through Recovery of Significant Information from Archeological Sites (ACHP 1999). Through data recovery these impacts would be reduced to a less than significant levels. A table with the area, site number, impact, NRHP criteria of significance, and potential mitigation measures for each resource is included in Volume 9, Appendix G.

With the BMPs implemented above, no further mitigation measures would be required.

14.2.3.2 Basic Alternative 2

Basic Alternative 2 would provide additional water capacity of 11.7 MGd (44.3 MLd), which is anticipated to be met by an estimated 20 new wells at Andersen Air Force Base (AFB) and 11 new wells at Air Force Base Barrigada, rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 1.8 MG (6.8 ML) water storage tanks would be constructed at ground level at NCTS Finegayan and one 1 MG (3.8 ML) water storage tank would be construction at Air Force Base Barrigada. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint. The tanks would be in different locations that would depend on the Main Cantonment Alternative. All of the APE on Finegayan, Air Force Barrigada, and Andersen AFB have been surveyed for archaeological resources (Dixon et al. 2010).

Figure 14.2-2 shows the proposed project locations at Andersen AFB. Two well locations would cause significant direct adverse impacts on two historic properties that are archaeological sites, T-W-4 and T-W-7. These sites could also be indirectly affected by erosion or construction personnel working in the area during the construction process.

Figure 14.2-2 and Figure 14.2-3 show the proposed project locations on Andersen AFB, Finegayan, and Barrigada. Waterline construction at Andersen AFB has the potential to cause significant direct adverse impacts ton one NRHP-eligible archaeological site, T-U-8. This site could also be indirectly affected by erosion or construction personnel working in the area during the construction process. All water distribution elements on non-DoD land are replacements of existing lines and are therefore already disturbed and assumed not to contain intact historic properties. Construction at Finegayan has the potential to require the removal of natural resources of cultural concern, an impact under NEPA. The new storage tank at Air Force Barrigada would have no impact on cultural resources. Likewise the new wells at Navy Barrigada would have no impact on cultural resources.

No direct or indirect impacts from operations of the new water supply and water storage facilities are expected.

BMPs implemented to protect cultural resources would be the same as those described above.

Proposed Mitigation Measures

Basic Alternative 2 would have significant adverse impacts to three historic properties (T-W-4, T-W-7, and T-U-8). Mitigation of impacts for the three NRHP-eligible sites would be resolved through data recovery because these sites are eligible under Criterion D and recovery efforts would follow the ACHP guidance, Resolving Adverse Effects through Recovery of Significant Information from Archeological Sites (ACHP 1999). Through data recovery these impacts would be reduced to less than significant levels.

A table with the area, site number, impact, NRHP criteria of significance, and potential mitigation measures for each resource is included in Volume 9, Appendix G.

Impacts on natural resources of cultural concern would be avoided if possible as described above. With the BMPs implemented above, no further mitigation measures would be required.

14.2.3.3 Summary of Impacts

Table 14.2-2 summarizes the potential impacts of each action alternative.

Construction and operation of Basic Alternative 1 would result in significant impacts to three historical properties. However, these impacts are mitigable to less than significant through data recovery. This alternative would not affect historic properties that are architectural resources, or submerged resources. Mitigation would include avoidance, survey, monitoring during construction, evaluation, and data recovery.

Table 14.2-2. Summary of Potential Impacts on Cultural Resources – Potable Water

*Basic Alternative 1**	*Basic Alternative 2*
Construction (direct impacts with indirect impacts in parentheses)	
Archaeological Resources	
SI-M • Adverse impacts to three historic properties at Andersen AFB (impacts to three archaeological sites at Andersen AFB from erosion or construction personnel during the construction process	SI-M • Adverse impacts to three historic properties at Andersen AFB (impacts to three archaeological sites at Andersen AFB from erosion or construction personnel during the construction process
Architectural Resources	
NI • No adverse impacts to architectural resources at North, South, or Central Guam (no adverse impacts)	NI • No adverse impacts to architectural resources at North, South, or Central Guam (no adverse impacts)
Submerged Resources	
NI • No adverse impacts to submerged resources or objects (no adverse impacts)	NI • No adverse impacts to submerged resources or objects (no adverse impacts)
Traditional Cultural Properties	
NI • No adverse impacts (no adverse impacts)	NI • No adverse impacts (no adverse impacts)
Operation (direct impacts with indirect impacts in parentheses)	
Archaeological Resources	
NI/SI-M • No adverse impacts	NI/SI-M • No adverse impacts
Architectural Resources	
NI • No adverse impacts to architectural resources at North, South, or Central Guam (no adverse impacts)	NI • No adverse impacts to architectural resources at North, South, or Central Guam (no adverse impacts)
Submerged Resources	
NI • No adverse impacts to submerged resources or objects (no adverse impacts)	NI • No adverse impacts to submerged resources or objects (no adverse impacts)
Traditional Cultural Properties	
NI • No adverse impacts (no adverse impacts)	NI • No adverse impacts (no adverse impacts)

Legend: AFB = Air Force Base; NI = No impact; SI-M = Significant impact mitigable to less than significant.
*Preferred Alternative.

Construction and operation of Basic Alternative 2 would result in significant impacts to three historic properties. Construction of new water supply wells and water storage facilities would result in significant impacts to three historic properties. However, these impacts are mitigable to less than significant through data recovery. This alternative would not affect historic properties that are architectural resources or submerged resources. Mitigation would include avoidance, survey, monitoring during construction, evaluation, and data recovery.

14.2.4 Wastewater

14.2.4.1 Basic Alternative 1a (Preferred Alternative) and 1b

Basic Alternative 1 (Alternative 1a supports Main Cantonment Alternatives 1 and 2; and Alternative 1b supports Main Cantonment Alternatives 3 and 8) combines upgrade to the existing primary treatment facilities and expansion to secondary treatment at the Northern District Wastewater Treatment Plant (NDWWTP). The difference between Alternatives 1a and 1b would be a requirement for a new sewer line from Barrigada housing to NDWWTP for Alternative 1b. All of the APE at the Main Cantonment and Air Force Barrigada have been surveyed for archaeological resources (Dixon et al. 2010). Approximately 75% of the Harmon Annex and Guam Land Use Plan 77 areas have been surveyed. Unsurveyed areas are designated as medium probability areas.

The construction of the collection system for Wastewater Basic Alternative 1a would take place in areas of medium archaeological sensitivity. Medium archaeological probability areas are located in portions of the Harmon Annex, Guam Land Use Plan 77 areas, and along some roadways. Monitoring during construction would be conducted for these areas. Operations of Basic Alternative 1a would not have significant impacts on cultural resources in the area, as operations would not bring an influx of people into the area and operational activities are unlikely to cause erosion.

BMPs implemented to protect cultural resources include:

- Archaeologists would monitor medium archaeological probability areas during construction in consultation with the SHPO.
- For post review discoveries, an assessment would be made for NRHP eligibility in consultation with the SHPO.
- For areas or properties that have not been inventoried for historic properties, the DoD would follow SOPs as outlined in the ICRMP and any existing agreements.

Possible Mitigation Measures

With the BMPs implemented above, no mitigation measures would be required.

14.2.4.2 Basic Alternative 1b

Under Basic Alternative 1b, the only difference with Basic Alternative 1a would be the additional new sewer and pump stations to convey wastewater from Barrigada to NDWWTP.

Operations of the construction of the collection system for Wastewater Basic Alternative 1b would take place in areas of medium archaeological sensitivity. Medium archaeological probability areas are located in the Harmon Annex, Guam Land Use Plan 77 areas, and along some roadways. Monitoring during construction would be conducted for medium probability areas in accordance with BMPs. Basic Alternative 1b would not have significant impacts on cultural resources in the area, as operations would not bring an influx of people into the area and operational activities are unlikely to cause erosion.

BMPs implemented to protect cultural resources would be the same as those described above.

Proposed Mitigation Measures

With the BMPs implemented above no mitigation measures would be required.

14.2.4.3 Summary of Impacts

Table 14.2-3 summarizes the potential impacts of each basic alternative. A text summary is provided below.

Table 14.2-3. Summary of Potential Impacts on Cultural Resources – Wastewater

Potentially Impacted Resource	*Basic Alternative 1a**	*Basic Alternative 1b*
Construction (direct and indirect impacts are the same)		
Archaeological Resources	NI • With use of BMPs, no impact to archaeological resources	NI • With use of BMPs, no impact to archaeological resources
Architectural Resources	NI • No adverse impacts to architectural resources at North, South, or Central Guam	NI • No adverse impacts to architectural resources at North, South, or Central Guam
Submerged Resources	NI • No adverse impacts to submerged resources or objects	NI • No adverse impacts to submerged resources or objects
Traditional Cultural Properties	NI • No adverse impacts to traditional cultural properties	NI • No adverse impacts to traditional cultural properties
Operation (direct and indirect are the same)		
Archaeological Resources	NI • No adverse impacts to archaeological resources at North, South, or Central Guam	NI • No adverse impacts to historic properties at North, South, or Central Guam
Architectural Resources	NI • No adverse impacts to structural resources at North, South, or Central Guam	NI • No adverse impacts to structural resources at North, South, or Central Guam
Submerged Resources	NI • No adverse impacts to submerged resources or objects	NI • No adverse impacts to submerged resources or objects
Traditional Cultural Properties	NI • No adverse impacts to traditional cultural properties	NI • No adverse impacts to traditional cultural properties

Legend: GLUP = Guam Land Use Plan; NI = No impact; SI-M = Significant impact mitigable to less than significant. *Preferred Alternative.

Construction of Wastewater Basic Alternative 1a would not result in significant impacts to historic properties. Ground disturbance would take place in areas with medium archaeological probability. However, in accordance with BMPs, this area would be monitored during construction. This alternative would not impact architectural resources, traditional cultural properties or submerged resources. Mitigation would include avoidance, survey, monitoring during construction, and data recovery.

Construction of Wastewater Basic Alternative 1b would not result in significant impacts to historic properties. Ground disturbance would take place in areas with medium archaeological probability. However in accordance with BMPs, this area would be monitored during construction. This alternative would not affect architectural resources, traditional cultural properties, or submerged resources.

14.2.5 Solid Waste

14.2.5.1 Basic Alternative 1 (Preferred Alternative)

The Preferred Alternative would be to continue to use the Navy Landfill at Apra Harbor for municipal solid waste (MSW) until the new GovGuam Layon Landfill at Dandan is available for use. Disposal of other waste streams excluded from Layon Landfill would continue at the Navy Landfill. Construction and demolition (C&D) debris would continue to be disposed at the Navy hardfill. All of the APE have been surveyed for archaeological resources.

Figure 14.2-1 provides the proposed project location in relation to the archaeological probability areas. Overall, this area is considered to be low probability. No archaeological or traditional cultural properties are known from this area. Therefore, no adverse direct or indirect impacts on historic properties would result from implementation of this component (Table 14.2-4).

Mitigation Measures

Since the potential in the construction area is low, no mitigation measures or further review under Section 106 are required for archaeology.

Table 14.2-4. Summary of Potential Impacts on Cultural Resources – Solid Waste

Potentially Impacted Resource	*Basic Alternative 1**
Construction and Operation Impacts (direct and indirect impacts are the same)	
Archaeological Resources	NI • No adverse impacts to architectural resources at North, South, or Central Guam
Architectural Resources	NI • No adverse impacts to architectural resources at North, South, or Central Guam
Submerged Resources	NI • No adverse impacts to submerged resources or objects
Traditional Cultural Properties	NI • No adverse impacts to traditional cultural properties

Legend: NI = No impact. *Preferred Alternative.

Since this alternative requires no construction, would use one existing facility, would use one facility that is currently under construction through non-project authorization and independent National Environmental Policy Act review, and would provide only for an increased volume of solid waste, there would be no impacts to cultural resources.

14.2.6 Off Base Roadways

Evaluation of the roadways projects' potential to impact historic properties includes a number of sources, in addition to ongoing consultation with Guam SHPO and Section 106 consulting parties. These sources include:

- SHPO's Geographic Information System files of historic property locations on Guam (up-to-date data, requested by FHWA, for greatest accuracy);
- Soil Survey of the Territory of Guam in 1988 by the United States Department of Agriculture;
- The research design and work plan for archaeological survey, testing, and monitoring developed for these projects;

- Project-level evaluations of possible historic architecture and traditional cultural properties;
- Existing literature regarding archaeology, history, ethnography and ethnohistory of the island; and
- Two field visits with Guam SHPO staff.

14.2.6.1 Alternative 1

North

Numerous archaeological surveys have been completed at military facilities in the North Region, many of which include haul-road corridors. These are summarized in Yee and Tomonari-Tuggle (2009:34). They include Naval Computer and Telecommunications Station Finegayan and South Finegayan along Route 3, Potts Junction (intersection of Routes 3 and 9), and at Andersen South between Routes 1 and 15. Tomonari-Tuggle and Tuggle (2003) present an ICRMP for Andersen AFB that includes summary information and management recommendations for areas of the installation along Routes 3A and 9. Recent, more focused studies and overview surveys for Andersen AFB include survey along a lengthy portion of Route 9. Alternative 1 includes 13 road improvement projects in the North Region.

No known historic properties are within the APE for any roadway project in the North Region (Figure 14.2-5). Table 14.2-5 summarizes Section 106 findings. Some projects are located in areas that may have potential to affect undocumented historic properties. Ongoing consultation is contributing to development of a plan to test and monitor areas where FHWA has found No Adverse Effect to historic properties.

Table 14.2-5. Section 106 Effects in the North Region, Alternative 1

GRN #	*Known Historic Properties*	*Section 106 Finding*
08	None	No Historic Properties Affected
09	None	No Adverse Effect
10	None	No Adverse Effect
22	None	No Adverse Effect
22A	None	No Adverse Effect
23	None	No Historic Properties Affected
38A	None	No Adverse Effect
39A	None	No Adverse Effect
41A	None	No Adverse Effect
42	None	No Adverse Effect
57	None	No Adverse Effect
117	None	No Historic Properties Affected
124	None	No Adverse Effect

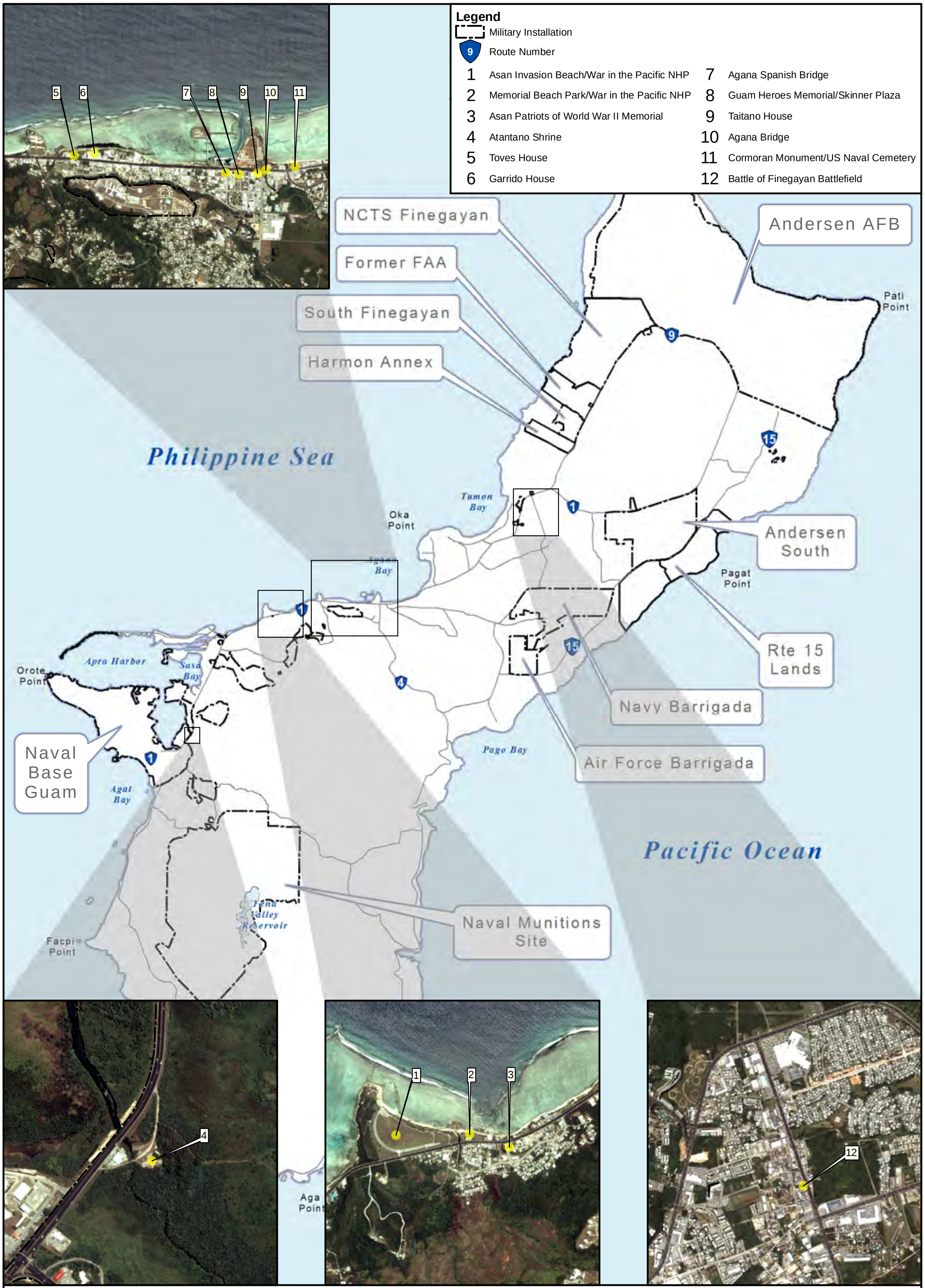

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Figure 14.2-5
Known Historic Properties within the APE

Central

Recent archaeological research in the Central Region has included investigations for non-military and military purposes. Yee and Tomonari-Tuggle (2009:38-40) detail these efforts. Briefly, there have been several projects within the heavily developed area of downtown Agana particularly along Route 1. Archeological data recovery excavations and monitoring has been conducted along Marine Drive from Route 8 to Camp Watkins Road in connection with Route 1 reconstruction. Most of the cultural deposits were found in the Apurguan area near the east end of Agana Bay, but one site was located in the Agana area. Most of the archaeological work in the Agana area found evidence of historic period occupation.

Alternative 1 includes 27 road improvement projects in the Central Region. Section 106 findings are summarized in Table 14.2-6. Figure 14.2-5 plots known historic properties in relation to road projects. GRN# 1, 3, 13, 14, 15 and 18 have known historic properties in their APE. Most projects would not have an effect on historic properties. Ongoing consultation is contributing to development of a plan to test and monitor areas where FHWA has found No Adverse Effect to historic properties. Each project with properties within its APE is discussed below.

GRN # 1 is a pavement strengthening project past the Cormoran Monument and U.S. Naval Cemetery. Although the proposed improvements do not extend beyond the existing roadway, the geographic information system right-of-way parcel line appears to indicate that the existing roadway is built partially inside the cemetery right-of-way. Since the publication of the Draft EIS, design refinements have avoided these impacts entirely. Thus, GRN#1 would have no effect on these historic properties.

GRN # 3 would replace the Hagatna (Agana) Bridge, which would constitute an Adverse Effect. However, it is likely that the bridge has lost its integrity and associations with its historic past through at least two widenings. Moreover, the Guam SHPO has indicated that the parapets along the bridge are the only contributing historic elements worth preserving. A Memorandum of Agreement is currently being developed to mitigate adverse effects. Stipulations would include providing new parapets in the style of the existing parapets to preserve the look and feel of the historic bridge. Historic American Engineering Record documentation and archival-quality photos would also be completed. Because the project would reconstruct the bridge in its historic location, and mitigation would preserve the only remaining historic attributes and features contributing to the bridge's NRHP eligibility, FHWA finds that, with mitigation, the project would have No Adverse Effect on Hagatna (Agana) Bridge.

GRN # 13 is a pavement strengthening project along Route 1 from Route 11 to the Asan River, with no widening or impacts outside the roadway prism. An archaeological site, Memorial Beach Park, and Asan Invasion Beach are all adjacent to Route 1 in this segment. Because the project would not extend outside of the existing roadway, the project would have no effect on these historic properties.

GRN # 14 is a pavement strengthening project along Route 1 from the Asan River to Route 6, with no widening or impacts outside the roadway prism. Two archaeological sites, the Nino Perdido Church and the Asan World War II Memorial, are adjacent to Route 1 in this segment. Because the project would not extend outside of the existing roadway, the project would have no effect on these historic properties.

GRN # 15 is a pavement strengthening project along Route 1 from Route 6 to Route 4, with no widening or impacts outside the roadway prism. Toves House, Agana Spanish Bridge (San Antonio Bridge), San Nicholas Bridge, and the Guam Heroes Memorial, are all adjacent to Route 1 in this segment. Because the project would not extend outside of the existing roadway, the project would have no effect on these historic properties.

GRN # 16 crosses portions of the Hagatna (Agana) Historic District walking tour/path. Although the project includes widening Route 8, no individual historic properties would be affected. Therefore, the project would have no effect on historic properties.

GRN # 18 is a pavement strengthening project that extends toward the Battle of Finegayan Battlefield. The precise boundaries of the battlefield are uncertain but likely extend into the APE. The site is not currently listed on the NRHP or GRHP, but Guam SHPO staff indicated it is eligible during a February 23, 2010, field visit. Because the project would not leave the existing roadway, the project would have no effect on this historic property.

Table 14.2-6. Section 106 Effects Central Area, Alternative 1

GRN #	*Known Historic Properties*	*Section 106 Finding*
01	Cormoran Monument, U.S. Naval Cemetery	No Historic Properties Affected
02	None	No Historic Properties Affected
03	Hagatna (Agana) Bridge	No Adverse Effect (mitigated)
06	None	No Historic Properties Affected
07	None	No Historic Properties Affected
11	None	No Historic Properties Affected
12	None	No Adverse Effect
13	Asan Invasion Beach, Memorial Beach Park, War in the Pacific National Historical Park, one archaeological site	No Adverse Effect
14	Asan World War II Memorial, Nino Perdido Church, two archaeological sites	No Adverse Effect
15	San Nicholas Bridge, Agana Spanish Bridge, Guam Heroes Memorial and Skinner Plaza, Taitano House, Garrido House, Toves House	No Adverse Effect
16	None	No Historic Properties Affected
17	None	No Historic Properties Affected
18	Battle of Finegayan Battlefield	No Historic Properties Affected
19	None	No Historic Properties Affected
20	None	No Historic Properties Affected
21	None	No Historic Properties Affected
28	None	No Adverse Effect
29	None	No Adverse Effect
30	None	No Historic Properties Affected
31	None	No Historic Properties Affected
32	Route 1 Reconstruction Site	No Historic Properties Affected
33	None	No Historic Properties Affected
35	None	No Adverse Effect
36	One archaeological site	Adverse Effect
44	None	No Adverse Effect
46	None	No Adverse Effect
113	Mesa House	No Historic Properties Affected

GRN # 36 proposes to re-align Route 15 on to DoD land inland from its current location. This area has been subject to pedestrian inventory. One archaeological site is located within the APE. The proposed re-alignment would cut through the site. Therefore, the project would have an Adverse Effect on the archaeological site. A Memorandum of Agreement is currently being developed to mitigate adverse effects.

GRN #113 is a striping and signing project with minor intersection improvements along Route 7 and 7A. Mesa House is located in or near the APE for this project, but is set far enough away from the roadway that no effects would result.

Apra Harbor

Extensive archaeological overviews and surveys have been undertaken in and around Apra Harbor. Five surveys have been completed in the Route 1/2A/5 area. The Route 1 and 2A corridors inland of Apra Harbor have been identified in previous archaeological and paleoenvironmental surveys as the locales of early Pre-Latte Period sites. Yee and Tomonari-Tuggle (2009:43) present a summary of previous investigations.

Alternative 1 includes five road improvement projects in the Apra Harbor Region. Effects on known historic properties are summarized in Table 14.2-7. Figure 14.2-5 plots known historic properties in relation to road projects. The Atantano Shrine is located within a parcel adjacent to GRN #24, but it is located well away from the roadway and would not be affected by the project. Ongoing consultation is contributing to development of a plan to test and monitor areas where FHWA has found No Adverse Effect to historic properties.

Table 14.2-7. Section 106 Effects in the Apra Harbor Region from Alternative 1

GRN #	*Known Historic Properties*	*Section 106 Finding*
04	None	No Adverse Effect
05	None	No Adverse Effect
24	Atantano Shrine	No Historic Properties Affected for the Shrine; No Adverse Effect elsewhere
26	None	No Historic Properties Affected
50	None	No Adverse Effect

South

Alternative 1 includes four road improvement projects in the South region. There are no known historic properties within the APE of any project in the South region. Table 14.2-8 summarizes Section 106 findings in the South region. Ongoing consultation is contributing to development of a plan to test and monitor areas where FHWA has found No Adverse Effect to historic properties.

Table 14.2-8. Section 106 Effects on Known Historic Properties in the South Region from Alternative 1

GRN #	*Known Historic Properties*	*Section 106 Finding*
25	None	No Historic Properties Affected
27	None	No Adverse Effect
52	None	No Adverse Effect
110	None	No Historic Properties Affected

Indirect Effects

Adverse indirect effects are unlikely to result from off base roadway projects. Most projects are along existing transportation corridors, where existing noise, visual impacts, and other elements are common to adjacent historic properties. Moreover, for all projects, any such impacts identified as adverse would be mitigated through sound walls or other appropriate measures, reducing potential indirect impacts below any adverse level. The potential for indirect impacts caused by increases in traffic and visitation, which may result from the roadway projects within Andersen South and South Finegayan are discussed in Volume 2, Chapter 12. There is little potential for such indirect impacts for remaining projects, because all are located on existing transportation corridors.

Proposed Mitigation Measures

Alternative 1 would create adverse effects to the Hagatna (Agana) Bridge and an archaeological site. Mitigation for impacts to the bridge would preserve its historic setting and appearance and could include Historic American Engineering Record documentation and photo recordation. Mitigation for the archaeological site would include data recovery.

14.2.6.2 Alternative 2 (Preferred Alternative)

Peak construction and permanent impacts on cultural resources under Alternative 2 would be similar to those described under Alternative 1 because the same projects, except for varying locations of the Military Access Points at Naval Computer and Telecommunications Station Finegayan, are proposed under this alternative. Proposed mitigation measures for Alternative 2 would be the same as those proposed for Alternative 1.

14.2.6.3 Alternative 3

Peak construction and permanent impacts on cultural resources under Alternative 3 would be similar to those described under Alternative 1 because the same projects are proposed under this alternative with a few projects more or less than Alternative 1 that would be built as part of the GRN improvements program. Proposed mitigation measures for Alternative 3 would be the same as those proposed for Alternative 1.

14.2.6.4 Alternative 8

Peak construction and permanent impacts on cultural resources under Alternative 8 would be similar to those described under Alternative 1 because the same projects are proposed under this alternative with a few projects more or less than Alternative 1 that would be built as part of the GRN improvements program. Proposed mitigation measures for Alternative 8 would be the same as those proposed for Alternative 1.

14.2.6.5 Summary of Impacts

Table 14.2-9 summarizes the potential impacts of each alternative.

Table 14.2-9. Summary of Potential Impacts on Cultural Resources – Roadway Project

Potentially Impacted Resource	*Alternative 1*	*Alternative 2**	*Alternative 3*	*Alternative 8*
Cultural Resources	SI-M	SI-M	SI-M	SI-M

Legend: SI-M = Significant impact mitigable to less than significant. *Preferred Alternative.

14.2.6.6 Summary of Proposed Mitigation Measures

Table 14.2-10 summarizes the proposed mitigation measures for roadway projects impacts on cultural resources.

Table 14.2-10. Summary of Proposed Mitigation Measures for Roadway Projects Impacts on Cultural Resources

Phase	*Mitigation Measure*
Construction	• Site monitoring • Data recovery
Operation	• Preservation of historic setting and appearance

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CHAPTER 15.
VISUAL RESOURCES

15.1 INTRODUCTION

This chapter discusses potential environmental consequences associated with implementing the alternatives within the region of influence on visual resources. A description of the affected environment for visual resources is provided in Volume 2. The locations described in Volume 2 include the region of influence for the utilities and roadway projects as they relate to visual resources.

15.2 ENVIRONMENTAL CONSEQUENCES

15.2.1 Approach to Analysis

15.2.1.1 Methodology

Utilities

Information on visual resources was gathered through onsite visits, background research, and participation in stakeholder and public meetings. The analysis of potential impacts on visual resources is based on the long-term (operational) effects (i.e., after construction has occurred and all buildings, facilities, and structures are in place). Construction-related activities would be relatively minimal in their impacts (i.e., earth-moving equipment clearing vegetation and constructing facilities and other structures).

Off Base Roadways

This visual assessment was prepared consistent with the methodologies established by the Federal Highway Administration's Visual Impact Assessment for Highway Projects (1981). This methodology divides the views into landscape or character units that have distinct but not necessarily homogenous visual character. Typical views, called key viewpoints, are selected for each unit to represent the views to/from the project. The view of the motorist is also considered as a separate character unit.

Existing visual quality from the viewpoints is judged by three criteria: vividness, intactness, and unity. Descriptions for the three criteria are:

- Vividness: The memorability of the landscape components as they combine to form striking or distinctive patterns.
- Intactness: The integrity of visual order in the view and its freedom from visual encroachment.
- Unity: The visual coherence and composition of the landscape viewed to form a harmonious visual pattern.

These criteria provide a method for describing the form, line, color, and texture of the components found within a view. As in all things aesthetic, "beauty is in the eye of the beholder;" therefore, there is a subjective component to this or any visual analysis evaluation. However, as outlined in the Federal Highway Administration methods, the use of these descriptors allows for a basis for understanding the evaluator's rationale behind a visual quality determination. Visual character terms are descriptive and non-evaluative, meaning that they are based on defined attributes that are neither good nor bad by themselves. Changes in visual character cannot be described as having good or bad attributes until compared with viewer responses to the change.

15.2.1.2 Determination of Significance

Utilities

For the purpose of the Environmental Impact Statement, the proposed actions would cause a significant impact to visual resources if they:

- Substantially alter the views or scenic quality associated with particularly significant and/or publicly recognized vistas, view sheds, overlooks, or features.
- Substantially change the light, glare, or shadows within a given area.
- Substantially affect sensitive receptors (i.e., viewers with particular sensitivity [or intolerance] to a changed view.
- Significant impacts that cannot be mitigated to less-than-significant levels are considered unavoidable.

A discussion is presented for each significance criterion listed that would be triggered by the utility alternatives.

Off Base Roadways

The National Environmental Policy Act (NEPA) requires consideration of visual resource impacts of projects in preparation of environmental documents. NEPA guidelines for the assessment of visual impacts stipulate that environmental documents:

- State whether the project alternatives have a potential for visual quality impacts.
- Identify the impacts on the existing visual resources.
- Identify the relationship of the impacts on potential viewers of and from the project.
- Identify measures to avoid, minimize, or reduce the adverse impacts.

For projects that do not create a substantial impact on existing visual quality, a more nuanced approach categorizes impact levels as low, moderate, moderately high, and high based on the following descriptions:

- Low: Minor adverse change to the existing visual resource, with low viewer sensitivity to any change. May or may not require mitigation.
- Moderate: Adverse change cannot be described as minor or viewer response is thought to be greater. Impacts can be mitigated within 5 years using conventional practices.
- Moderately High: Moderate adverse change in the visual resource with high viewer response or high adverse change with a moderate viewer response. Extraordinary mitigation measures may be required, and landscape treatments required may take more than 5 years to mitigate.
- High/Substantial: High level of adverse change or a high level of sensitivity to the change such that architectural design and landscape treatments cannot mitigate impacts. An alternative project design may be required to avoid adverse impacts.

For this analysis, the proposed roadway project would be considered to have a substantial impact if it were to result in the obstruction or impairment of important views from a public roadway or scenic vista, result in the substantial modification to the height of the existing structures or topography of an area, or cause a large reduction in the landscape/vegetation within the project area. Such impacts would be considered substantial only if it was not possible to mitigate the impacts on the visual environment of the project.

15.2.1.3 Issues Identified during Public Scoping Process

No issues regarding impact on visual resources as a result of proposed utility and road improvements were raised at the April 2007 public scoping meetings.

15.2.2 Power

15.2.2.1 Basic Alternative 1: Recondition up to Five Existing Guam Power Authority–Permitted Facilities to Provide Peaking Power/Reserve Capacity

Basic Alternative 1 would recondition up to five existing Combustion Turbines and upgrade Transmission and Distribution (T&D) systems and would not require new construction or enlargement of the existing footprint of the facilities. Reconditioning would be made to the existing permitted facilities at the Marbo, Yigo, Dededo (2 units), and Macheche Combustion Turbines. The T&D system upgrades would be on existing above-ground and underground transmission lines. This alternative supports Main Cantonment Alternatives 1 and 2. Main Cantonment Alternatives 3 and 8 would require additional upgrades to the T&D system.

The Basic Alternative 1 presented would recondition the existing Guam Power Authority facilities, and it is assumed new distribution lines would be routed within the existing utility corridors. Therefore, any changes to the landscape at these affected areas would be consistent with the existing environment and any impacts on visual resources would be less than significant. Table 15.2-1 summarizes the potential impacts of the Basic Alternative 1.

Proposed Mitigation Measures

No mitigation measures are needed.

15.2.2.2 Summary of Impacts

Table 15.2-1. Summary of Potential Impacts on Visual Resources – Power

*Basic Alternative 1**
Views toward upgraded GPA facilities
NI

Legend: GPA = Guam Power Authority; NI = No impact. * Preferred Alternative.

15.2.3 Potable Water

As discussed in Volume 6, Chapter 2, Section 2.2.2, potable water alternatives are not distinguished as interim or long-term.

15.2.3.1 Basic Alternative 1 (Preferred Alternative)

Basic Alternative 1 would provide additional water capacity of 11.3 MGd (42.8 MLd), which is anticipated to be met by an estimated 22 new wells at Andersen Air Force Base (AFB), rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 2.5 MG (9.5 ML) water storage tanks would be constructed at ground level at NCTS Finegayan. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

New Water Supply Facilities

The proposed development would be confined to Department of Defense properties and keeping with other planned and surrounding facilities. Views from Route 3 into NCTS Finegayan vary from altered landscapes (i.e., the existing gate and NCTS facilities in the south) to a natural-appearing landscape in the north. Ground-level water storage tanks proposed at NCTS Finegayan would be located near the training area at the Main Cantonment and would not be visible as seen from the existing view corridor along Route 3. Elevated storage tanks situated inside of the Main Cantonment and Route 3, respectively, would be visible from the view corridor on Route 3, though on a varying degree. The resulting view of the elevated water storage tank adjacent to Route 3 would be apparent because of the height of the proposed structure and proximity to the view corridor. However, the resulting view impact would not be significant because a similar existing structure (i.e., elevated water storage tank) presently exists on NCTS Finegayan. The elevated water storage tank situated at the interior of the Main Cantonment would appear distant as seen from the view corridor and may appear to blend in with the proposed base facilities. Inland facilities at NCTS Finegayan would be visible in the middle ground or background and would have less impact on the skyline and visual resources. The proposed water storage tank would not impede upon any particularly significant and/or publicly recognized vistas, view sheds, overlooks, or features. Furthermore, no substantial change would occur related to the light, glare, or shadows in the area. Therefore, any impacts on visual resources would be less than significant.

Proposed Mitigation Measures

Because adverse impacts are anticipated to be less than significant, no mitigation measures are proposed.

15.2.3.2 Basic Alternative 2

Basic Alternative 2 would provide additional water capacity of 11.7 MGd (44.3 MLd), which is anticipated to be met by an estimated 20 new wells at Andersen Air Force Base (AFB) and 11 new wells at Air Force Base Barrigada, rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 1.8 MG (6.8 ML) water storage tanks would be constructed at ground level at NCTS Finegayan and one 1 MG (3.8 ML) water storage tank would be construction at Air Force Base Barrigada. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

New Water Supply Facilities

The proposed development of up to 20 potable water supply wells at Andersen AFB and up to 11 water supply wells at Air Force Barrigada would be consistent with other planned and surrounding facilities and would not be visible outside of the installations. Therefore, no impacts on existing visual resources are anticipated. New water storage facilities (tanks) proposed at NCTS Finegayan and Air Force Barrigada would be installed at ground level and partially visible as the result. One of the water storage facilities proposed at NCTS Finegayan would be located adjacent to Route 3, and the facility at Air Force Barrigada would be located approximately 1/2 mile (1 kilometer [km]) north of Route 15. Two of these types of water storage facilities already exist at Finegayan (one at NCTS and the other at South Finegayan), and both are adjacent to Route 3.

Views from Route 3 into NCTS Finegayan vary from an altered landscape (i.e., the existing gate and NCTS facilities in the south) to a naturally appearing landscape in the north. The resulting view of the elevated water storage tanks adjacent to Route 3 would be apparent because of the height of the proposed structure and proximity to the view corridor. However, the resulting view impact would not be significant because a similar existing structure presently exists on NCTS Finegayan. The elevated water storage tank situated interior of the Main Cantonment would appear distant as seen from the view corridor and may appear to blend in with the proposed base facilities.

Inland facilities at NCTS Finegayan and Air Force Barrigada would be seen in the middle ground or background and have less impact on the skyline and visual resources, because they would be partially visible. These storage facilities would be adjacent to other installation facilities. None of the proposed water storage tanks would degrade any particularly significant and/or publicly recognized vistas, view sheds, overlooks, or features. No substantial change would occur to the light, glare, or shadows in the area. Therefore, any impacts on visual resources are anticipated to be less than significant.

Proposed Mitigation Measures

Because adverse impacts are anticipated to be less than significant, no mitigation measures are proposed.

15.2.3.3 Summary of Impacts

Table 15.2-2 summarizes the potential impacts of each action alternative.

Table 15.2-2. Summary of Potential Impacts on Visual Resources – Potable Water

*Basic Alternative 1**	*Basic Alternative 2*
Views along Highway 3 adjacent to Finegayan	
LSI	LSI

Legend: LSI = Less than significant impact. *Preferred Alternative.

Both of the alternatives related to potable water supply and storage would introduce new features into the landscape. Due to the size and location of the water supply and treatment features, only the water storage elements (i.e., ground-level tanks and elevated water storage tanks) would be expected to have an impact on visual resources. One of the two new water towers would be located inland of readily visible public features, making them middle ground and background visual elements in the landscape and causing a less than significant impact on visual resources. One elevated water tower would be located directly adjacent to a public highway (Route 3) making it visible in the foreground as well.

15.2.4 Wastewater

15.2.4.1 Basic Alternative 1a (Preferred Alternative) and 1b

Basic Alternative 1 (Alternative 1a supports Main Cantonment Alternatives 1 and 2; and Alternative 1b supports Main Cantonment Alternatives 3 and 8) combines upgrade to the existing primary treatment facilities and expansion to secondary treatment at the Northern District Wastewater Treatment Plant (NDWWTP). The difference between Alternatives 1a and 1b is a requirement for a new sewer line from Barrigada housing to NDWWTP for Alternative 1b.

Upgrading and expanding the primary and secondary treatment system, respectively, would not be visible outside of the facility. The existing visual character of the proposed location would not be altered. Therefore, no impacts on existing visual resources are anticipated.

Proposed Mitigation Measures

No mitigation measures are needed.

15.2.4.2 Alternative 1b

Alternative 1b is identical to Alternative 1a with the additional requirement for a new sewer line from Barrigada housing to NDWWTP. The development of a sewer line would involve ground-level construction work, and while views may be interrupted by the presence of construction equipment, no permanent degradation of visual resources is expected. Therefore, less than significant impacts on visual resources are anticipated.

Proposed Mitigation Measures

No mitigation measures are needed.

15.2.4.3 Summary of Impacts

Little, if any of the features associated with the new or upgraded wastewater treatment facilities would be visible from public viewpoints, particularly those along Route 3. Therefore, no impacts on visual resources are anticipated under any of the wastewater treatment alternatives. Table 15.2-3 summarizes the potential impacts of each interim alternative. An analysis of long-term alternatives was not developed because the alternatives are not ready for project-specific analysis.

Table 15.2-3. Summary of Potential Impacts on Visual Resources – Wastewater

*Basic Alternative 1a**	*Basic Alternative 1b*
Views from Highway 3 near Finegayan South	
NI	LSI

Legend: LSI = Less than significant impact; NI = No impact. * Preferred Alternative.

15.2.5 Solid Waste

15.2.5.1 Basic Alternative 1 (Preferred Alternative)

The Preferred Alternative would be to continue to use the Navy Landfill at Apra Harbor for municipal solid waste (MSW) until the new Government of Guam (GovGuam) Layon Landfill at Dandan is available for use. Disposal of other waste streams excluded from Layon Landfill would continue at the Navy Landfill. Construction and demolition (C&D) debris would continue to be disposed at the Navy hardfill.

The proposed location in Layon is a rocky badland at high elevation adjacent to the Inarajan Village. The proposed mound-shape landfill, situated approximately 435 feet (ft) (133 meters [m]) above mean sea level, is likely to be visible from different vantage points, from road travelers on Route 4 and adjoining villages on the fringe of the rolling southern mountains. Although the proposed landfill location is situated at least 1.5 miles (2.4 km) inland from Route 4, the mound shape of the new landfill could potentially appear prominently among the existing mountain peaks and rolling hills. However, this landfill is already in construction and has been through a separate NEPA review. These potential impacts are not due to the action proposed in this Environmental Impact Statement. Therefore, there are no additional visual impacts from this solid waste alternative from this proposed action.

Proposed Mitigation Measures

Because there are no visual impacts from solid waste alternatives caused by the proposed action, no mitigation measures would be required (see Table 15.2-4).

Table 15.2-4. Summary of Potential Impacts on Visual Resources – Solid Waste

*Basic Alternative 1**
NA

Legend: NA = not applicable.

15.2.6 Off Base Roadways

The visual impact of project alternatives is determined by assessing the visual resource change due to the project and predicting viewer response to that change. Visual resource change is the total change in visual character and visual quality. The first step in determining visual resource change is to assess the compatibility of the proposed project with the existing visual character of the landscape. The second step is to compare the visual quality of the existing resources with the projected visual quality after the project is constructed. Viewer response to the changes is the sum of viewer exposure and viewer sensitivity to the project, as previously described. The resulting level of visual impact is determined by combining the severity of resource change with the degree to which people are likely to oppose the change.

Existing Viewer Sensitivity

Viewer response is based on two elements – viewer sensitivity and viewer exposure. These elements combine to form a method of predicting how the public might react to visual changes that result from the roadway improvements.

Viewer sensitivity can be defined as an individual's concern for scenic quality and his/her response to change in the visual environment that creates the view. Local values and goals may place greater significance on certain landscape components or locations that might appear unremarkable to an outside observer. Viewer exposure is typically assessed by considering the number of viewers exposed to the view, the type of viewer activity associated with the view, the duration of their view, the speed at which the viewer moves through the environment, and the position of the viewer.

Given the number of changes to the island anticipated as part of the relocating of forces to Guam, it is likely that there would be a high degree of sensitivity on the part of local residents to changes to the visual environment of the island. In addition, because tourism is such a large part of the economy of the island, the overall visual quality would be an important consideration to tourists and those on the island that cater to them.

Local Policy and Goals

In anticipation of the upcoming relocation of Marines from Okinawa to Guam and its effects to the island, the GovGuam has begun a process to develop a Draft Land Use Plan for the North and Central portions of the island. The following are some of the goals established in this document:

- Promote sustainable community development through such measures as development of green spaces and greenways; develop transit-oriented development or transit-ready development; provide diverse opportunities for arts, recreation, and entertainment; increase in-fill in developed areas; and develop design standards.
- Promote the long-term health, character, and identity of the village communities by the development of design standards and practices among other activities.
- Provide a park and recreation system that enhances the quality of life for residents and visitors to Guam by identifying key parks, trails, and greenways needed; and consider a master-planning process for specific significant areas, such as the buffer along Marine Corps Drive (Route 1) between the Micronesia Mall and Y Send Song, to create attractive and functional public areas.
- Integrate future development with open space and natural amenities, including public views of significant natural features and water.
- Establish an interconnected multimodal street network that adequately addresses the travel needs of the community, consistent with community vision by, among other policy directions, establishing requirements for streetscape and design standards that reflect the community character and provide balanced multimodal access.
- Contribute to the quality of life on Guam through the planned provision of infrastructure by describing the role of capital facilities in responding to growth, encouraging beneficial growth, contributing to community character, protecting public health, and environmental quality.

The sum of this effort shows a community that is working to develop in ways and with a quality that would enhance the existing visual environment on the island, and specifically for the Guam Road Network (GRN).

Existing Viewer Groups, Exposure, and Awareness

Community Residents

Residents can be expected to have the highest sensitivity and be the most aware of any groups because they have to live with the projects and are the most familiar with the current visual setting. For the proposed roadway improvements, residents are located adjacent to many of the roads. From these homes, the view to the project area would be direct. It is likely that these residents would be highly sensitive to changes in the visual environment.

Business Owners, Employees, and Customers

This user group would be associated with the existing business within the area of the new bridge, although except for a church, most businesses are far enough removed to not have a clear view into the project area. These viewers would likely have a high awareness of the project, but the principal concern is likely to be the effect of any construction on business access for employees or customers. It is anticipated that these viewers would have a low level of concern regarding the changes to the visual environment.

Regular Motorists

Included in this user group are commuters and local residents and workers who frequently travel within the project area. It is likely that these viewers would be aware of any changes to the visual environment because of their repeated exposure. It is anticipated that viewers from the road would be moderately sensitive to the change in the visual environment.

Occasional Motorists

Occasional motorists include tourists and regional residents from outside the immediate area who infrequently travel the area. These viewers generally have a low exposure and awareness of changes to the visual environment.

Tourists

Tourists, particularly from Japan and Asia, make up a large percentage of the people on the island at any one time. It can generally be assumed that tourists are not familiar with the island. Therefore, tourists are less sensitive to changes in the visual environment; however, they would be very sensitive to the overall visual quality, particularly in areas around the resorts.

15.2.6.1 Alternative 1

The affected environment for visual resources for the proposed roadway improvement projects on Guam is described in Volume 2, Chapter 13, in the Affected Environment section.

Pavement strengthening projects are not anticipated to change the visual environment of the proposed roadway corridors. Because these projects are strictly repaving projects within the existing roadway prism, they should not alter the existing views or visual quality, and the changes should be little noticed. Viewer responses to the changes from repaving of the roadways are likely to be very low. The most noticeable changes would be temporary impacts associated with construction equipment and crews. The existing visual quality of the roadway corridor is anticipated to remain after reconstruction of the pavement. Based on this reason, visual impacts from the proposed pavement strengthening projects are not further analyzed.

In addition to the pavement strengthening projects, the Military Access Points (MAP) are generally not anticipated to alter the existing visual quality of the roadways. In many instances, the proposed improvements are to existing gate locations. These improvements generally include widening approach roadways to facilitate turning movements; but the facility elements, including low buildings, roadways, fencing, and gate arms, would be similar to the existing elements and would not be anticipated to appreciably change the current visual environment. The MAPs are also located some distance from the main island routes, generally between 0.5-mile (0.8-km) to 1.0-mile (1.6-km) off of the main route that also reduces any visual impact to the routes. Based on this reason, visual impacts from the proposed MAP projects are not further analyzed.

Year 2014 (Peak Construction and Population)

Construction of the proposed projects would occur between 2010 and 2014, with 2014 being the peak year for construction. It is anticipated that the relocation of military personnel would be complete by 2015. With this number of projects being constructed in a 4- to 5-year period, it is anticipated that residents and other viewers on the island would likely notice a rapid increase in urbanization on the island. The widened roadways and intersections, combined with the new roadways, would contribute to this change in visual character for many of the roadway corridors. This would also likely be the peak year for temporary impacts associated with views to equipment, signage, and other elements related to construction of the roadway corridors.

Year 2030

For the horizon year of 2030, it is anticipated that all of the construction of all corridors is complete, and only routine maintenance is necessary along the roadways. The temporary impacts associated with construction would no longer be an issue. For the visual environment, it can be anticipated that the island would exhibit a more urban character, particularly in the North, Central, and Apra Harbor Regions, where most of the proposed projects are located.

North Region

Table 15.2-5 identifies all projects within the North Region and the disposition of each project in terms of this analysis. Following the table is a description of the anticipated impact of each of the projects analyzed within the North Region. This information is also summarized in Table 15.2-6. An analysis of a key view for GRN #57 depicts the anticipated changes to the visual environment.

Table 15.2-5. Guam Roads Network Projects Considered for Analysis, North Region

GRN #	*Route Number*	*Alternatives*				*Carried Forward for Further Analysis?*	*Reason for Inclusion or Exclusion*
		1	*2*	*3*	*8*		
8	3	x	x	x	x	No	This project does not require widening (only pavement strengthening), and to modify the access to Okkodo High School on the interior portion of the road.
9	3	x	x	x	x	**Yes**	Pavement strengthening, widen from 2 lanes to 4 lanes, add median and shoulders from NCTS Finegayan to Route 28; add an additional southbound left-turn lane and add northbound right-turn lane to the Route 3/28 intersection.
10	3	x	x	x	x	**Yes**	Pavement strengthening, widen from 2 lanes to 4 lanes, add median and shoulders from NCTS Finegayan to Route 9; eliminate Y-intersection; provide T-intersection with one left-turn and one right-turn lane on Route 3A, a northbound left-turn lane on Route 3.
22	9	x	x	x	x	**Yes**	Pavement strengthening, widen from 2 lanes to 4 lanes, with median from Route 3 to the Andersen AFB North Gate.
22A	9	x	x	x	x	No	This project does not require widening (only pavement strengthening).
23	1	x	x	x	x	No	This project does not require widening (only pavement strengthening) of Route 1, from Chalan Lujuna to Route 9.
38	MAP		x	x		No	Anticipated changes are expected to be minor and would not alter the existing visual environment.
38A	MAP	x			x	No	Anticipated changes are expected to be minor and would not alter the existing visual environment.
39	MAP	x	x	x	x	No	Anticipated changes are expected to be minor and would not alter the existing visual environment.
39A	MAP		x	x		No	Anticipated changes are expected to be minor and would not alter the existing visual environment.
41	MAP		x			No	Anticipated changes are expected to be minor and would not alter the existing visual environment.
41A	MAP	x			x	No	Anticipated changes are expected to be minor and would not alter the existing visual environment.
42	MAP	x	x	x	x	No	Anticipated changes are expected to be minor and would not alter the existing visual environment.
57	28	x	x	x	x	**Yes**	Pavement strengthening, widen from 2 to 3 lanes between Route 1 and Route 3. Provide northbound left-turn, through, through/right-turn, southbound left-turn, through, and through/right-turn, eastbound left-turn, through, and right-turn lane.
117	15	x	x	x	x	**Yes**	Route 15/29 Intersection – signalize, additional northbound, southbound left-turn lanes, southbound right-turn lane.
124	New Road	x	x		x	**Yes**	The Finegayan Connector road would be a new roadway where only dirt roads and forested land currently exist.

Legend: AFB = Air Force Base; GRN = Guam Road Network; MAP = Military Access Point; NCTS = Naval Computer and Telecommunications Station.

Table 15.2-6. General Visual Quality per Road Corridor/Project Area, North Region

			FHWA Visual Assessment Criteria				
GRN #	*Route Number*	*Segment Limits*	*Vividness*	*Intactness*	*Unity*	*Overall Visual Quality (V + I + U/3)*	*Existing vs. Proposed Visual Quality*
9	3	NCTS Finegayan to Route 28	Moderate	Moderate	Moderate	Moderate	Existing
			Moderate	Moderate	Moderate	Moderate	Post-Construction
10	3	NCTS Finegayan to Route 9	Moderate	Moderate	Moderate	Moderate	Existing
			Moderate	Moderate	Moderate	Moderate	Post-Construction
22	9	Route 3 to Andersen AFB (North Gate)	Moderate	Moderate	Moderate	Moderate	Existing
			Moderate	Moderate	Moderate	Moderate	Post-Construction
57	28	Route 1 to Route 3	Moderately High	Moderate	Moderate	Moderately High	Existing
			Moderate	Moderate	Moderate	Moderate	Post-Construction
117	15	Route 15/29 Intersection	Moderate	Moderate	Moderately Low	Moderate	Existing
			Moderate	Moderate	Moderately Low	Moderate	Post-Construction
124	New	Finegayan Connection	Moderately High	Moderate	Moderately High	Moderately High	Existing
			Moderate	Moderate	Moderately High	Moderate	Post-Construction

Legend: AFB = Air Force Base; GRN = Guam Road Network; NCTS = Naval Computer and Telecommunications Station.

GRN #9, Route 3 from NCTS Finegayan to Route 28

This project would widen the existing Route 3 from two to four lanes and add a median. In addition, the intersection with Route 28 would include a new left-turn lane. Most of the traffic that would use this roadway is traveling to and from Andersen AFB. Currently, there is little residential space in the area not associated with the military base, which would tend to limit the viewers exposed to the changes and would equate to a lower sensitivity to the proposed changes.

It is anticipated that the project would increase the appearance of pavement in the views along the roadway. The shoulders are still anticipated to be mown grass, and curb and gutter would not be included in the pavement section, as it would be in a more urban setting. It is anticipated that the overall visual quality would remain at moderate, with moderate vividness, intactness, and unity.

GRN #10, Route 3 from NCTS Finegayan to Route 9

This project is a continuation of the widening of Route 3, as described in GRN #9, and the impacts are anticipated to be similar. As with the previous section, the overall visual quality is expected to remain moderate, with moderate vividness, intactness, and unity.

GRN #22, Route 9 from Route 3 to the Andersen AFB North Gate

This project would widen the existing two-lane road to four lanes. The changes would increase the urban appearance of the roadway in the rural-appearing area. There are a few residences that face the roadway in some sections of the road. These viewers could be expected to be more sensitive of the changes to the roadway appearance; however, the average roadway traveler is expected to have a low sensitivity. The overall visual quality of the corridor would be maintained at moderate, with moderate vividness, intactness, and unity.

GRN #57, Route 28 from Route 1 to Route 3

This project would add a center turn lane to the roadway. In the southern residential sections, it is anticipated that viewer sensitivity would be high. To the north, where there are fewer viewers, this sensitivity could be expected to diminish to some extent. The project is anticipated to lower the existing overall visual quality to moderate, with moderate vividness, moderate intactness, and moderate unity.

GRN #117, Route 15/29 Intersection

This project would increase the overall size of the intersection by adding new left-turn lanes to Route 15, plus a southbound right-turn lane. Given the existing rural character of the intersection, the widening would cause the intersection to have a bigger presence in the landscape; however, the overall effect of the additional pavement is likely to be small to most viewers, thereby maintaining the overall visual quality of the area at moderate, with moderate vividness, moderate intactness, and moderately low unity.

GRN #124, Finegayan Connection

This new roadway would be located in an area that is partially disturbed by dirt roads, including Tanguisson Road, among other less formal dirt roads in the area. Because this area is not regularly traveled, viewer sensitivity is expected to be low. The new roadway would add paving and vehicular traffic where there is none, but there are no residences or other “receptors” that might have a view out to the new corridor.

It is anticipated that the new Finegayan Connection would be expected to lower the visual quality of the area slightly to moderate, with moderate vividness, moderate intactness, and moderate unity from its existing moderately high rating.

Key Viewpoint 1: GRN #57, Route 28 Roadway Widening

Because it is not possible to analyze every view within the project area, it is necessary to select a key viewpoint that typifies the visual effects of the project. The key view represents the specific locations for an individual project, with a view from one of the affected viewer groups that might potentially be affected by the project. A photo simulation of the proposed Route 28 realignment can be seen in Figure 15.2-1.

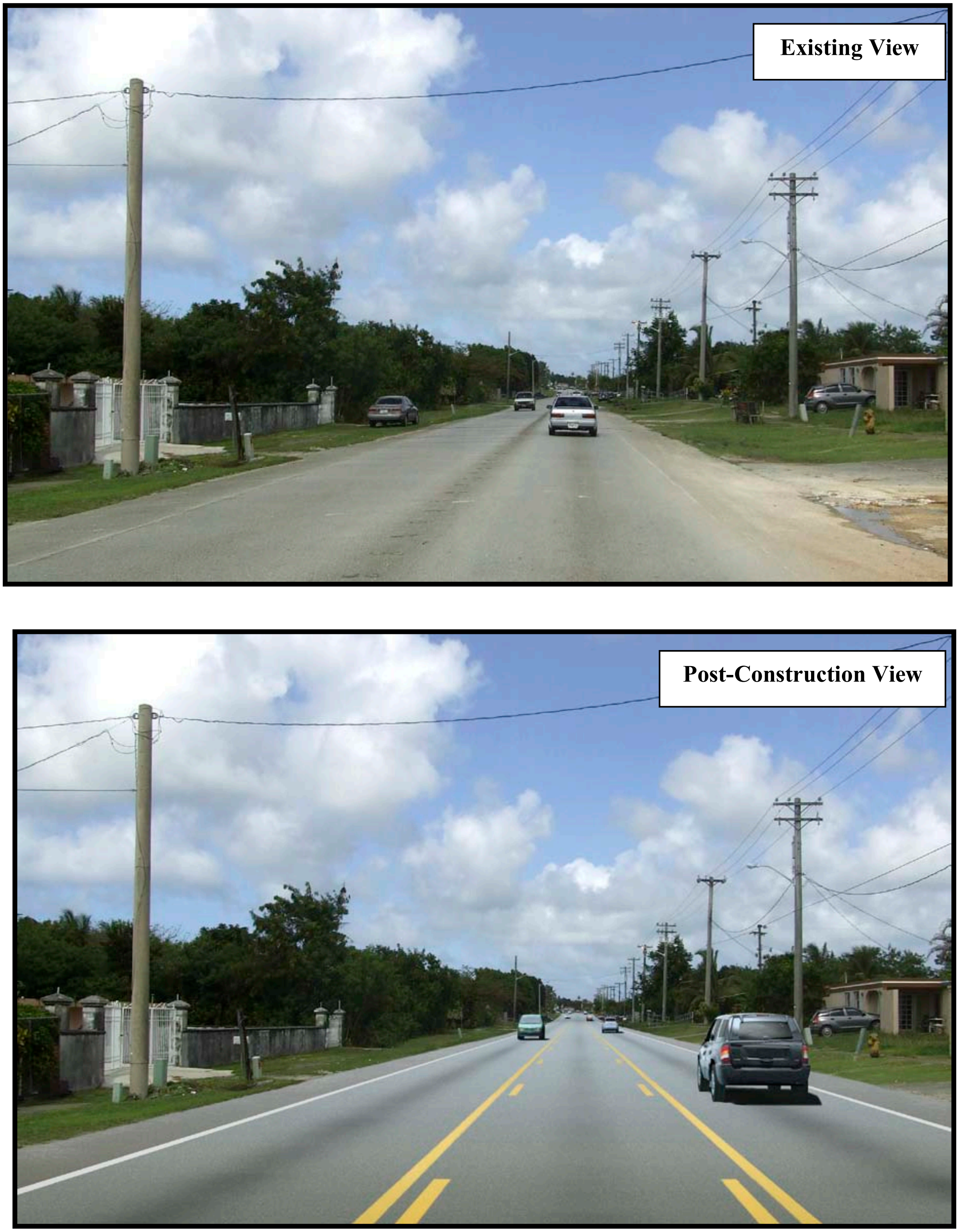

Figure 15.2-1. Key Viewpoint 1. GRN #57, Route 28 Widening

Orientation: The photograph is taken looking north along Route 28. The photograph is taken just north of the Route 28/1 intersection. This view was selected to show the anticipated impacts on a residential area of the proposed roadway widening.

- Existing Visual Character/Quality: The existing visual character of the roadway is that of a residential street. The power lines are considered a visual encroaching element, while the lack of curb and gutter creates a more rural appearance to the residences. The general visual quality of the view is moderate, with moderate vividness, moderately low intactness, and moderate unity.
- Proposed Project Features: The project would add a center turn lane to the existing two-lane roadway, widening the road cross section. There would still be no curb and gutter along the roadway, helping to maintain the "rural" nature of the corridor.
- Changes to Visual Character/Quality: It is anticipated that the existing moderate visual quality would be maintained with the addition of the center turn lane.
- Anticipated Viewer Response: It is anticipated that the primary viewers would be the residents along the roadway and residents traveling along the road. Secondary viewers would be those on the roadway not associated with the area. The residents would be expected to have a moderately high to high sensitivity to the changes in the area, given their familiarity with the existing roadway.
- Resulting Visual Impact: The anticipated resulting visual impact would not substantially alter the existing views.

Summary

Within the North Region, GRN #s 9, 10, 22, 57, 117, and 124 have been identified as having a potential to affect the visual quality of the island, specific to their project areas. In general, the roadways and intersections widened by the GRN projects would have an increased urban character to the views of the roadways. Those traveling on the roadway would likely find the wider pavement sections very noticeable. Pedestrians and those living or working adjacent to the roadway or intersection would likely find the changes very noticeable as well; however, it is not anticipated that these viewers would be highly sensitive to the individual changes, given the cumulative nature of the roadway visual quality changes.

Of the projects in the North Region, it is anticipated that GRN #57 (Route 28 widening), and GRN #124 (new Finegayan Connection), would cause a slight decrease in the existing visual quality of the corridors. In the case of Route 28, viewer sensitivity is expected to be high, given the residential character of portions of the roadway. The Finegayan Connection does not have the viewer sensitivity of Route 28; however, because the roadway would be located through an area of unpaved roads, it would add an urban element where none currently exists.

Indirect impacts of the projects, particularly the roadway and intersection widening projects, would be an increase in the urban character of the North Region of the island from its current, generally rural appearance.

A cumulative impact is defined as the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of which agency or person undertakes such actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. The cumulative nature of all of the proposed projects associated with Alternative 1 across the island is to change the overall visual character to a more urban view.

Central Region

Table 15.2-7 identifies all of the projects within the Central Region and indicates the disposition of each project in terms of this analysis. Following the table is a description of the anticipated impact of each of the projects analyzed within the Central Region; this information is also summarized Table 15.2-8. An analysis of a key view for GRN #36 depicts the anticipated changes to the visual environment.

Table 15.2-7. Guam Road Network Projects Considered for Analysis, Central Region

GRN #	*Route Number*	*Alternatives*				*Carried Forward for Further Analysis?*	*Reason for Inclusion or Exclusion*
		1	*2*	*3*	*8*		
1	Route 1/ Route 8	x	x	x	x	**Yes**	Project widens the existing Route 1/8 intersection by providing 2 left-turn lanes and 2 right-turn lanes for northbound Route 8 approaching Route 1.
2	Route 1/ Route 3	x	x	x	x	**Yes**	Project would widen the existing Route 1/3 intersection by providing a southbound left-turn lane, a combined left-/right-turn lane, and free right-turn lane with acceleration lane. Also includes east-to-north double left-turn lane.
3	1	x	x	x	x	**Yes**	Replacement of an existing bridge over the Agana River.
6	1	x	x	x	x	No	This project does not require widening (only pavement strengthening).
7	1	x	x	x	x	No	This project does not require widening (only pavement strengthening).
11	Chalan Lujuna	x	x	x	x	**Yes**	This project includes pavement strengthening (2 lanes) from Route 1 to Route 15; add turning lane and intersection improvements for trucks.
12	15	x	x	x	x	No	This project does not require widening (only pavement strengthening).
13	1	x	x	x	x	No	This project does not require widening (only pavement strengthening).
14	1	x	x	x	x	No	This project does not require widening (only pavement strengthening).
15	1	x	x	x	x	No	This project does not require widening (only pavement strengthening).
16	8	x	x	x	x	**Yes**	Project includes pavement strengthening, widening from 4/6 lanes to 6 lanes, with median from Tiyan Parkway/Route 33 (east) to Route 1.
17	8	x	x	x	x	No	This project does not require widening (only pavement strengthening).
18	16	x	x	x	x	No	This project does not require widening (only pavement strengthening).
19	16	x	x	x	x	**Yes**	Pavement strengthening, widening from 4 to 6 lanes, with median from Route 10A to Sabana Barrigada Drive.
20	16	x	x		x	No	This project does not require widening (only pavement strengthening).
21	27	x	x	x	x	No	This project does not require widening (only pavement strengthening).

GRN #	*Route Number*	*Alternatives*				*Carried Forward for Further Analysis?*	*Reason for Inclusion or Exclusion*
		1	*2*	*3*	*8*		
28	26	x	x	x	x	**Yes**	Pavement strengthening, widen from 2 lanes to 4 lanes from Route 1 to Route 15. Provide northbound left-turn, through, through/right, southbound left-turn, 2 through lanes, and right-turn, eastbound left-turn, left-through, and right-turn lane. Southbound right-turn should have raised island and free right to westbound Route 25 curb lane.
29	25	x	x	x	x	**Yes**	Pavement strengthening and widen from 2 lanes to 4 lanes from Route 16 to Route 26.
30	10	x	x	x	x	No	This project does not require widening (only pavement strengthening).
31	8A	x	x		x	No	This project does not require widening (only pavement strengthening).
32	15	x	x	x	x	No	This project does not require widening (only pavement strengthening).
33	1	x	x	x	x	No	This project does not require widening (only pavement strengthening).
35	1	x	x	x	x	**Yes**	Replacement of the existing bridge over the Fonte River.
35	1	x	x	x	x	**Yes**	Replacement of the existing bridge (culvert) No. 1 over the Asan River.
35	1	x	x	x	x	No	Replacement of the existing bridge (culvert) No. 2 over the Asan River tributary.
36	15	x	x	x	x	**Yes**	This project would require a new road alignment through forested areas.
44	MAP	x	x	x	x	No	Anticipated changes are expected to be minor and would not alter the existing visual environment.
46	MAP	x	x	x	x	No	Anticipated changes are expected to be minor and would not alter the existing visual environment.
47	MAP			x		No	Anticipated changes are expected to be minor and would not alter the existing visual environment.
48	MAP			x		No	Anticipated changes are expected to be minor and would not alter the existing visual environment.
49	MAP			x		No	Anticipated changes are expected to be minor and would not alter the existing visual environment.
49A	MAP			x	x	No	MAP 13A, new access across from Chada Street.
63	16			x		**Yes**	Pavement strengthening, widening from 4 to 6 lanes, with median from Route 10A to Sabana Barrigada Drive.
74	8A			x		**Yes**	Widen to provide median and shoulders along roadway.
113	7	x	x	x	x	No	Signing, striping, and minor intersection construction to establish 2-lane circulation around “Y” intersection.

Legend: GRN = Guam Road Network; MAP = Military Access Point.

Table 15.2-8. General Visual Quality per Road Corridor/Project Area, Central Region

GRN #	*Route Number*	*Segment Limits*	*FHWA Visual Assessment Criteria*			*Overall Visual Quality (V + I + U/3)*	*Existing vs. Proposed Visual Quality*
			Vividness	*Intactness*	*Unity*		
1	1	Route 1/8 Intersection	Moderate	Moderate	Moderately Low	Moderate	Existing
			Moderate	Moderate	Moderately Low	Moderate	Post-Construction
2	1	Route 1/3 Intersection	Moderately High	Moderately High	Moderate	Moderately High	Existing
			Moderately High	Moderately High	Moderate	Moderately High	Post-Construction
3	1	Agana Bridge Replacement	Moderate	Moderate	Moderate	Moderate	Existing
			Moderate	Moderate	Moderate	Moderate	Post-Construction
11	Chalan Lujuna	Route 1 to Route 15	Moderately High	Moderately High	Moderate	Moderately High	Existing
			Moderately High	Moderately High	Moderate	Moderately High	Post-Construction
16	8	Tiyan Parkway/ Route 33 (east) to Route 1	Moderate	Moderate	Moderate	Moderate	Existing
			Moderate	Moderate	Moderate	Moderate	Post-Construction
19	16	Route 10A to Sabana Barrigada Drive	Moderate	Moderate	Moderate	Moderate	Existing
			Moderate	Moderate	Moderately Low	Moderate	Post-Construction
28	26	Route 3 to Andersen AFB (North Gate)	Moderately High	Moderately High	Moderately High	Moderately High	Existing
			Moderate	Moderate	Moderate	Moderate	Post-Construction
29	25	Route 1 to Route 3	Moderately High	Moderately High	Moderately High	Moderately High	Existing
			Moderate	Moderate	Moderate	Moderate	Post-Construction
35	1	Fonte Bridge Replacement	Moderately High	Moderate	Moderate	Moderate	Existing
			Moderate	Moderate	Moderate	Moderate	Post-Construction
35	1	Asan Bridge No. 1 Culvert Replacement	Moderately High	Moderate	Moderate	Moderate	Existing
			Moderate	Moderate	Moderate	Moderate	Post-Construction
36	15	Route 15 Realignment	Moderate	Moderately High	Moderately High	Moderately High	Existing
			Moderate	Moderate	Moderate	Moderate	Post-Construction
63	16	Route 10A to Sabana Barrigada Drive	Moderate	Moderate	Moderate	Moderate	Existing
			Moderate	Moderate	Moderately Low	Moderate	Post-Construction
74	8A	Route 10A to Sabana Barrigada Drive	Moderately High	Moderately High	Moderate	Moderately High	Existing
			Moderate	Moderate	Moderately High	Moderate	Post-Construction

Legend: AFB = Air Force Base; GRN = Guam Road Network.

GRN #1, Route 1/8 Intersection

Changes to the visual environment for the intersection include creating double turn lanes (both right and left) for Route 8 as it approaches Route 1. It is anticipated that this change would not alter the existing visual quality of the area. The overall visual quality of the interchange should remain at moderate, with moderate vividness, moderate intactness, and moderately low unity.

GRN #2, Route 1/3 Intersection

The intersection would be modified by outside pavement widening along southbound Route 1 and southbound Route 3 to accommodate increased traffic volumes. The approaches to the intersection would consist of two left and three through lanes (northbound Route 1); one u-turn, three through, and one right-turn lanes (southbound Route 1); and one left, one shared left/right, and one right lane (southbound Route 3). The departures from the intersection would replicate the existing conditions, except that an acceleration lane would be added on Route 1 south of the intersection to facilitate right turns from southbound Route 3. The interchange improvements would not require the removal of trees or other large vegetation. It is anticipated that the overall visual quality of the intersection would remain at moderately high, with moderately high vividness, moderately high intactness, and moderate unity.

GRN #3, Bridge Replacement on Route 1 over the Agana River

The new structure would be lengthened to approximately 54.5 ft (16.6 m) with 15 ft (5 m) approach slabs to adequately accommodate the hydraulic flow of the river. The width of the new structure would be similar to the existing, at approximately 84 ft (26 m), accommodating six 11-ft (3-m) wide lanes, a 4.5-ft (1.4-m) wide median, and a 5.5-ft (1.7-m) wide sidewalk with a 1.0-ft (0.3-m) barrier on each side. Figure 15.2-2 shows an elevation of a typical replacement bridge. The new structure, although larger, is anticipated to appear approximately the same in scale within the visual environment. Providing an open railing to the bridge would help connect the traveler on Route 1 to the surrounding landscape. Given that the bridge is near one of the tourist attractions on the island, the aesthetics of the visible bridge elements should be considered in the overall design of the bridge. It is anticipated that the overall visual quality of the area would remain at moderate, with moderate vividness, intactness, and unity. Additional mitigation measures that address the aesthetics of the bridge could increase the vividness to moderately high, if applied.

GRN #11, Chalan Lujuna from Route 1 to Route 15

This project would improve the intersections of Chalan Lujuna with Routes 1 and 15 to allow for truck turning movements, which equates to bigger radii at the corners of the intersections. While the intersections may appear slightly bigger due to the increase of corner radii, the roadway itself would retain the same appearance. It is anticipated that the general visual quality for the roadway would remain at moderately high, with moderately high vividness, moderately high intactness, and moderate unity.

GRN #16, Route 8 from Tiyan Parkway (Route 33 East) to Route 1

This project would widen the existing Route 8 from four to six lanes. Portions of the existing Route 8 are already at six lanes, leaving sections approaching Route 1 to be widened. Since portions of the road are already at six lanes, the project is not anticipated to change the overall visual quality of the roadway; therefore, the general visual quality of the roadway should maintain a moderate rating, with moderate vividness, intactness, and unity.

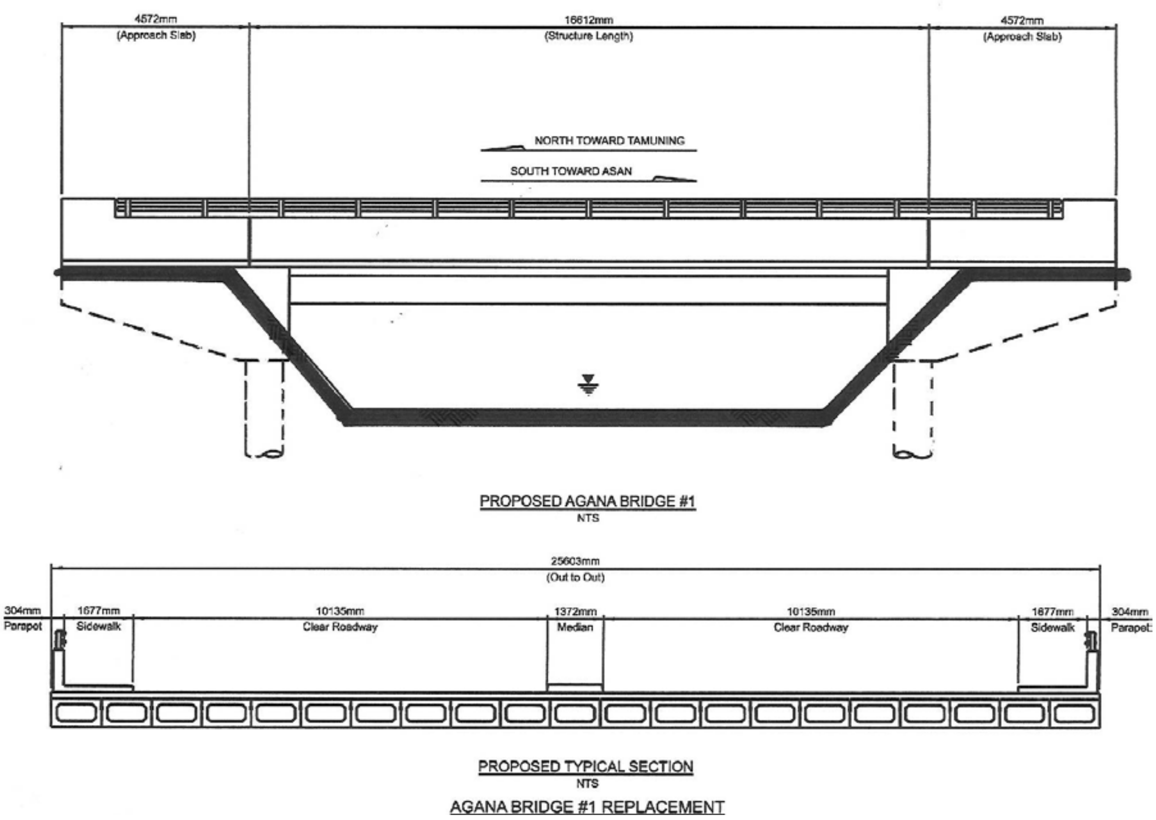

Figure 15.2-2. Typical Bridge Replacement Elevations

<u>GRN #19, Route 16 from Route 10A to Sabana Barrigada Drive</u>

This project would add a lane in each direction, making Route 16 a six-lane facility with a center median. In addition a four lane, signalized, access would be provided to the new MAP. Given the urban nature of the development along the roadway, it is unlikely that the impacts would substantially alter the existing visual environment. The overall visual quality would likely remain at moderate, with moderate vividness, intactness, and unity. If the median is a planted median, then the vegetation within the median would likely provide a break from the expanse of pavement created by the six-lane facility and could improve the visual quality of the roadway.

<u>GRN #28, Route 26 from Route 1 to Route 15</u>

This project would widen an existing two-lane road to four lanes. The roadway currently travels through heavily residential areas. The sensitivity of the viewers, especially residents, is expected to be high. The widening project would reduce the overall moderately high visual quality to moderate, with moderate vividness, intactness, and unity. This is due to the widened pavement section and the anticipated sensitivity of the viewers.

<u>GRN #29, Route 25 from Route 16 to Route 26</u>

This project would widen the existing narrow two-lane road to a four-lane road. The area is heavily residential. It is anticipated that the project would reduce the overall visual quality from moderately high to moderate, with moderate vividness, intactness, and unity. The reduced visual quality is caused by the anticipated high viewer sensitivity from the residences and the anticipated removal of vegetation along the roadway that would likely change the character of the existing roadway.

GRN #35, Bridge Replacement on Route 1 over the Fonte River

The new bridge over the Fonte River is anticipated to be 78 ft (24 m) long, matching the existing structure length. The width would also match the existing 100-ft (30-m) width, which accommodates six 12-ft (4-m) wide lanes and a 14-ft (4-m) wide median, with a 6-ft (2-m) wide sidewalk and a 1-ft (1-m) barrier on each side. In addition to the concrete abutments supported on drilled shafts, the new Fonte Bridge would include concrete columns founded on spread footings, drilled shafts, or steel piles.

The existing visual quality of the bridge and area is anticipated to remain at moderate, with moderately high vividness, moderate intactness, and moderate unity. The removal of utilities visibly suspended across the bridge and the use of an open railing would improve the visual quality of the bridge.

GRN #35, Culvert Replacement on Route 1 over the Asan River (Asan Bridge No. 2)

The new bridge over the Asan River is anticipated to match the existing structure length. The width would also match the existing 100-ft (30-m) width, which accommodates six 12-ft (4-m) wide lanes and a 14-ft (4-m) wide median, with a 6-ft (2-m) wide sidewalk and a 1-ft (1-m) barrier on each side. The new Asan Bridge No. 1 would be a large box culvert.

The existing visual quality of the bridge and area is anticipated to remain moderate, with moderately high vividness, moderate intactness, and moderate unity. The removal of utilities visibly suspended across the bridge and the use of an open railing would improve the visual quality of the bridge.

GRN #36, Route 15 Realignment

For drivers on Route 15, its realignment would provide new views to the roadway. The new Route 15 would have a wider cross section in the landscape, with wider shoulders and a median for future widening. East of the new alignment would be a buffer road that parallels the alignment. This road would be on military property and separated from Route 15 by a fence. It is also anticipated that this new road would sit higher in the landscape, and the area between the two roads would be cleared of vegetation other than grasses. The new buffer road would have two new bridges that would cross over the new Route 15 and be very noticeable to those traveling on the road. These bridges would represent a new element in the landscape. Currently, there are very few bridge overcrossings on the island. It is anticipated that the effects to the general visual quality of the area would be moderate, with moderate vividness, intactness, and unity. This equates to maintaining the vividness visual quality from existing and lowering the intactness and unity ratings from moderately high to moderate.

GRN #63, Route 16 from Route 10A to Sabana Barrigada Drive

Similar to GRN #19, this project would add a lane in each direction, making Route 16 a six-lane facility with a center median. In addition a four lane, signalized, access would be provided to the new MAP. Given the urban nature of the development along the roadway, it is unlikely that the impacts would substantially alter the existing visual environment. The overall visual quality would likely remain at moderate, with moderate vividness, intactness, and unity. If the median is a planted median, then the vegetation within the median would likely provide a break from the expanse of pavement created by the six-lane facility and could improve the visual quality of the roadway.

GRN #74, Route 8A from Route 16 to Naval Communication Area Master Station Barrigada

This project would widen Route 8A to include a center median for left turns and shoulders. The changes would increase the paving section. Particularly in the residential and elementary school area, viewers are likely to be very sensitive; however, the changes are not anticipated to change the existing overall visual quality for the roadway that should remain at moderately high, with moderately high vividness, moderately high intactness, and moderate unity.

Key Viewpoint 2: GRN #36, Route 15 Roadway Realignment

Orientation: The photograph is taken looking north through the old military entrance gate toward the proposed new alignment of Route 15 (see Figure 15.2-3).

- Existing Visual Character/Quality: The existing character has a weedy, abandoned appearance. The surrounding forested areas have been removed, as has the old housing. What is left are the cleared areas and old road network where the housing once was. The general visual quality of the view is moderately low, with low vividness, moderately low intactness, and unity.
- Proposed Project Features: The project would construct a new two-lane roadway through the area, with a second road (the parameter road) paralleling the new Route 15 to the east. This new road would sit higher in the landscape than Route 15. In the distance, the new bridge over Route 15 would be visible.
- Changes to Visual Character/Quality: The project is anticipated to maintain or slightly improve the existing moderately low visual quality in the view. Construction of the two roadways would, in some ways, unify the overall appearance in the view by removing the abandoned elements in the current view. It is anticipated that the vividness would increase to moderate, along with the intactness, while the unity would remain at moderately low.
- Anticipated Viewer Response: It is anticipated that viewers would primarily be associated with roadway travelers. These viewers would have a moderate sensitivity to the changes in the area, with daily commuters having a greater sensitivity than those new to this portion of the island. Residents, who generally live north of the realignment area, would have a higher sensitivity, but because the roadway is not visible from the homes, their views would be associated with roadway travel.
- Resulting Visual Impact: The anticipated resulting visual impact would not substantially alter the existing views.

Summary

Projects within the Central Region that are part of Alternative 1 that have been identified as having potential impacts are GRN #s 1, 2, 3, 11, 16, 28, 29, 35, and 36. These impacts are associated with GRN #s 28, 29, 35, and 36. As discussed in the North Region, the projects would cause an increase in the urban character of the island. Currently, the Central Region is the most densely developed portion of the island, and the widening of these roadways and intersections would extend that urban character farther, causing a slight degradation of the existing rural character of some of these roadways.

In particular, GRN #28 on Route 26 and GRN #29 on Route 25 would reduce the visual quality of the roadways from moderately high to moderate. These roads are currently narrow two-lane roads through residential areas, with substantial vegetation along portions of the roadways. Widening these to four-lane roads would change the character of the roadways to a more urban character. Given that these roadways are residential in nature, it is anticipated that viewer sensitivity would be high. In addition to the roadway and intersection widening projects, there are two bridge replacement projects, all of which would be along Route 1: GRN #3 (Agana Bridge) and GRN #35. Construction of the new bridges, from a driver's perspective on Route 1, is anticipated to cause only a minor change to the visual environment of the Route 1 corridor. Viewer sensitivity of those on Route 1 is anticipated to be low. The most noticeable change would be associated with the new railing that would be visible from the roadway. Because Route 1 crosses over each of the rivers, the railings are the only visible element of the bridge.

In general terms and given the proximity to adjacent development for most of the bridges, it is unlikely that the new bridges would be noticeable from off the roadway in the long-term. Many of these views are screened from adjacent uses by existing vegetation; however, for the short-term in many of these locations, the most noticeable changes associated with construction of the new bridges would be the need for temporary clearing in and around the bridge sites to make way for the bridge construction.

The bridges do present an opportunity to increase the visual quality of the corridor over the existing moderate to moderately high ratings. Mitigation in the form of urban design elements could increase the visual quality of the structure to those traveling on Route 1. These are discussed further under the Proposed Mitigation Measures subsection.

Indirect impacts of the projects, particularly the roadway and intersection widening projects, would be an increase in the urban character of the Central Region of the island from its current, generally rural appearance.

Apra Harbor Region

Table 15.2-9 identifies all projects within the Apra Harbor Region. The table indicates the disposition of each project in terms of this analysis. Following the table is a description of the anticipated impact of each of the projects analyzed within the region.

Table 15.2-9. Guam Road Network Projects Considered for Analysis, Apra Harbor Region

GRN #	*Route Number*	*Alternatives*				*Carried Forward for Further Analysis?*	*Reason for Inclusion or Exclusion*
		1	*2*	*3*	*8*		
4	11	x	x	x	x	No	This project does not require widening (only pavement strengthening).
5	Route 1/ Route 11	x	x	x	x	**Yes**	Add a second left-turn lane from Route 11 to Route 1, adding an additional 14-ft (4-m) wide lane to the outside of Route 11.
24	5	x	x	x	x	No	This project does not require widening (only pavement strengthening).
26	2A	x	x	x	x	No	This project does not require widening (only pavement strengthening).
35	1	x	x	x	x	**Yes**	Replacement of bridges or culverts over the Atantano, Laguas, Sasa, and Agueda rivers.
50	MAP	x	x	x	x	No	Anticipated changes are expected to be minor and would not alter the existing visual environment.

Legend: GRN = Guam Road Network; MAP = Military Access Point.

Figure 15.2-3. Key Viewpoint #2. GRN #36, Route 15 Roadway Realignment

Table 15.2-10 summarizes the anticipated changes to the visual environment based on the proposed projects.

Table 15.2-10. General Visual Quality per Road Corridor/Project Area, Apra Harbor Region

			FHWA Visual Assessment Criteria				
GRN #	*Route Number*	*Segment Limits*	*Vividness*	*Intactness*	*Unity*	*Overall Visual Quality (V + I + U/3)*	*Existing vs. Proposed Visual Quality*
5	1	Route 1/11 Intersection	Moderate	Moderate	Moderately Low	Moderate	Existing
			Moderate	Moderate	Moderately Low	Moderate	Post-Construction
35	1	Atantano Bridge Replacement	Moderately High	Moderately High	Moderate	Moderately High	Existing
			Moderate	Moderate	Moderate	Moderate	Post-Construction
35	1	Sasa Bridge Replacement	Moderate	Moderately Low	Moderate	Moderate	Existing
			Moderate	Moderately Low	Moderate	Moderate	Post-Construction
35	1	Laguas Bridge Replacement	Moderately High	Moderate	Moderate	Moderate	Existing
			Moderately High	Moderate	Moderate	Moderate	Post-Construction
35	1	Agueda Culvert Replacement	High	Moderately High	Moderately High	Moderately High	Existing
			High	Moderately High	Moderately High	Moderately High	Post-Construction

Legend: FHWA = Federal Highway Administration; GRN = Guam Road Network.

GRN #5, Route 1/11 Intersection

Reconstruction of the intersection, including pavement strengthening and other project elements within the existing roadway associated with the pavement strengthening project (GRN #4), is not anticipated to change the visual environment of the intersection. Given the industrial nature of the area, viewer responses to the changes are likely to be very low to the new intersection. The overall visual quality for the Route 1/11 intersection is anticipated to remain at moderate, with moderate vividness, moderate intactness, and moderately low unity.

GRN #35, Atantano Bridge Replacement

The new bridge over the Atantano River would be lengthened to 60 ft (18 m) to adequately accommodate the hydraulic flows in the river. The bridge would have a similar width to the existing, at approximately 82 ft (25 m), accommodating four 12-ft (4-m) wide lanes, an 8-ft (2-m) wide median, and a 12-ft (4-m) wide shoulder and 1.0-ft (0.3-m) barrier on each side. In addition to the concrete abutments supported on drilled shafts, the new Atantano Bridge would include concrete columns founded on spread footings, drilled shafts, or steel piles.

This new bridge is not anticipated to substantially change the existing visual environment of the area. The bridge does not currently have adjacent development within close enough proximity to see any change to the bridge elevation. The new railing would be a visible element to those on Route 1. The current railing is open, allowing views into the surrounding forested land. As currently proposed, the new railing would be solid, with a railing on the top. This would likely reduce the views out to the forested areas, somewhat reducing the quality of the existing views. The general visual quality in the bridge area is anticipated to be moderate to moderately high, with moderate to moderately high vividness and intactness, and moderate unity.

GRN #35, Laguas Bridge Replacement

The new Laguas Bridge would be lengthened to approximately 60 ft (18 m) to accommodate hydraulic flows. The width of the proposed bridge would be similar to the existing 82 ft (25 m) and would accommodate the existing four 12-ft (4-m) wide lanes, an 8-ft (2-m) wide median, and a 12-ft (4-ft) wide shoulder and 1.0-ft (0.8-m) barrier on each side. The new bridge is not likely to alter the existing visual quality of the area, which is likely to remain at moderate, with moderately high vividness, moderate intactness, and moderate unity.

GRN # 35, Sasa Bridge Replacement

The new bridge over the Sasa River would match the existing length of 46 ft (14 m) with an 82-ft (25-m) width, similar to the proposed widths for the Laguas and Atantano bridges. It is anticipated that the new bridge would maintain the overall visual quality of the area at moderate, with moderate vividness, moderately low intactness, and moderate unity. Elements that might improve the visual quality would be to remove the utilities from the bridge and include a more open railing to create views to the surrounding forested areas.

GRN #35, Agueda Culvert Replacement

As with the other bridges, the new culvert would match the existing length and widths of the existing culvert. The new culvert is anticipated to maintain the existing overall moderately high visual quality of the area, with the high vividness and moderately high intactness and unity left intact.

Summary

Two projects within the Apra Harbor Region have been identified as having potential impacts on the existing environment. These are GRN #5 and 35. GRN #5 would widen the Route 1/11 intersection. This is anticipated to increase the urban character of the intersection, but it would not substantially alter the existing visual quality of the project area.

GRN #35 includes the replacement of the Atantano, Laguas, Sasa, and Agueda bridges or culverts. Of these projects, the proposed bridge or culvert replacements would maintain the existing visual quality of the project areas for the Laguas, Sasa, and Agueda bridges or culverts and cause a slight degradation of the views at the Atantano Bridge. The degradation is due in part to the removal of the open railing on this bridge that currently allows views into the forested lands beyond the bridge. Proposed mitigation measures for the bridge replacement can be found under the Proposed Mitigation Measures subsection.

Indirect impacts of the projects, particularly the roadway and intersection widening projects, would be an increase in the urban character of the Apra Harbor Region of the island from its current, generally rural appearance.

South Region

Table 15.2-11 identifies all of the projects within the South Region. The table indicates the disposition of each project in terms of this analysis. Following the table is a description of the anticipated impact of each of the projects analyzed within the region. None of the projects in the South Region have been carried forward for further analysis. It is not anticipated that they would have an impact to the visual environment.

Table 15.2-11. Guam Road Network Projects Considered for Analysis˜ South Region

GRN #	*Route Number*	*Alternatives*				*Carried Forward for Further Analysis?*	*Reason for Inclusion or Exclusion*
		1	*2*	*3*	*8*		
25	5	x	x	x	x	No	This project does not require widening (only pavement strengthening).
27	5	x	x	x	x	No	This project does not require widening (only pavement strengthening).
52	MAP	x	x	x	x	No	Anticipated changes are expected to be minor and would not alter the existing visual environment.
110	2	x	x	x	x	No	Convert northbound right-turn lane to a combined through/right-turn lane. No widening required.

Legend: GRN = Guam Road Network; MAP = Military Access Point.

Summary

None of the projects identified as part of Alternative 1 for the South Region are anticipated to have impacts associated with their implementation.

Proposed Mitigation Measures

While the pavement strengthening projects do not require specific mitigation measures because there are no anticipated changes to the visual environment with these projects, as a whole cumulatively for the proposed GRN, the following mitigation measures could be implemented:

Proposed Mitigation Measures Outside of Department of Defense Control

- Provide an open railing to the extent possible to provide views from the bridge out to the adjacent areas.
- Hide utility crossings on the bridge between the girders or other methods of screening utilities from pedestrians on the bridge or adjacent land uses.
- Preserve existing trees or stands of vegetation by shifting the roadway alignment to the extent feasible where roadways are widened.

15.2.6.2 Alternative 2 (Preferred Alternative)

North

The roadway projects proposed for the North Region under Alternative 2 are the same as those proposed under Alternative 1 in terms of the effects to the visual environment; therefore, the impact conclusions are the same as those discussed for the North Region of Alternative 1.

Central

The roadway projects proposed for the Central Region under Alternative 2 are the same as those proposed under Alternative 1 in terms of the effects to the visual environment; therefore, the impact conclusions are the same as those discussed for the Central Region of Alternative 1.

Apra Harbor

The roadway projects proposed for the Apra Harbor Region under Alternative 2 are the same as those proposed under Alternative 1 in terms of the effects to the visual environment; therefore, the impact conclusions are the same as those discussed for the Apra Harbor Region of Alternative 1.

South

None of the projects identified as part of Alternative 2 for the South Region are anticipated to have impacts associated with their implementation.

Proposed Mitigation Measures

Proposed mitigation for Alternative 2 is the same as discussed for Alternative 1.

15.2.6.3 Alternative 3

North

Alternative 3 is substantially the same as Alternatives 1 and 2 for the North Region; however, GRN #s 38A, 39A, 41, 41A and 124, are not included in this alternative. It is anticipated that this project would not alter the existing visual environment of the project area; therefore, the impacts discussed under Alternative 1 for the North Region should be similar for Alternative 3 for the North Region.

Central

Within the Central Region, Alternative 3 includes two additional projects with potential impacts. These projects are GRN #63 that would widen portions of Route 16 from four to six lanes, and GRN #74 that would widen Route 8A to provide shoulders and a median. Neither of these two widening projects is anticipated to alter the existing visual quality of either roadway; therefore, the impacts in the Central Region for Alternative 3 are similar to those discussed for Alternative 1.

Apra Harbor

The roadway projects proposed for the Apra Harbor Region under Alternative 3 are the same as those proposed under Alternative 1; therefore, the impact conclusions are the same as those discussed for Alternative 1 in the Apra Harbor Region.

South

None of the projects identified as part of Alternative 3 for the South Region are anticipated to have impacts associated with their implementation.

Proposed Mitigation Measures

Proposed mitigation for Alternative 3 is the same as those discussed for Alternative 1.

15.2.6.4 Alternative 8

North

Alternative 8 is substantially the same as Alternatives 1 and 2 for the North Region; however, GRN #s 38, 39, and 41 are not included in this alternative. It is anticipated that these projects would not alter the existing visual environment of the project area; therefore, the impacts discussed under Alternative 1 for the North Region should be similar for Alternative 8 for the North Region.

Central

Within the Central Region, Alternative 8 has the same list of projects with potential impacts as that associated with Alternative 1; therefore, the impacts in the Central Region for Alternative 8 are the same as those discussed for Alternative 1.

Apra Harbor

The roadway projects proposed for the Apra Harbor Region under Alternative 8 are the same as those proposed under Alternative 1; therefore, the impact conclusions are the same as those discussed for Alternative 1.

South

None of the projects identified as part of Alternative 8 for the South Region are anticipated to have impacts associated with their implementation.

Proposed Mitigation Measures

Proposed mitigation for Alternative 8 is the same as those discussed for Alternative 1.

15.2.6.5 Summary of Impacts

Table 15.2-12 summarizes the potential impacts of each interim alternative. An analysis of long-term alternatives was not developed because the alternatives are not ready for project-specific analysis. A text summary is provided below.

Table 15.2-12. Summary of Potential Impacts on Visual Resources – Roadway Projects

Potentially Impacted Resource	*Alternative 1*	*Alternative 2**	*Alternative 3*	*Alternative 8*
Existing visual quality changes to a more urban visual character	SI-M	SI-M	SI-M	SI-M
Removal of vegetation in residential areas, changing the visual character	LSI	LSI	LSI	LSI

Legend: LSI = Less than significant impact; SI-M = Significant impact mitigable to less than significant; *Preferred Alternative.

In addition, there is limited land for development on the island, and large portions are already developed or off limits to non-military development. Therefore, as the island population grows, either through the increase in military personnel or through endemic growth on the island, the development patterns would also likely become denser.

Mitigation in the form of aesthetic and design considerations and the preservation of vegetation within developed areas can help diminish or soften these changes to the visual character.

15.2.6.6 Summary of Proposed Mitigation Measures

Table 15.2-13 summarizes the proposed mitigation measures for roadway projects impacts on visual resources.

Table 15.2-13. Summary of Proposed Mitigation Measures for Roadway Projects Impacts on Visual Resources

Phase	*Mitigation Measure*
Construction	None
Operation	• Provide an open railing to the extent possible to provide views from the bridge to the adjacent areas • Hide utility crossings on the bridge between the girders or using other methods of screening utilities from pedestrians on the bridge and adjacent land uses • Preserve existing trees or stands of vegetation by shifting the roadway alignment to the extent feasible where roadways are widened.

CHAPTER 16.
MARINE TRANSPORTATION

16.1 INTRODUCTION

This chapter discusses the potential environmental consequences associated with implementing the alternatives for utilities and roadway projects (Guam) within the region of influence for marine transportation. For a description of the affected environment for marine transportation, refer to Volume 2, Chapter 14.

16.2 ENVIRONMENTAL CONSEQUENCES

16.2.1 Approach to Analysis

The primary military, commercial, and recreational port facilities on Guam are located in Apra Harbor. It is critical that navigational access to the channels be maintained for these users. The consequences of the alternatives for the proposed project have been evaluated based on the magnitude and duration of impacts to navigation. For activities that would have an adverse impact on navigation, appropriate mitigation measures have been identified. The following analysis focuses on possible effects to marine transportation from the proposed relocation of the Marines from Okinawa to Guam.

16.2.1.1 Methodology

Apra Harbor is the only Department of Defense (DoD) harbor that could accommodate the ships needed to support the Marine Corps relocation. No documented alternatives analysis was conducted.

16.2.1.2 Determination of Significance

For marine transportation, the significance of impacts of the alternatives for utilities and roadway projects are determined by the potential interference to marine vessel navigation from any proposed increase in vessel usage in Apra Harbor.

16.2.1.3 Issues Identified During Public Scoping Process

As part of the analysis, the concerns relating to navigation that were identified by the public during scoping meetings were reviewed. These concerns are related to the potential increase in the number of vessels in Outer Apra Harbor as a result of the proposed action.

16.2.2 Power

The power improvement alternative would involve facilities that use fuel oil. Fuel oil would be delivered by ship. It is expected that there would be up to one additional shipment of fuel oil per month.

Additionally, a switch from high-sulfur diesel fuel currently used at power facilities to lower sulfur diesel fuel is anticipated based on discussions with Guam Power Authority (GPA), United States Environmental Protection Agency Region 9, and Guam Environmental Protection Agency. This switch is expected to occur sometime in the year 2012 in response to the need for low-sulfur diesel fuels in newer model diesel vehicles, as required under the Clean Air Act Amendments of 1990. GPA has indicated that the lower sulfur fuel required by new diesel vehicles could also be used in their Combustion Turbines. DoD is currently working with relevant stakeholders including United States Environmental Protection Agency, Guam Environmental Protection Agency, GPA, and suppliers to determine an appropriate strategy for implementing an islandwide switch to low-sulfur fuel. There are several ongoing logistics, economics, contracts, and regulatory issues that must be resolved before an islandwide switch to ultra-low sulfur diesel fuel can be realized. It is anticipated that lower sulfur diesel fuel would be shipped in the future in the same manner as fuel oil is shipped today; therefore, there would be no change in vessel traffic or needed facilities based on this switch to lower sulfur diesel fuel.

The annual number of vessels visiting the Port of Guam has decreased by 1,902 vessels between 1995 and 2008. It is expected that the addition of up to 12 vessels per year transporting fuel for the power facilities above the average annual number of vessels would result in a less than significant impact on marine transportation in Apra Harbor. During construction, to recondition the five Combustion Turbines, a negligible increase in the use of the port would be expected. Thus, during construction, no impact on marine transportation in Apra Harbor would occur.

16.2.2.1 Summary of Impacts

Table 16.2-1 summarizes the potential impact of the basic alternative.

Table 16.2-1. Summary of Potential Impacts to Marine Transportation – Power

Potentially Impacted Resource	*Basic Alternative 1**
Construction – Apra Harbor (direct and indirect same)	NI
Operations – Apra Harbor (direct and indirect same)	LSI

Legend: LSI= Less than significant impact; NI = No impact. *Preferred Alternative.

Only 12 additional ships are estimated to be needed annually to provide extra fuel for power plant operations; therefore, the impact on marine transportation would be less than significant. During construction, a negligible increase in shipping would occur; thus, no impact would occur. With the 12 additional ships estimated to be needed annually to provide extra fuel for power plant operations, the impact on marine transportation would be less than significant.

16.2.3 Potable Water

Neither construction nor operation of the potable water improvement alternatives would have an impact on Apra Harbor or marine transportation within the harbor. The indirect impacts of improvements to the Guam Waterworks Authority water system would also not have an impact on Apra Harbor or marine transportation within the harbor.

16.2.3.1 Summary of Impacts

Table 16.2-2 summarizes the potential impacts of each alternative.

Table 16.2-2. Summary of Potential Impacts to Marine Transportation – Potable Water

Potentially Impacted Resource	*Basic Alternative 1**	*Basic Alternative 2*
Construction – Apra Harbor (direct and indirect same)	NI	NI
Operations – Apra Harbor (direct and indirect same)	NI	NI

Legend: NI = No impact. *Preferred Alternative.

16.2.4 Wastewater

Construction of the wastewater improvement alternatives would have a very minor impact on Apra Harbor or marine transportation within the harbor. None of the operations of the wastewater improvement alternatives would have an impact on Apra Harbor or marine transportation within the harbor. Indirect impacts from the Guam Waterworks Authority wastewater systems would not have an impact on Apra Harbor or marine transportation within the harbor.

16.2.4.1 Summary of Impacts

Table 16.2-3 summarizes the potential impacts of each basic alternative.

Table 16.2-3. Summary of Potential Impacts to Marine Transportation – Wastewater

Potentially Impacted Resource	*Basic Alternative 1a* and 1b (direct impact with indirect impact in parenthesis)*
Construction – Apra Harbor	LSI (NI)
Operations – Apra Harbor	NI (NI)

Legend: LSI= Less than significant impact; NI = No impact. *Preferred Alternative.

16.2.5 Solid Waste

Solid waste improvement alternatives would not have an impact on Apra Harbor or marine transportation within the harbor. No new construction would occur; therefore, no construction impacts would occur.

16.2.6 Summary of Impacts

Table 16.2-4 summarizes the potential impacts of the preferred basic alternative.

Table 16.2-4. Summary of Potential Impacts to Marine Transportation – Solid Waste

Potentially Impacted Resource	*Basic Alternative 1**
Construction – Apra Harbor (direct and indirect same)	NA
Operations – Apra Harbor (direct and indirect same)	NI

Legend: NA = not applicable; NI = No impact. *Preferred Alternative.

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CHAPTER 17.
SOCIOECONOMICS AND GENERAL SERVICES

17.1 INTRODUCTION

This chapter discusses the potential environmental consequences associated with implementing the alternatives within the region of influence for each resource. For a description of the affected environment for all resources, refer to the respective chapter of Volume 2. The locations described in Volume 2 include the region of influence for the utilities and roadway projects, and the chapters are presented in the same order as the resource areas contained Volume 6.

Socioeconomic impacts would be islandwide in nature with little difference in effects among the various alternatives. Therefore, the summary of impacts presented below covers all of the alternatives except the no-action alternative, which is treated separately in Section 17.2.2.6.

17.2 ENVIRONMENTAL CONSEQUENCES

17.2.1 Methodology

Refer to corresponding section of Volume 2.

Analysis of impacts for Volume 6 is limited to the construction component, due to insufficient information about operational configurations.

No distinction is made among alternatives, as the critical input variable – construction cost – is not available for different alternatives. All calculations in this chapter are based on single construction cost estimates for each Related Action provided by Joint Guam Program Office as of May 2009.

17.2.1.1 Determination of Significance

Refer to corresponding section of Volume 2.

The Federal Council on Environmental Quality’s guidelines for determining significance states, “significance cannot be avoided by terming an action temporary or by breaking it down into small component parts” (Code of Federal Regulations Title 40 Sec 1508.27(b)(7)). Compared to the Marine Relocation action discussed in Volume 2, the individual utility and roadway proposals discussed in this Volume are relatively “small component parts.” However, because Volume 7 provides an assessment of significance for all the combined parts of the military relocation (the “aggregate action”), any finding in this chapter that the power, water, wastewater, solid waste, or roadways alone would have no impact (or a less than significant impact) does not avoid the possibility that the larger impact from the aggregate action would be significant.

17.2.1.2 Issues Identified During Scoping

Refer to corresponding section of Volume 2 for general discussion.

Most scoping comments focused on the specifics of utility ownership and operation (whether there would be joint use or independent Department of Defense [DoD] facilities), choice of technology, resistance to storms, and other logistical questions that have been previously addressed in the description and justification for the various alternatives.

There was also attention to the question of impacts on civilian ratepayers from the various utility alternatives, especially the rate differences dependent on whether the utilities would be strictly for DoD operations or provide any benefit to the civilian population. Also, several comments predicted adverse social reactions if certain roads and facilities "outside the fence" are designated military-only.

17.2.1.3 Guam Road Network Projects

Methodology used in assessing impacts to socioeconomic and general services as a result of the proposed roadway improvements follows Federal Highway Administration (FHWA) Guidance for Preparing and Processing Environmental and Section 4(f) Documents. This socioeconomic analysis has been conducted to study the impacts from the proposed roadway improvements that are collectively referred to as the Guam Road Network (GRN).

17.2.2 Utilities

17.2.2.1 Population Impacts

Refer to the corresponding section of Volume 2 for introductory statements.

Project Related Population

Approach to Analysis

Table 17.2-1 provides assumptions made in conducting analysis for the construction phase and the source of or rationale for those assumptions.

Table 17.2-1. Construction Component Assumptions for Project Related Population Impacts

Assumption	*Assumed Value*	*Source/Rationale*
Average number of dependents for in-migrating direct, on-site, construction jobs	0.20 - 0.35	Estimate based on contractor interviews (Appendix F SIAS)
Average number of dependents for in-migrating direct from purchases jobs	0.95 - 1.0	U.S. Census national data on persons per jobs (U.S. Census Bureau 2000) and GDoL interviews (Appendix F SIAS)
Average number of dependents for in-migrating indirect/induced jobs	0.95 - 1.0	U.S. Census national data on persons per jobs (U.S. Census Bureau 2000) and GDoL interviews (Appendix F SIAS)

Legend: GDoL = Guam Department of Labor; SIAS = Socioeconomic Impact Assessment Study; U.S. = United States.

Table 17.2-2 indicates a 2012 peak-year impact of about 4,580 additional people.

Table 17.2-2. Population Increase related to Utilities

	2010	*2011*	*2012*	*2013*	*2014*
Total Impact	993	2,463	4,580	3,525	2,066

Figure 17.2-1 shows the projected total population for the baseline trend (projected future without the proposed action) plus the total combined impact of the proposed action. The chart shows the population rising to about 190,000 in 2012. The 2012 figure represents a 2.5 percent (%) increase over the baseline trend. This meets the criteria used in this analysis for a significant impact, although population increases are considered to be inherently mixed (both beneficial and adverse), because population growth fuels economic expansion but sudden growth also strains government services and the social fabric.

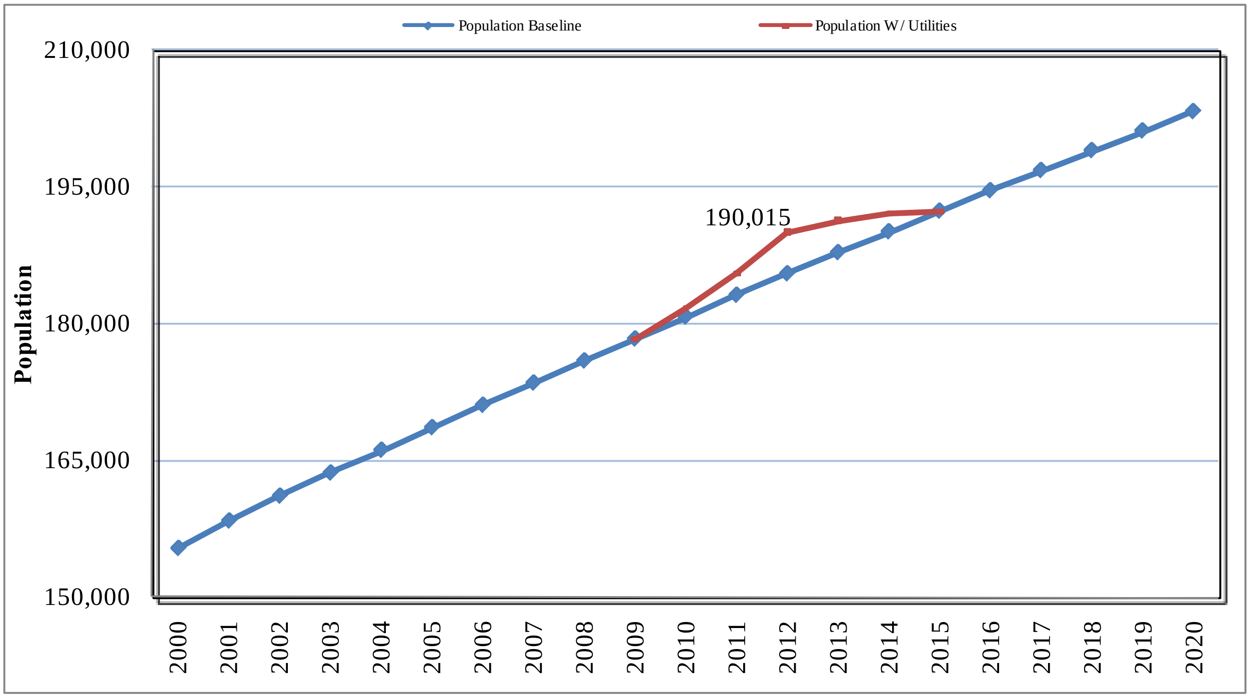

Figure 17.2-1. Population With and Without Utilities

Demographic Characteristics

Refer to the corresponding section of Volume 2.

Household Characteristics

Refer to the corresponding section of Volume 2.

17.2.2.2 Economic Impacts

Employment and Income

Refer to the corresponding section of Volume 2 for introductory statements, approach to analysis (including data sources), and impact analysis.

Civilian Labor Force Demand

Table 17.2-3 shows a civilian labor force demand for 3,333 workers in the peak year of 2012.

Table 17.2-3. Civilian Labor Force Demand (Full-Time Equivalent Jobs), Utilities

	2010	*2011*	*2012*	*2013*	*2014*
Total Impact	732	1,794	3,333	2,599	1,539

Figure 17.2-2 shows the projected total labor force demand for the baseline trend (projected future without the proposed action) plus the total combined impact of the proposed action. The chart shows the labor force demand rising to 60,940 in 2012, a 5.8% increase over the baseline trend. By the criteria used for this analysis, the impact is considered significant and beneficial.

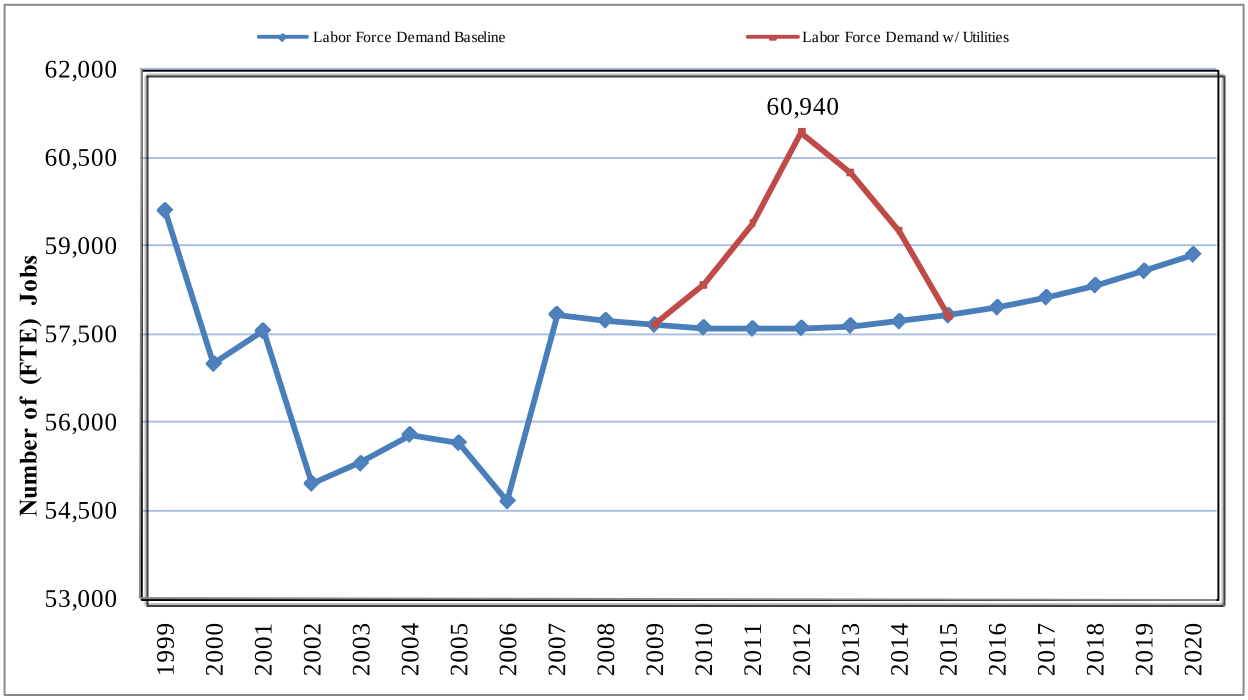

Figure 17.2-2. Civilian Labor Force Demand (Full-Time Equivalent Jobs) With and Without Utilities

Labor Source Supply

Table 17.2-4 shows the probable labor source supply for direct onsite military construction jobs.

Table 17.2-4. Estimated Origin of Workers Connected to Utilities Construction

	2010	*2011*	*2012*	*2013*	*2014*
TOTAL	**413**	**1,013**	**1,884**	**1,471**	**871**
GUAM	**73**	**163**	**272**	**188**	**111**
OFF-ISLAND	**339**	**849**	**1,611**	**1,283**	**760**
H-2B Workers	289	726	1,381	1,103	653
Philippines	245	617	1,174	938	555
Other	26	65	124	99	59
CONUS/HI/Japan	5	13	24	19	11
CNMI	9	23	42	33	20
Other U.S. Pacific Islands	36	88	164	128	76

Notes: Numbers may not add exactly due to rounding.
Legend: CNMI = Commonwealth of the Northern Mariana Islands; CONUS = Continental United States; HI = Hawaii; U.S. = United States.

Table 17.2-5 estimates the share of non-military construction direct and indirect jobs, going to Guam residents versus off-island workers.

Table 17.2-5. Estimated Numbers of On-Island Workers for Various Job Categories Other Than Direct On-Site Construction, Utilities

	2010	*2011*	*2012*	*2013*	*2014*
Guam Workers	50	99	166	140	92
Off-Island Workers	269	682	1,284	988	576

Civilian Labor Force Income

Table 17.2-6 below shows that labor force income from the proposed action increases by $125 million at the 2012 peak.

Table 17.2-6. Impact on Civilian Labor Force Income (Millions of 2008 $s), Utilities

	2010	*2011*	*2012*	*2013*	*2014*
Total Impact	$28	$68	$125	$98	$58

Figure 17.2-3 shows the projected total labor force income for the baseline trend (projected future without the proposed action) plus the total combined impact of the proposed action. The chart shows the labor force income rising to about $1.69 billion in 2012. The 2012 figure represents an 8% increase over the baseline trend. This meets the criteria used in this analysis for a significant beneficial impact.

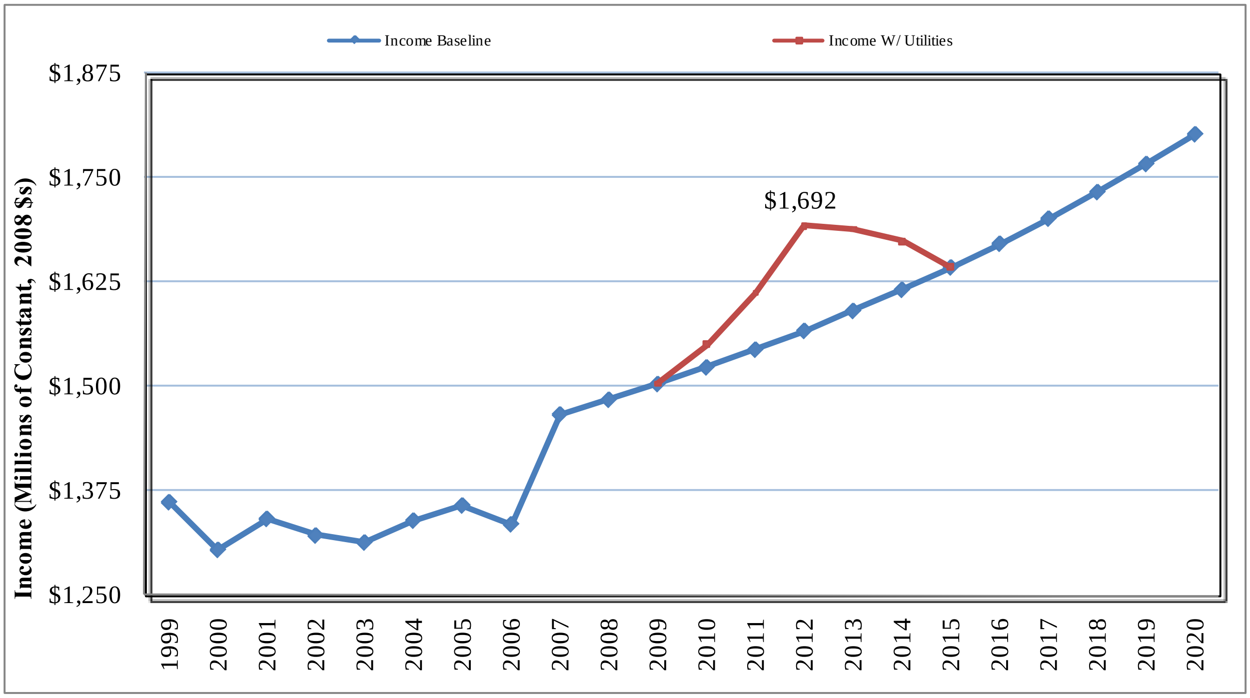

Figure 17.2-3. Civilian Labor Force Income (Millions of 2008 $s) With and Without Utilities

Figure 17.2-4 shows the projected total housing demand for the baseline trend (projected future without the proposed action) plus the total combined impact of the proposed action. The chart shows the housing demand rising to 66,088 in 2012. By the criteria used for this analysis, this is a less than significant impact for the utilities alone, except in conjunction with the aggregate action effects summarized in Volume 7.

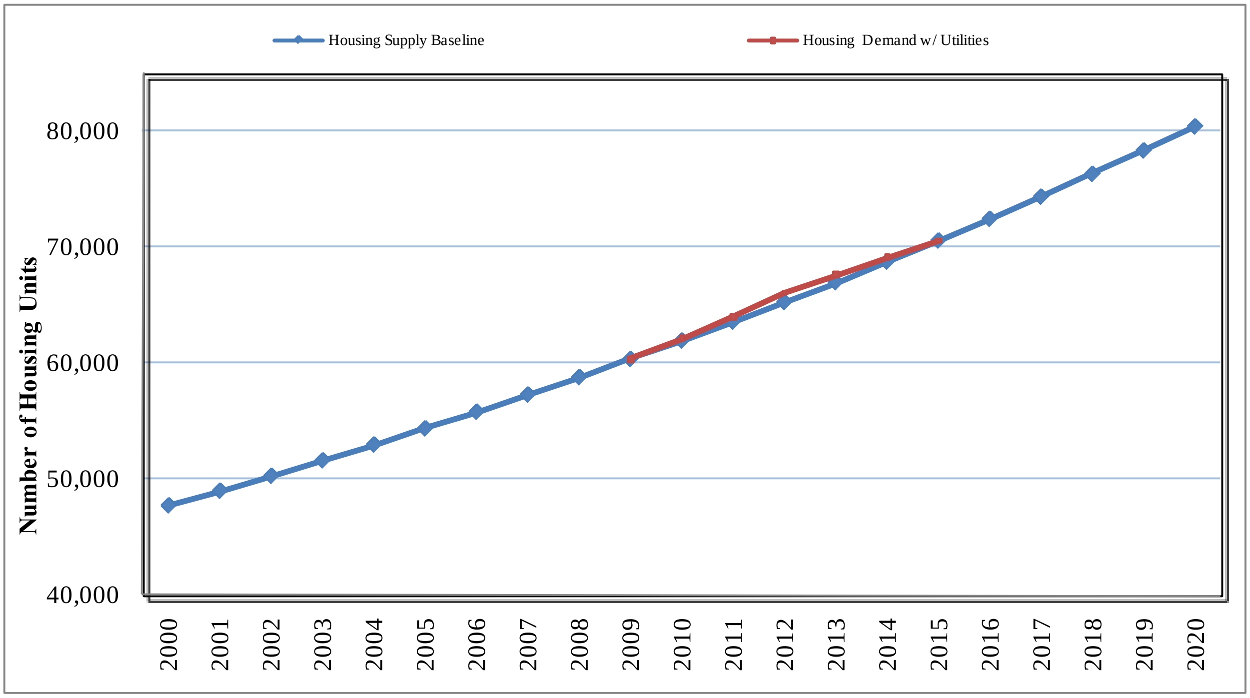

Figure 17.2-4. Housing Demand With and Without Utilities

Standard of Living

Refer to the corresponding section of Volume 2.

Unemployment

Refer to the corresponding section of Volume 2.

<u>Housing</u>

Refer to the corresponding section of Volume 2 for introductory statements and approach to analysis (including data sources).

Civilian Housing Demand

Table 17.2-7 indicates that the impact of the proposed action would result in a demand for 822 new units in the peak year of 2012.

Table 17.2-7. Demand for New Civilian Housing Units, Utilities

	2010	*2011*	*2012*	*2013*	*2014*
Total Impact	181	446	822	622	363

Housing Supply

The housing market would be able to accommodate the demand if it did not occur simultaneously with other and larger aspects of the aggregate action.

Utility Rates - Power

Potential effects on ratepayers are unknown at this time and would depend in large part on agreements reached between the Department of the Navy and Guam Power Authority (GPA). The current Customer Agreement that was originally adopted in 1992, has since been updated, and is scheduled to end in 2012.

This agreement would likely need to be renegotiated. The outcome of the negotiations would determine, among other factors, the rates the DoD would pay for the interim demand provided by the reconditioned generating systems owned by the GPA. The systems are expected to be more expensive to operate than the average of the current GPA generating systems that are currently used. However, it is expected that these systems would primarily be used for peaking power and reliability reserve; thus, limiting the cost increases from operations. There would be additional capital expenses to upgrade transmission and distribution systems and install some of those upgrades underground for improved reliability.

Utility Rates - Water

New DoD water facilities are likely to be operated separately from the system operated by Guam Waterworks Authority (GWA). Hence, no impacts to Guam ratepayers are expected from use by DoD facilities. However, current water customers, civilian military workers, induced civilian growth, and other direct and indirect workers related to the proposed action would be affected because GWA requirements would involve major capital improvements. These projects would be expected to require rate increases because GWA's current financial condition does not appear to be able to fund such projects.

Utility Rates – Wastewater

GWA has been working under two federal waivers to the Clean Water Act. The waivers have relieved GWA from having to conduct secondary sewage treatment. As of October 2009, the United States (U.S.) Environmental Protection Agency has denied the renewal of these waivers (GWA may appeal the ruling). Without the waivers GWA would be required to upgrade existing facilities to conduct secondary treatment. Upgrading the facilities would be costly and drive wastewater rates higher. In the future, if the waiver denial is not revised, Guam ratepayers should expect higher wastewater rates. The proposed action would upgrade the Northern District Wastewater Treatment Plant (NDWWTP) primary treatment capacity in the near term and provide for secondary treatment in the medium term. The financing arrangements would likely be through an SPE, who would obtain financing through Japan's Joint Bank for International Cooperation. It is expected that the DoD would pay for these upgrades to the primary treatment capabilities of the NDWWTP through hook up and other user fees. The SPE would also design, construct, and operate the NDWWTP for a fee, which would be used to repay the Joint Bank for International Cooperation loan. There would also be the potential of an SPE arrangement to facilitate the secondary capability for this plant. Under this scenario, the expected rate increases should be similar with or without the proposed action and could be less due to an expanded customer base over which to spread the impact.

There would also be impacts to the GWA wastewater systems that are not used by DoD but that would have to service the added civilian populations from the construction workforce and induced civilian growth. These systems need maintenance and upgrades, and the added populations would exacerbate the urgency and size of the maintenance and upgrade items. This issue would likely put upward pressure on wastewater rates for all current and future customers.

Utility Rates – Solid Waste

Population increases as a result of the proposed action would increase the level of solid waste service that would need to be provided along with the total cost of providing services. The increased costs, though, would be spread over a larger group of ratepayers. It is possible that, as the level of service increases the services would become more efficiently operated and rates for individuals would decline. It is more likely; however, that rates would have little changes as a result of the proposed action.

Local Government Revenues

Refer to the corresponding section of Volume 2 for introductory statements and approach to analysis (including data sources).

Table 17.2-8, Table 17.2-9, and Table 17.2-10, show that the impact of the proposed action would add $12.27 million to the Gross Receipts Tax (GRT), $3.1 million to the corporate income tax revenue, and $15 million to the personal income tax revenue in the 2012 peak.

Table 17.2-8. Impact on Gross Receipts Tax Revenue (1,000s of 2008 $s), Utilities

	2010	*2011*	*2012*	*2013*	*2014*
GRT	$2,692	$6,604	$12,278	$9,583	$5,674

Table 17.2-9. Impact on Corporate Income Taxes Revenue (1,000s of 2008 $s), Utilities

	2010	*2011*	*2012*	*2013*	*2014*
Corporate Income	$686	$1,684	$3,131	$2,444	$1,447

Table 17.2-10. Impact on Personal Income Taxes Revenue (1,000s of 2008 $s), Utilities

	2010	*2011*	*2012*	*2013*	*2014*
Personal Income	$3,306	$8,103	$15,049	$11,734	$6,948

Figure 17.2-5 shows the projected total GRT for the baseline trend (projected future without the proposed action) plus the total combined impact of the proposed action. The chart shows the GRT rising to $179 million at the 2012 construction peak, a 7% increase over the baseline trend. This meets the criteria used in this analysis for a beneficial significant impact.

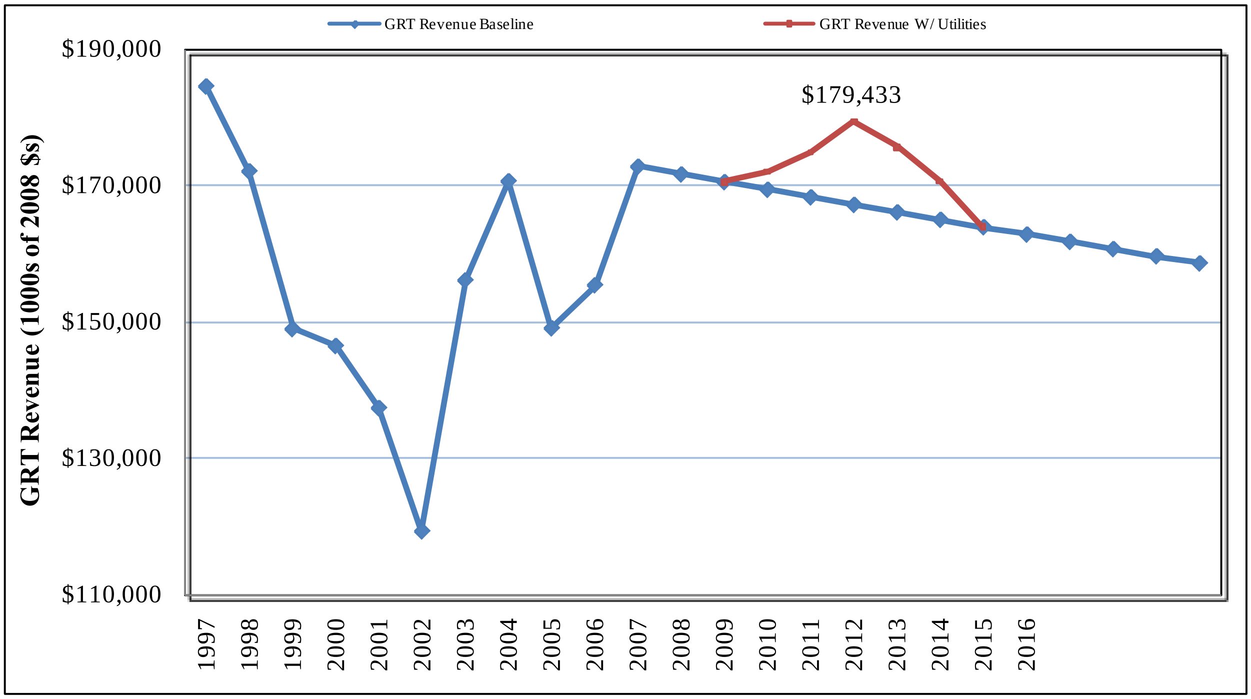

Figure 17.2-5. Gross Receipts Tax Revenue With and Without Utilities

Figure 17.2-6 shows the projected total income tax revenue – corporate and personal income taxes – for the baseline trend plus the total combined impact of the proposed action. The chart shows the income tax revenue rising to $259 million in 2012, an 8% increase over the baseline trend. This meets the criteria used in this analysis for a beneficial significant impact.

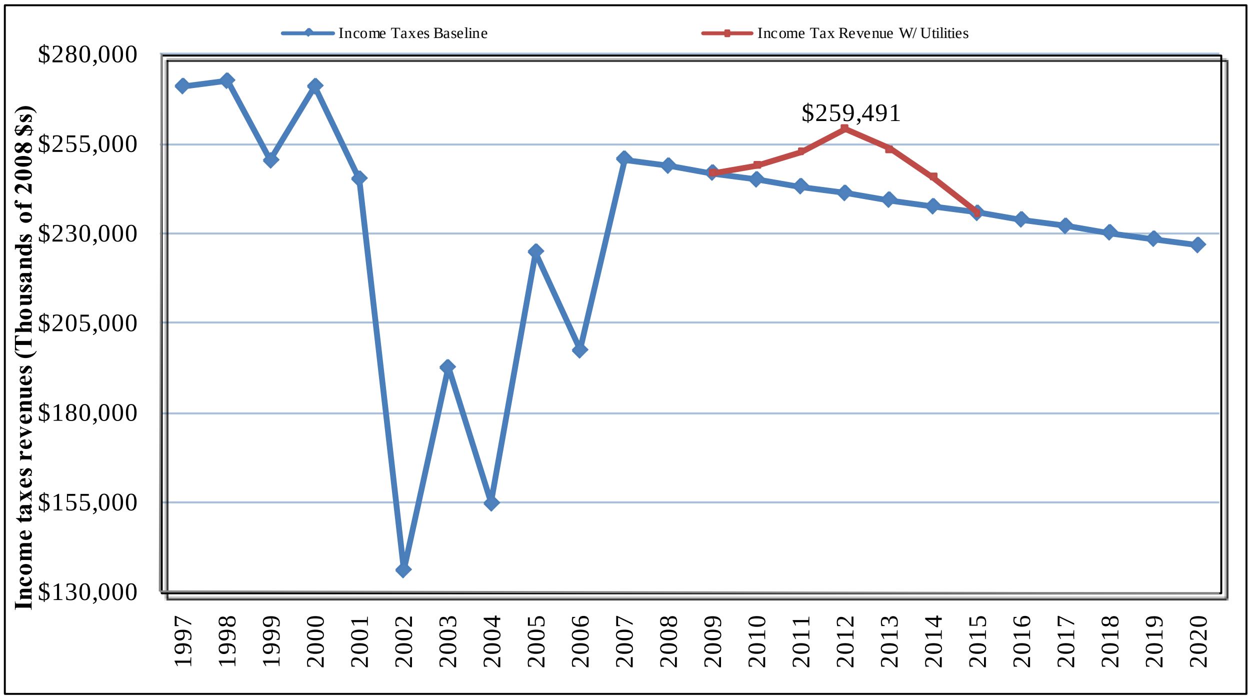

Figure 17.2-6. Income Taxes Revenue (Combined) With and Without Utilities

Gross Island Product

Refer to the corresponding section of Volume 2 for introductory statements and approach to analysis (including data sources).

Table 17.2-11 shows the impact would add a peak amount of $83 million to the Gross Island Product (GIP) in 2012.

Table 17.2-11. Impact on Gross Island Product (Millions of 2008 $s), Utilities

	2010	*2011*	*2012*	*2013*	*2014*
Total Impact	$18	$45	$83	$65	$38

Figure 17.2-7 shows the projected total GIP for the baseline trend (projected future without the proposed action) plus the total combined impact of the proposed action. The chart shows the GIP rising to just over $5 billion in 2012. The 2012 impact on GIP of $83 million represents a 2% increase over the baseline trend. This is a significant beneficial impact.

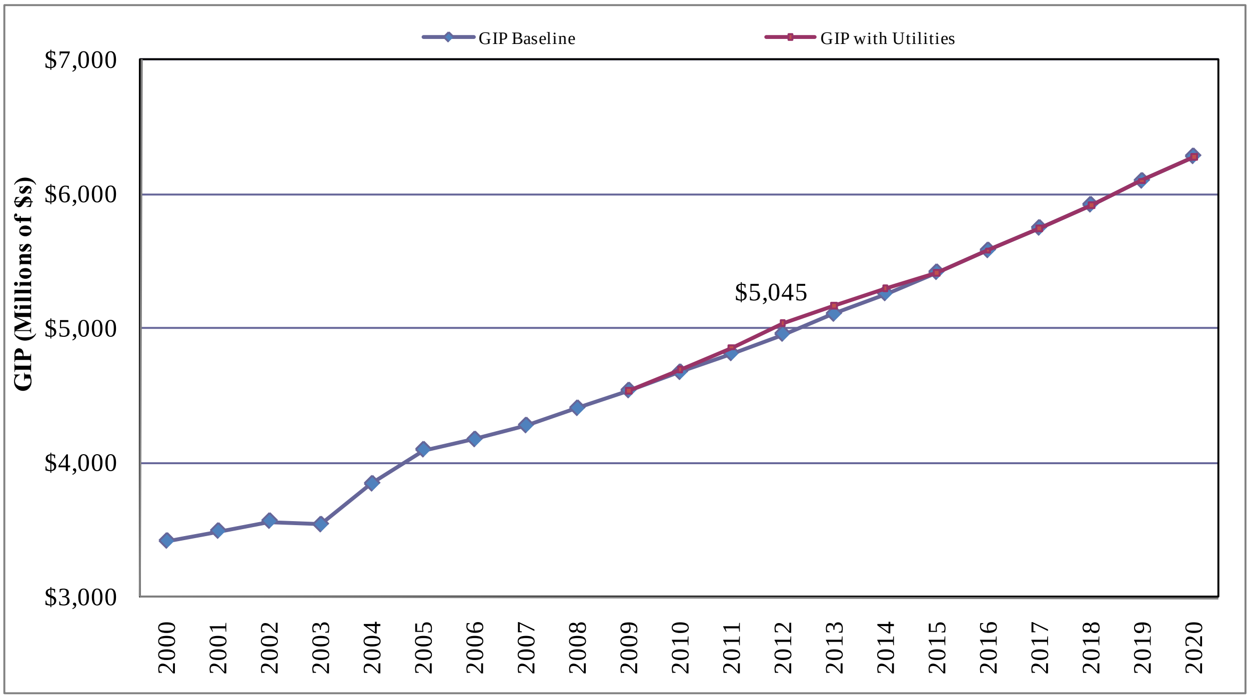

Figure 17.2-7. Gross Island Product (Millions of 2008 $s) With and Without Utilities

17.2.2.3 Public Service Impacts

Refer to the corresponding section of Volume 2 for introductory statements, approach to analysis (including data sources), and qualitative impact analysis. Some public service impacts associated with utilities alternatives are expected to be significant.

Public Education

Table 17.2-12 shows the estimated number of key full time equivalent (FTE) professional staff required due to utilities projects. The peak requirement in 2012, stemming from construction direct and indirect impacts, is about 2% greater than baseline staffing levels for all the agencies listed below. By the criteria used for this analysis, this would be considered a significant (adverse) impact.

Table 17.2-12. Additional Public Education Key Professionals Required, Utilities

	2010	*2011*	*2012*	*2013*	*2014*
GPSS Elementary Schools	4.5	11	20	15	9
GPSS Middle Schools	2	5	9	7	4
GPSS High Schools	2	5	8	6	4
GCC	0	1	2	2	1
UoG	1	2	4	3	2

Legend: GCC = Guam Community College; GPSS = Guam Public School System; UoG = University of Guam.

Public Health and Human Services

Further discussion on public health implications can be found in Volume 6, Chapter 19, “Public Health and Safety.”

Table 17.2-13 shows the estimated number of key FTE professional staff required due to the action. The peak requirement in 2012 is about 3% greater than reported baseline staffing levels for each agency listed in Table 17.2-13. By the criteria used for this analysis, this would be considered a significant (adverse) impact.

Table 17.2-13. Additional Public Health and Human Service Key Professionals Required, Utilities

	2010	*2011*	*2012*	*2013*	*2014*
GMHA Physicians	0.4	1	2	1	1
GMHA Nurses, Allied Health Professionals	2	5	10	8	5
GDPHSS Bureau of Primary Care Medical Providers and Nursing Staff	0.2	1	1	1	1
GDPHSS CDC Prevention Specialists	0.2	0.5	0.9	0.7	0.4
GDPHSS BFHNS Nursing Personnel	0.1	0.3	0.6	0.5	0.3
GDMHSA Mental Health Professionals	1	2	3	3	2
GDISID Social Workers and Counselors	0.1	0.2	0.4	0.3	0.2

Legend: BFHNS = Bureau of Family Health and Nursing Services; CDC = Communicable Disease Control; GDISID = Guam Department of Integrated Services for Individuals with Disabilities; GDMHSA = Guam Department of Mental Health and Substance Abuse; GDPHSS = Guam Department of Public Health and Social Services; GMHA = Guam Memorial Hospital Authority.

Public Safety Services

Further discussion on public safety implications can be found in Volume 6, Chapter 19, “Public Health and Safety.”

Table 17.2-14 shows the estimated number of key FTE professional staff required due to the action. The peak requirement in 2014, when the full effects of the action are added to ongoing construction, is about 2% greater than reported baseline staffing levels. By the criteria used for this analysis, this would be considered a significant (adverse) impact.

Other Selected General Services

Table 17.2-15 shows the estimated number of key FTE professional staff required due to the proposed action. The peak requirement in 2012 is about 2% greater than reported baseline staffing levels for each agency listed in Table 17.2-15. By the criteria used for this analysis, this would be considered a significant (adverse) impact.

Table 17.2-14. Additional Public Safety Key Professionals Required, Utilities

	2010	*2011*	*2012*	*2013*	*2014*
GPD Sworn Police Officers	2	4	8	6	4
GFD Uniformed Fire Personnel	1	3	6	5	3
GDoC Custody and Security Personnel	1	2	4	3	2
GDYA Youth Service Professionals	0.4	1	2	1	1

Legend: GDoC = Guam Department of Corrections; GDYA = Guam Department of Youth Affairs; GFD = Guam Fire Department; GPD = Guam Police Department.

Table 17.2-15. Additional Key Professionals Required for Selected Other General Services, Utilities

	2010	*2011*	*2012*	*2013*	*2014*
GDPR Staffing	0.5	1.3	2.3	1.8	1.1
PLS Staffing	0.2	0.4	0.7	0.6	0.3
Judiciary Judges	0.0	0.1	0.2	0.1	0.1

Legend: GDPR = Guam Department of Parks and Recreation; PLS = Public Library System.

Growth Permitting and Regulatory Agencies

Table 17.2-16 shows the estimated number of key FTE professional staff required due to the action. The peak requirement for most agencies is only slightly above reported baseline staffing levels, but for a few agencies with very small baseline staff levels even a small number represents a fairly high percentage increase. For example, the Alien Labor Processing and Certification Division peak value of 2.3 is 46% greater than the baseline level (just five positions), and the peak Guam Department of Parks and Recreation - Historic Preservation Office, number of 1.3 is 19% greater than baseline. Although the percentages vary by agency, the overall assessment would be one of less than significant impacts for the utilities alone.

Table 17.2-16. Additional Growth Permitting Staff Required, Utilities

	2010	*2011*	*2012*	*2013*	*2014*
Guam DPW Permitting Staff	0.0	0.0	0.0	0.0	0.0
GDLM Permitting Staff	3.5	3.4	3.4	3.3	3.3
GEPA Permitting Staff	1.1	1.2	7.2	6.4	5.6
CMP Permitting Staff	1.4	1.4	1.7	1.3	1.1
GPA Permitting Staff	0.3	0.6	0.8	0.6	0.3
GWA Permitting Staff	0.6	2.8	2.1	1.4	0.3
GFD Permitting Staff	0.0	0.1	0.1	0.1	0.0
GDPHSS – DEH Permitting Staff	0.1	0.2	0.3	0.2	0.1
GDPR – HPO Permitting Staff*	1.6	1.3	1.0	0.7	0.5
GDoL – ALPCD Permitting Staff	1.0	1.5	2.3	0.0	0.0

Legend: ALPCD = Alien Labor Processing and Certification Division; CMP = Coastal Management Program; DEH = Division of Environmental Health; DPW = Department of Public Works; GDLM = Guam Department of Land Management; GDoL = Guam Department of Labor; GDPHSS = Guam Department of Public Health and Social Services; GDPR = Guam Department of Parks and Recreation; GEPA = Guam Environmental Protection Agency; GFD = Guam Fire Department; GPA = Guam Power Authority; GWA = Guam Waterworks Authority; HPO = Historic Preservation Office

* The Programmatic Agreement (further described in Volume 6, Chapter 14, Cultural Resources) helps the HPO with staffing issues by streamlining the Section 106 process. Because staffing requirements to meet federal regulations would be reduced by this agreement, freeing up current staff to work on non-federal projects, the staffing requirements noted in this table may not be as high.

17.2.2.4 Sociocultural Impacts

The sociocultural impacts associated with utilities alternatives are not expected to be significant, except as they contribute to the significant aggregate effects discussed in Volume 7.

17.2.2.5 Summary of Utilities Impacts

The economic activity from the proposed action would add about 4,580 residents to Guam's population at the 2012 construction peak for utilities work.

Including all the spin-off activity, the proposed action would provide jobs for about 3,330 civilian workers in 2012. Guam residents are estimated to capture about 270 of the direct onsite construction jobs for utilities at the 2012 peak, as well as approximately 170 spin-off jobs that year.

Civilian housing unit demand driven by the utilities work would peak at about 820 units in 2012.

Increased population related to the proposed action would place upward pressure on wastewater rates.

Although a more detailed fiscal impact assessment would be done by the Government of Guam (GovGuam) using output from this Environmental Impact Statement, preliminary estimates in this chapter suggest revenues from the three most important tax sources – gross receipts, corporate income, and personal income – would exceed $30.4 million in 2012.

Guam's GIP, the total market value of all final goods and services produced in a given year, would increase by $83 million (2008 dollars) at the 2012 construction peak due to utilities.

GovGuam's public service agencies would need to make small but significant staffing increases to service new population associated with roadways construction. Most of these agencies would need to expand their services and staff by more than 2%.

Sociocultural impacts of utility construction would be negligible.

Table 17.2-17 summarizes the potential impacts and bullets with the rationale.

17.2.2.6 No-Action Alternative

The assumed no-action alternative is that all parts of the aggregate action, not just the proposed action covered in this Volume, but also other components addressed in other Volumes do not occur. Therefore, the no-action conclusions given below are identical to those in Volume 2 for the Marine Corps relocation and/or Volume 7 for the aggregate action. The references below to substantial impacts with the proposed action would apply more to those Volumes than to this Volume 6 covering the Utilities action, because Utilities impacts alone sometimes would not attain significance.

Unlike physical resources, socioeconomic systems do not tend to remain completely at baseline conditions if a proposed action is not implemented. Economies and population levels change for other reasons as well. The various foregoing exhibits showing baseline trends for economic and demographic variables indicate long-term trends expected to continue without the proposed action, and Volume 7 lists a number of specific socioeconomic changes expected to occur independent of the proposed action. Furthermore, the announcement of the proposed action has already had socioeconomic consequences, such that a 2010 decision not to follow through on the military relocation would have short-term effects associated with a reversal of those existing consequences.

Table 17.2-17. Summary of Potential Socioeconomic Impacts-Utilities

Impact Area	*Utilities*
Population Impacts	• Beneficial impact due to economic expansion fueled by increased population. • Significant impacts due to strains placed on government services and the social fabric.
Economic Impacts	• Beneficial impacts due to provision of permanent jobs on Guam. • Beneficial impacts due to permanent infusion of income into the Guam economy. • Beneficial impacts due to increase in local government revenue. • Beneficial operational phase impacts due to permanent increased GIP strengthening the Guam economy. • Beneficial impacts due to increased military service contract opportunities for local Guam businesses. • Less than significant direct and indirect impact demand for civilian (private-market, excluding temporary construction workforce housing) housing units peaking at 822 units in 2012. • No impact to standard of living from the proposed action construction or operation. • No impact on tourism from the proposed action construction or operation.
Public Service Agencies	• Significant impacts due to difficulty in meeting fluctuating staffing requirements during and following the construction phase with an existing environment of staffing and budget shortfalls and recruitment complications. • Significant impact due to difficulty in recruiting and funding adequate staffing during operational phase. • Beneficial impact due to provision of additional jobs on Guam, if labor supply and funding is available during operational phase. • Less than significant construction-related impacts to growth permitting and regulatory agencies due to difficulty in meeting fluctuating staffing requirements with an existing environment of staffing and budget shortfalls and recruitment complications.
Sociocultural Impacts	• No impacts to crime and social order. • No impacts to Chamorro issues. • No impacts to community cohesion.
Utility Rate Payer	LSI • Effects on ratepayers would be dependent upon renegotiations of Customer Agreements and could be affected by more expensive system operations. It is also possible that rates for some utilities could decline due to the increased customer base. SI • There would be impacts to the GWA wastewater systems that are not used by DoD but would have to service the added civilian populations from the construction workforce and induced civilian growth. These systems are currently in need of maintenance and upgrades, and these added populations would exacerbate the urgency and size of the maintenance and upgrade items. This would likely put upward pressure on wastewater rates for all current and future customers.

Legend: BI = Beneficial impact; DoD = Department of Defense; GIP = Gross Island Product; GWA = Guam Waterworks Authority; LSI = Less than significant impact; NI = No impact; SI-M = Significant impact mitigable to less than significant.

Population/Economic Impacts

In the short term, a decision not to implement the proposed action would deflate any current speculative activity attributable the proposed action. Real estate values in particular would likely drop, hurting investors but increasing the affordability of housing. The contrast between the business community's expectations and a negative Record of Decision would likely produce a period of pessimism about Guam's economic future, especially if the current national and international economic crisis has not yet abated. These effects, though, would be attributable to an unstable world economic landscape and poor decision making by investors – not to the proposed action.

Long term, the island's prospects would remain linked to international economic conditions and the health of its tourism industry. Conceivably, a smaller military profile might remove some barriers to growing the potential Chinese tourism market. Growth would resume, though probably with the same volatility experienced in recent decades.

Public Service Impacts

In the case of the no-action alternative, the specific agencies discussed earlier in this chapter would not face the listed pressures to expand professional staffing, and agencies involved in planning and regulating growth would not experience such a sharp increase in workload. Although this was not specifically covered in the foregoing analysis, it may also be noted that agencies that are required to implement major infrastructure developments, such as the ports and highways, would have substantially more time to implement long-term plans rather than having to achieve much of their objectives over the next few years.

However, at the broader level, the no-action alternative and the elimination of prospective long-term revenues expected from the proposed action still would leave GovGuam agencies in the difficult financial condition described in Volume 2, Section 16.22.11. At least for the foreseeable future, this would negatively impact the various service agencies because of budget cuts, and would probably represent the most important overall consequence for GovGuam.

Sociocultural Impacts

To the extent that Guam experiences job losses, crime rates may rise in the short term. The political attention given to some Chamorro issues would likely recede as the militarization of Guam is stabilized at something close to present levels. Military-civilian relations would likely remain at the current generally positive level.

The incentive for increased in-migration from the Freely Associated States of Micronesia would decrease, reducing sociocultural issues associated with assimilating that population. However, the current incentives for providing support to those populations, both on Guam and the Micronesian states, would also be lessened, with detrimental implications for both populations.

17.2.2.7 Utilities Proposed Mitigation Measures

A review of the above impacts shows that the proposed action has the potential to have primarily beneficial impacts or no impacts on Guam with the exception of population and public service agencies where the proposed action could have significant adverse impacts. Therefore, the mitigation measures identified below provide avenues to mitigate these adverse impacts while taking into account Guam's unique position as an isolated island economy.

Table 17.2-18 shows proposed mitigation measures related to power utilities.

Table 17.2-18. Proposed Mitigation Measures for Utilities

Impact Area	*Mitigation Measures*
Population	The DoD would decrease the rapid population increase associated with the operations phase by implementing force flow and adaptive program management. (See mitigation measures in General category).
Public Service Agencies	Continue to support existing DoD programs that contribute and/or donate excess equipment to local agencies. The DoD would continue to participate in CMTF to address community health needs such as facilitating information sharing between military and civilian health agencies, including health service needs data and health services utilization rates. The DoD would coordinate with the Governor's Office of Community Affairs to facilitate volunteer opportunities at Guam public service agencies for military personnel and their dependents. The DoD would assist by leading a federal inter-agency effort to identify other federal programs and funding sources for GovGuam addressing the following: a) Enhancement of GovGuam Tax Revenue Collection efficacy. For example, improved revenue could be used to enhance recruitment and retention of the GovGuam work force and contractual support; b) Examination of currently existing caps on benefits such as Medicaid and Medicare, the non-provision of benefits such as Supplemental Security Income benefits, and the appropriateness of these caps and limits for Guam; c) Increase of the number of Guam-based offices for the distribution of federal social service support, and support of the work of GovGuam public service agencies; d) Review and implementation of programs to assist the GovGuam's public agencies in adapting to peaks in service population growth; e) Provision of technical assistance for the development and implementation of a system of interpreters and translators available for the interpreting and translating needs of the GovGuam public service agencies, to facilitate timely and appropriate provision of services for the English as a Second Language service population; f) The development of AmeriCorps, Teach for America, National Health Service Corps programs, and other similar programs on Guam; g) Improving the grant-writing capabilities within GovGuam agencies to improve possibilities of attracting federal support programs; h) Support for the recruitment of professionals during the construction phases of the proposed action for GovGuam public agency positions; i) Support for the use of the Interagency Personnel Act to support identified GovGuam agency personnel requirements, and/or j) Provision to GovGuam of technical assistance for, and development and implementation of, comprehensive data collection systems focused on the following topics: 1. GovGuam public services provided to Freely Associated States of Micronesia citizens to facilitate GovGuam access to Compact Impact and other related funding; 2. GovGuam agency services provided to military individuals to facilitate GovGuam access of TRICARE and other related funding; 3. GovGuam public health agency patient information, records, and services accessed to facilitate appropriate care administered in a timely manner; and 4. GovGuam public agency billing systems to facilitate GovGuam collection of payment for services.

17.2.3 Roadway Projects

17.2.3.1 Alternative 1

North

Effects on Neighborhoods and Businesses

Community cohesion addresses the degree to which residents have senses of belonging to their neighborhood or experience attachment to community groups and institutions as a result of continued association over time. Possible community cohesion impacts of a project include effects on interactions among persons and social groups, whether certain people would be isolated from others, and the perceived impact on community quality of life.

Within the North Region, Alternative 1 would include roadway widening, pavement strengthening, and intersection improvement activities. Most of these roadway improvements would primarily occur within the existing right-of-way (ROW); therefore, they would not constitute any new physical or psychological barriers that would divide, disrupt, or isolate neighborhoods, individuals, or community focal points in the corridor. At certain locations, roadway improvements would require the acquisition of additional ROW that may result in effects on community cohesion.

Property Acquisition and Relocation

Table 17.2-19 summarizes ROW acquisitions and residential and non-residential relocations associated with the GRN projects. Federal and state laws require consistent and fair treatment of owners of the property to be acquired, including just compensation for their property. Uniform and equitable treatment of displaced persons or businesses is also required by these laws. For purposes of presenting a conservative analysis, properties or easements are assumed to be acquired permanently. During final engineering, it may be determined that some parcels can be leased during construction, avoiding permanent displacement impacts. In addition, the number of acquisitions and easements required could decrease during final design and engineering, as could the amount of land required from individual parcels. Estimates presented here are assumed to represent the “maximum potential adverse effect” and are based on preliminary engineering ROW documents.

Within the North Region, Alternative 1 would require the acquisition of approximately 82 acres (ac) (33 hectares [ha]) of land area. Approximately 22 ac (9 ha) of residential property would be acquired. As shown in Table 17.2-19, approximately 20 residential units would be subject to relocation in the region. Based on the 2000 U.S. Census Bureau data for the average persons per household for the North Region (4.26 persons per household), the estimated number of persons displaced would be 85.

In this region, the proposed GRN projects would require acquisition of approximately 13 ac (5 ha) of non-residential property and the relocation of approximately four non-residential or business units. In addition, approximately 47 ac (19 ha) of military-owned land within the North Region would be acquired.

Businesses identified for possible acquisition in the North Region include a fast-food restaurant, a convenience/outdoor supply store, and two storage facilities. These businesses would be subjected to a primary field survey to determine their general characteristics. Full assessment of all affected residential and non-residential uses would be obtained prior to their acquisition to determine their specific characteristics and values.

Table 17.2-19. Summary of Right-of-Way Acquisitions and Estimated Residential and Non-residential Relocations

Alternatives	*Total Est. Land Area (acres)*	*Total Est. Residential Acquisition (acres)*	*Total Est. Business/ Non-Residential Acquisition (acres)*	*Total Est. Military Acquisition (acres)*	*Total Est. Residential Relocations (Units)*	*Total Est. Business/ Non-Residential Relocations (Units)*	*Total Estimated Residents**
Alternative 1							
North Region	82	22	13	47	20	4	85
Central Region	74	42	10	22	51	7	184
Apra Harbor Region	16	16	0	0	0	0	0
South Region	0	0	0	0	0	0	0
Alternative 1 Totals	172	80	23	69	71	11	269
Alternative 2							
North Region	82	22	13	47	20	4	85
Central Region	74	42	10	22	51	7	184
Apra Harbor Region	16	16	0	0	0	0	0
South Region	0	0	0	0	0	0	0
Alternative 2 Totals	172	80	23	69	71	11	269
Alternative 3							
North Region	71	22	2	47	20	4	85
Central Region	84	42	20	22	51	7	184
Apra Harbor Region	16	16	0	0	0	0	0
South Region	0	0	0	0	0	0	0
Alternative 3 Totals	171	80	22	69	71	11	269
Alternative 8							
North Region	82	22	13	47	20	4	85
Central Region	75	42	10	23	51	7	184
Apra Harbor Region	16	16	0	0	0	0	0
South Region	0	0	0	0	0	0	0
Alternative 8 Totals	173	80	23	70	71	11	269

Note: * Estimate based on 2000 U.S. Census Bureau data for each region (North 4.26; Central 3.61 persons per household).
Source: Parsons.

Public Services and Facilities Impacts

No adverse effects on the public services and facilities identified within the GRN study area are anticipated.

Best Management Practices/Proposed Mitigation Measures

Relocation Assistance Program and Relocation Resources. All property acquisitions would be completed in compliance with the Uniform Relocation Assistance and Real Property Acquisition Policies of 1970 (Uniform Relocation Act) and Title VI of the Civil Rights Act of 1964. The Uniform Relocation Act requires that no person shall be displaced until adequate, decent, safe, and sanitary housing is made available. The acquisition and relocation program would be conducted in accordance with 49 Code of Federal Regulations Part 24, and relocation resources are available to all residential and business relocatees without discrimination. Information about project relocation assistance would be made available during a public involvement process. Affected individuals would be contacted personally, and all benefits and services of the program would be made available to them.

No mitigation measures are required.

Central

Effects on Neighborhoods and Businesses

Within the Central Region, Alternative 1 would include roadway widening, roadway alignments, pavement strengthening, intersection improvements, or bridge replacements. Most of these roadway improvements would primarily occur within the existing ROW; therefore, they would not constitute any new physical or psychological barriers that would divide, disrupt, or isolate neighborhoods, individuals, or community focal points in the corridor. At certain locations, roadway improvements would require the acquisition of additional ROW that may result in community cohesion effects.

Property Acquisition and Relocation

Within the Central Region, Alternative 1 would require the acquisition of approximately 74 ac (30 ha) of land area. Approximately 42 ac (17 ha) of residential property would be acquired. As shown in Table 17.2-19, approximately 51 residential units would be subject to relocation in the region. The estimated number of persons displaced would be 184, based on the 2000 U.S. Census Bureau average persons per household for the Central Region (3.61 persons per household).

In this region, the proposed GRN projects would require acquisition of approximately 10 ac (4 ha) of non-residential property and the relocation of approximately seven non-residential or business units. In addition, approximately 22 ac (9 ha) of military-owned land within the Central Region would be acquired.

Businesses identified for possible acquisition include three fast-food restaurants, one office space, one gas station, and one rental car office. These businesses would be subjected to a primary field survey to determine their general characteristics. Full assessment of all affected residential and non-residential uses would be obtained prior to their acquisition to determine their specific characteristics and values.

Public Services and Facilities Impacts

No adverse effects on public services and facilities identified within the GRN study area are anticipated.

Best Management Practices/Proposed Mitigation Measures

Best Management Practices (BMPs) and mitigation measures would be similar to those described for the North Region.

Apra Harbor

Effects on Neighborhoods and Businesses

Within the Apra Harbor Region, roadway improvements under Alternative 1 would include pavement strengthening and intersection improvements. These roadway improvements would primarily occur within the existing ROW; therefore, they would not constitute any new physical or psychological barriers that would divide, disrupt, or isolate neighborhoods, individuals, or community focal points in the corridor.

Property Acquisition and Relocation

Within the Apra Harbor Region, Alternative 1 would require the acquisition of 16 ac (6 ha) of land area that is zoned for residential uses. As shown in Table 17.2-19, no residential units and/or residents would be subject to relocation in this region. In this region, the proposed GRN projects would not require acquisition of non-residential or military-owned property, as shown in Table 17.2-19.

There would be no non-residential and/or business relocations in this region.

Public Services and Facilities Impacts

No public services and facilities identified within the GRN study area would be affected in this region.

Proposed Mitigation Measures

Mitigation measures would be similar to those described for the North Region.

South

Effects on Neighborhoods and Businesses

Within the South Region, roadway improvements under Alternative 1 would include pavement strengthening and intersection improvements. These improvement projects would primarily occur within the existing ROW; therefore, they would not constitute any new physical or psychological barriers that would divide, disrupt, or isolate neighborhoods, individuals, or community focal points in the corridor.

Property Acquisition and Relocation

As listed in Table 17.2-19, no residential or non-residential units would be relocated, and no lands would be acquired.

Public Services and Facilities Impacts

No public services and facilities identified within the GRN study area would be affected in this region.

Best Management Practices/Proposed Mitigation Measures

No BMPs or mitigation measures are required.

17.2.3.2 Alternative 2

North

Effects on Neighborhoods and Businesses

Under Alternative 2, impacts for this region would be identical to those of the North Region under Alternative 1.

Property Acquisition and Relocation

Property acquisition and relocation impacts would be the same as those under Alternative 1.

Public Services and Facilities Impacts

Impacts to public services and community facilities would be the same as those under Alternative 1.

Best Management Practices/Proposed Mitigation Measures

BMPs and mitigation measures would be similar to those described under Alternative 1.

Central

Effects on Neighborhoods and Businesses

Under Alternative 2, impacts for this region would be identical to those of the Central Region under Alternative 1.

Property Acquisition and Relocation

Property acquisition and relocation impacts would be the same as those under Alternative 1.

Public Services and Facilities Impacts

Impacts to public services and community facilities would be the same as those under Alternative 1.

Best Management Practices/Proposed Mitigation Measures

BMPs and mitigation measures would be similar to those described under Alternative 1.

Apra Harbor

Effects on Neighborhoods and Businesses

Under Alternative 2, impacts for this region would be identical to those of the Apra Harbor Region under Alternative 1.

Property Acquisition and Relocation

Property acquisition and relocation impacts would be the same as those for the Apra Harbor Region under Alternative 1.

Public Services and Facilities Impacts

Impacts to public services and community facilities would be the same as those under Alternative 1.

Best Management Practices/Proposed Mitigation Measures

BMPs and mitigation measures would be similar to those described under Alternative 1.

South

Effects on Neighborhoods and Businesses

Under Alternative 2, impacts for this region would be identical to those of the South Region under Alternative 1.

Property Acquisition and Relocation

Property acquisition and relocation impacts would be the same as those for the South Region under Alternative 1.

Public Services and Facilities Impacts

Impacts to public services and community facilities would be the same as those under Alternative 1.

Best Management Practices/Proposed Mitigation Measures

No BMPs or mitigation measures are required.

17.2.3.3 Alternative 3

North

Effects on Neighborhoods and Businesses

Within the North Region, Alternative 3 would include roadway widening, pavement strengthening, and intersection improvement activities. Most of these roadway improvements would primarily occur within the existing ROW; therefore, they would not constitute any new physical or psychological barriers that would divide, disrupt, or isolate neighborhoods, individuals, or community focal points in the corridor. At certain locations, roadway improvements would require the acquisition of additional ROW that may result in community cohesion effects.

Property Acquisition and Relocation

Within the North Region, Alternative 3 would require the acquisition of approximately 71 ac (29 ha) of land area. Approximately 22 ac (9 ha) of residential property would be acquired in this region. As shown in Table 17.2-19, approximately 47 residential units would be subject to relocation in the region. Based on the 2000 U.S. Census Bureau data for the average persons per household for the North Region (4.26 persons per household), the estimated number of persons displaced would be 85.

In this region, the proposed GRN projects would require the acquisition of approximately 2.0 ac (0.8 ha) of non-residential property and the relocation of approximately four non-residential or business units. In addition, approximately 47 ac (19 ha) of military-owned land within the North Region would be acquired.

Businesses identified for possible acquisition in the North Region include one fast-food restaurant, one convenience/outdoor supply store, and two storage facilities. These businesses would be subjected to a primary field survey to determine their general characteristics. Full assessment of all affected residential and non-residential uses would be obtained prior to their acquisition to determine their specific characteristics and values.

Public Services and Facilities Impacts

No adverse effects on public services and facilities identified within the GRN study area are anticipated.

Best Management Practices/Proposed Mitigation Measures

BMPs and mitigation measures would be similar to those described under Alternative 1.

Central

Effects on Neighborhoods and Businesses

Within the Central Region, Alternative 3 would include roadway widening, roadway alignments, pavement strengthening, intersection improvements, or bridge replacements. Most of these roadway improvements would primarily occur within the existing ROW; therefore, they would not constitute any new physical or psychological barriers that would divide, disrupt, or isolate neighborhoods, individuals, or community focal points in the corridor. At certain locations, roadway improvements would require the acquisition of additional ROW that may result in community cohesion effects.

Property Acquisition and Relocation

Within the Central Region, Alternative 3 would require the acquisition of approximately 84 ac (34 ha) of land area. Approximately 42 ac (17 ha) of residential property would be acquired. As shown in Table 17.2-19, approximately 51 residential units would be subject to relocation in the region. The estimated number of persons displaced would be 184, based on the 2000 U.S. Census Bureau average persons per household for the Central Region (3.61 persons per household).

In this region, the proposed GRN projects would require acquisition of approximately 20 ac (8 ha) of non-residential property and the relocation of approximately seven non-residential or business units. In addition, approximately 22 ac (9 ha) of military-owned land within the Central Region would be acquired.

Businesses identified for possible acquisition include three fast-food restaurants, one office space, one gas station, and one rental car office. These businesses would be subjected to a primary field survey to determine their general characteristics. Full assessment of all affected residential and non-residential uses would be obtained prior to their acquisition to determine their specific characteristics and values.

Public Services and Facilities Impacts

No adverse effects on public services and facilities identified within the GRN study area are anticipated.

Best Management Practices/Proposed Mitigation Measures

BMPs and mitigation measures would be similar to those described under Alternative 1.

Apra Harbor

Effects on Neighborhoods and Businesses

Under Alternative 3, impacts for this region would be identical to those of the Apra Harbor Region under Alternatives 1 and 2.

Property Acquisition and Relocation

Property acquisition and relocation impacts for this region would be the same as those for the Apra Harbor Region under Alternatives 1 and 2.

Public Services and Facilities Impacts

Impacts to public services and facilities would be the same as those under Alternatives 1 and 2.

Best Management Practices/Proposed Mitigation Measures

BMPs and mitigation measures would be similar to those described under Alternative 1.

South

Effects on Neighborhoods and Businesses

Under Alternative 3, impacts for this region would be identical to those of the South Region under Alternatives 1 and 2.

Property Acquisition and Relocation

Property acquisition and relocation impacts would be the same as those for the South Region under Alternatives 1 and 2.

Public Services and Facilities Impacts

Impacts to public services and facilities would be the same as those of Alternatives 1 and 2.

Best Management Practices/Proposed Mitigation Measures

No BMPs or mitigation measures are required.

17.2.3.4 Alternative 8

North

Effects on Neighborhoods and Businesses

Within the North Region, Alternative 8 would include roadway widening, pavement strengthening, and intersection improvement activities. Most of these roadway improvements would primarily occur within the existing ROW; therefore, they would not constitute any new physical or psychological barriers that would divide, disrupt, or isolate neighborhoods, individuals, or community focal points in the corridor. At certain locations, roadway improvements would require the acquisition of additional ROW that may result in community cohesion effects.

Property Acquisition and Relocation

Within the North Region, Alternative 8 would require the acquisition of approximately 82 ac (33 ha) of land area. Approximately 22 ac (9 ha) of residential property would be acquired. As shown in Table 17.2-19, approximately 20 residential units would be subject to relocation in the region. Based on the 2000 U.S. Census Bureau data for the average persons per household for the North Region (4.26 persons per household), the estimated number of persons displaced would be 85.

In this region, the proposed GRN projects would require acquisition of approximately 13 ac (5 ha) of non-residential property and the relocation of approximately four non-residential or business units. In addition, approximately 47 ac (19 ha) of military-owned land within the North Region would be acquired.

Businesses identified for possible acquisition in the North Region include one fast-food restaurant, one convenience/outdoor supply store, and two storage facilities. These businesses would be subjected to a primary field survey to determine their general characteristics. Full assessment of all affected residential and non-residential uses would be obtained prior to their acquisition to determine their specific characteristics and values.

Public Services and Facilities Impacts

No adverse effects on public services and facilities identified within the GRN study area are anticipated.

Proposed Mitigation Measures

Mitigation measures would be similar to those described under Alternative 1.

Central

Effects on Neighborhoods and Businesses

Within the Central Region, Alternative 8 would include roadway widening, roadway alignments, pavement strengthening, intersection improvements, or bridge replacements. Most of these roadway improvements would primarily occur within the existing ROW; therefore, they would not constitute any new physical or psychological barriers that would divide, disrupt, or isolate neighborhoods, individuals, or community focal points in the corridor. At certain locations, roadway improvements would require the acquisition of additional ROW that may result in community cohesion effects.

Property Acquisition and Relocation

Within the Central Region, Alternative 8 would require the acquisition of approximately 75 ac (30 ha) of land area. Approximately 42 ac (17 ha) of residential property would be acquired. As shown in Table 17.2-19, approximately 51 residential units would be subject to relocation in the region. The estimated number of persons displaced would be 184, based on the 2000 U.S. Census Bureau average persons per household for the Central Region (3.61 persons per household).

In this region, the proposed GRN projects would require approximately 10 ac (4 ha) of non-residential property and the relocation of approximately seven non-residential or business units. In addition, approximately 23 ac (9 ha) of military-owned land within the Central Region would be acquired.

Businesses identified for possible acquisition include three fast-food restaurants, one office space, one gas station, and one rental car office. These businesses would be subjected to a primary field survey to determine their general characteristics. Full assessment of all affected residential and non-residential uses would be obtained prior to their acquisition to determine their specific characteristics and values.

Public Services and Facilities Impacts

No adverse effects on public services and facilities identified within the study area are anticipated.

Best Management Practices/Proposed Mitigation Measures

BMPs and mitigation measures would be similar to those described under Alternative 1.

Apra Harbor

Effects on Neighborhoods and Businesses

Under Alternative 8, impacts for this region would be identical to those of the Apra Harbor Region under Alternatives 1, 2, and 3.

Property Acquisition and Relocation

Property acquisition and relocation impacts for this region would be the same as those for the Apra Harbor Region under Alternatives 1, 2, and 3.

Public Services and Facilities Impacts

Impacts to public services and facilities would be the same as those under Alternatives 1, 2, and 3.

Best Management Practices/Proposed Mitigation Measures

BMPs and mitigation measures would be similar to those described under Alternative 1.

South

Effects on Neighborhoods and Businesses

Under Alternative 8, impacts for this region would be identical to those of the South Region under Alternatives 1, 2, and 3.

Property Acquisition and Relocation

Property acquisition and relocation impacts would be the same as those for the South Region under Alternatives 1, 2, and 3.

Public Services and Facilities Impacts

Impacts to public services and facilities would be the same as those under Alternatives 1, 2, and 3.

Best Management Practices/Proposed Mitigation Measures

No BMPs or mitigation measures are required.

17.2.3.5 No-Action Alternative

Existing (2009) (Pre-Project)

Under the no-action alternative, GRN projects would not be constructed. The no-action alternative would not result in GRN construction activities; therefore, there would be no potential for effects on neighborhoods and businesses.

Property acquisition for expanding ROWs for GRN projects would not be needed, and there are no GovGuam projects that would occur in 2009. The no-action alternative would result in no impacts from property acquisition and relocation.

2014 (Peak Construction)

Under the no-action alternative, only roadway projects needed for organic growth on Guam would be constructed. The no-action alternative would not result in construction activities; therefore, there would be no potential for effects on neighborhoods and businesses.

GRN projects associated with the military relocation would not be constructed. ROW acquisition associated with Year 2014 GovGuam planned projects would be limited to the four roadway capacity (road widening) projects to occur along Routes 10A, 27 extension, and the Tiyan Parkway, and three intersection projects associated with Routes 1 and 7 (Volume 6, Chapter 2). These four GovGuam projects are located in the Central Region. The no-action alternative may result in impacts from property acquisition and relocation associated with the GovGuam planned projects. Mitigation by GovGuam can be identified and implemented to reduce possible impacts to a less than significant level.

2030

Under the no-action alternative, only roadway projects needed for organic growth on Guam would be constructed. The no-action alternative would not result in construction activities; therefore, there would be no potential for effects on neighborhoods and businesses.

GRN projects associated with the military relocation would not be constructed. Property acquisition of potential contaminated sites would be limited. ROW acquisition associated with Year 2030 GovGuam planned projects would be limited to four road segment projects to occur along Routes 1, 2, 7A, 16, 25, and 26, and nine intersection projects associated with Routes 1, 4, and 16 (Volume, 6, Chapter 2). These 13 Year 2030 GovGuam projects are located in the Central Region. The no-action alternative may result in impacts from property acquisition and relocation. Mitigation by GovGuam can be identified and implemented to reduce possible impacts to a less than significant level.

17.2.3.6 Creation of Jobs and Economic Activity

Table 17.2-20 provides an estimate of the number of positions and level of economic activity created by the expenditure of construction funds for the no-action and the four build alternatives. Estimates are based in part on an input/output study of construction activity in Texas by the FHWA (Politano and Roadifer 1989). Funds created in economic output include the multiplier effect of direct construction being re-spent in service or other sectors of the economy. Economic activity generated by the proposed project is anticipated to benefit Guam and would also follow the labor and material markets for transportation-related construction.

With respect to job creation, FHWA found nationally in the early 1980s that a $1 million investment in transportation construction would directly generate 10 onsite, full-time construction jobs (person years of employment [PYE]). This number has been adjusted to 5.3 PYE positions to reflect inflation through 2009. When offsite, construction-related and service-industry-related jobs and related increases in consumer demand (i.e., direct, indirect, and induced effects) are considered, the total number of full-time PYE positions created rises to approximately 10.6, adjusting for inflation, for each $1 million of highway investment.

Table 17.2-20. Impacts from Construction Investment in the Guam Road Network Projects (in millions of 2009 dollars)

Alternative	*Construction Value **	*Regional Economic Output*	*Total Earnings*	*Job Creation (Person Years of Employment)*	
				Onsite	*Total*
Alternatives 1 and 2	$1,669.13	$2,900.76	$768.39	9,000	18,000
Alternative 3	$1,610.61	$2,799.24	$741.45	8,700	17,400
Alternative 8	$1,627.34	$2,828.32	$749.15	8,800	17,600
No-Action Alternative	NA	NA	NA	NA	NA

Notes: * Construction impacts are based on preliminary estimates for construction value, which exclude right-of-way costs and include design, construction management, and agency costs.
Legend: NA = not applicable.
Sources: Parsons; Politano and Roadifer 1989 (Model adjusted to reflect inflation).

Compared with the no-action alternative, construction value for construction of either Alternatives 1 or 2 would total $1,669.13 million, exclusive of ROW. Construction value, exclusive of ROW, for Alternatives 3 and 8 would total $1,610.61 million and $1,627.34 million, respectively. Construction expenditures for Alternatives 1 and 2 would generate approximately 9,000 onsite full-time construction positions (PYE). Alternatives 3 and 8 would generate approximately 8,700 and 8,800 onsite full-time construction positions (PYE), respectively. Approximately 17,400 to 18,000 total positions (PYE), including direct, indirect, and induced, as compared to the no-action alternative, would be generated by construction expenditures under the build alternatives (i.e., Alternatives 1, 2, 3, or 8).

The impact of this direct and indirect employment added to the regional economy would be positive.

Best Management Practices/Proposed Mitigation Measures

Because the impacts are beneficial, no BMPs or mitigation measures are proposed.

17.2.3.7 Summary of Impacts

Table 17.2-21 summarizes the potential impacts of each action alternative and the no-action alternative. A text summary is provided below.

Table 17.2-21. Summary of Potential Roadway Project Impacts to Socioeconomics and General Services

Potentially Impacted Resource	*Alternative 1*	*Alternative 2*	*Alternative 3*	*Alternative 8*	*No-Action Alternative*
Effects on Neighborhoods and Businesses	SI-M	SI-M	SI-M	SI-M	NI
Property Acquisition and Relocation	SI-M	SI-M	SI-M	SI-M	LSI
Public Services and Facilities Impacts	LSI	LSI	LSI	LSI	NI
Impacts from Construction Investment on Jobs and Economy	BI	BI	BI	BI	NI

Legend: BI = Beneficial impact; LSI = Less than significant impact; NI = No impact; SI = Significant impact; SI-M = Significant impact mitigable to less than significant.

Most of the roadway improvements would primarily occur within the existing ROW; therefore, they would not constitute any new physical or psychological barriers that would divide, disrupt, or isolate neighborhoods, individuals, or community focal points in the corridor. At certain locations, roadway improvements would require the acquisition of additional ROW; however, these would primarily occur adjacent to the existing ROW. Therefore, community cohesion effects would be minimal.

Acquisition of residential, non-residential, and military property would be required. Residential and non-residential units would require relocation. Federal and state laws require consistent and fair treatment of owners of property to be acquired, including just compensation for their property. The Uniform Relocation Assistance and Real Property Acquisition Act of 1970, as amended would be followed.

No adverse effects on public services and facilities are anticipated.

Economic activity generated by the proposed project is anticipated to benefit Guam through the generation of jobs, including onsite full-time construction positions (PYE) and direct, indirect, and induced total positions (PYE).

17.2.3.8 Summary of Proposed Mitigation Measures

No mitigation measures are required for roadway projects impacts to socioeconomics and general services.

Implementation of the adaptive program management and force flow mitigation measures could further reduce roadway projects impacts to socioeconomics and general services by lowering peak population levels during construction. See Volume 7 for a full description of these two mitigation measures.

CHAPTER 18.
HAZARDOUS MATERIALS AND WASTE

18.1 INTRODUCTION

This chapter discusses the potential environmental consequences associated with implementing the alternatives within the region of influence (ROI) for this resource. For a description of the affected environment for all resources, including current hazardous substance handling, storage, transportation, and management plans; techniques; approaches; and proposed mitigation measures, refer to the respective chapter of Volume 2 (Marine Corps Relocation – Guam). The locations described in Volume 2 include the ROI for the utilities projects. The chapters are presented in the same order as the resource areas discussed in Volume 6.

18.2 ENVIRONMENTAL CONSEQUENCES

18.2.1 Approach to Analysis

18.2.1.1 Methodology

Utilities

Potential environmental consequences and mitigation measures related to the expansion of the utilities infrastructure on Guam were evaluated regarding the following:

- Utilities infrastructure construction impacts
- Utilities operational impacts

Both direct impacts (i.e., effects from the construction and operation of utilities provided for the new military facilities on base) and indirect impacts (i.e., effects that occur off base from the influx of construction workers and an induced population) are described in this chapter. For more information on direct and indirect impacts, see Volume 6, Chapter 1.

These potential impacts (direct and indirect) were assessed for the site workers, the general public, and various media (i.e., soils, surface water, groundwater, air, and biota). Potential hazardous substance-related indirect impacts of proposed utilities projects result primarily from:

- The increased demands placed on public utility systems and their associated operations.
- Construction workforce housing, and the associated increased housing and development.
- The increased population that is expected to migrate to Guam because of the economic growth brought about by the United States (U.S.) Department of Defense (DoD) relocation.

Roadway Projects

Hazardous substances are controlled in the U.S. primarily by laws and regulations administered by U.S. Environmental Protection Agency (USEPA), the U.S. Occupational Safety and Health Administration (OSHA), and the U.S. Department of Transportation (DOT). Each agency incorporates hazardous substance controls and safeguards according to its unique Congressional mandate. USEPA regulations focus on the protection of human health and the environment. OSHA regulations primarily protect employee and workplace health and safety. DOT regulations promote the safe transportation of hazardous substances used in commerce. In addition, the U.S. Territory of Guam oversees and administers its environmental laws and regulations through Guam Environmental Protection Agency (GEPA). All public and Special Purpose Entities located on Guam are subject to the GEPA environmental requirements. The GEPA Hazardous Waste Management Program and statutory authority is based primarily on Title 10 Guam Code Annotated.

This contamination screening was prepared pursuant to the Federal Highway Administration Technical Advisory T 6640.8, dated October 30, 1987 (Federal Highway Administration 1987). This advisory provides guidance on the evaluation of hazardous waste sites that would have an effect on the proposed roadway improvements. This advisory recommends that hazardous waste sites be identified and mapped in relation to the location of project alternatives under consideration.

The potential presence of polychlorinated biphenyls (PCBs) would also be a concern because of the presence of pole-mounted transformers on electrical transmission poles throughout the island.

A contamination screening of the roadway projects within the study area was conducted to determine the potential for contamination of the corridor right-of-way (ROW) and intersection improvements from adjacent properties and business operations. The screening included a review of an environmental database search, document and file reviews, a review of previous studies, a review of aerial photography, a review of company websites, and field visits. The impacts to the proposed roadway alternatives, and evaluation of hazardous material and hazardous waste generation associated with the roadway construction, are discussed in Section 18.2.6 of this chapter.

Environmental Database Review

An environmental database search was performed by Environmental Data Resources (EDR). The resulting EDR ZIP/Plus reports identified potential hazardous materials and petroleum contamination sites that are listed in USEPA databases (EDR 2009). This database search utilized a geographic information system-integrated database that included federal- and state-regulated sites.

The EDR ZIP/Plus reports provided information on potential contamination sites within the study area by zip codes. Maps to locate the sites were not available. Locally known sites previously documented in the land use review or known military facilities that were identified by the EDR ZIP/Plus reports were located and field verified. The remaining EDR information was cross referenced with additional potential contamination sites identified in the field to include available regulatory information in the site descriptions. After field verification, potential contamination sites were eliminated from further consideration if they were not within 0.25-mile (0.40-kilometers) of the centerline of the proposed roadway or intersection improvement.

The agency list descriptions define the regulatory databases reviewed for this report, along with the dates that each database was last updated by the respective agency and EDR. The following USEPA databases provided support documentation for the evaluation process:

National Priorities List (NPL), January 26, 2009 – The NPL was devised to prioritize sites for the purpose of taking remedial action as funded by the Hazardous Waste Substance Superfund program, (initially established under the Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] of 1980).

- Proposed NPL, January 26, 2009 – Proposed NPL Sites.
- NPL Deletions, January 26, 2009 – A listing of sites that have been deleted from the NPL. The National Oil and Hazardous Substance Pollution Contingency Plan established the criteria that USEPA uses to delete sites from the NPL.
- NPL Liens, February 16, 2009 – Federal Superfund Liens.

- Comprehensive Environmental Response, Compensation, and Liability Information Systems (CERCLIS), January 30, 2009 – This list contains facilities or locations that USEPA is investigating to determine if an existing or threatened release of hazardous substance is present.
- CERCLIS-No Further Remedial Action Planned (NFRAP) List, January 26, 2009 – As of February 15, 1995, CERCLIS no longer includes sites that USEPA has assessed and designated as an NFRAP site. An NFRAP designation means that, to the best of USEPA's knowledge, USEPA (or its agent) has completed assessment activities at the site and has determined that no further steps to list this site on the NPL would be taken unless information indicating this decision was not appropriate or other considerations make a recommendation for listing appropriate at a later time.
- Liens 2, March 3, 2009 – CERCLA Lien Information.
- Resource Conservation and Recovery Act (RCRA) Information System National Oversite Database Handlers With Corrective Action Activity, March 3, 2009 – This database is a listing of hazardous waste handlers that have undergone RCRA corrective action activity.
- RCRA Information System, February 20, 2009 – This list identifies those facilities or locations that have notified USEPA of their activities relative to the handling of hazardous wastes. It includes facilities that generate, transport, store, treat, and/or dispose of hazardous waste as defined by the RCRA. Transporters are individuals or Special Purpose Entities that move hazardous waste from the generator off site to a facility that can recycle, treat, store, or dispose of the waste. Large quantity generators generate more than 1,000 kilograms (kg) of hazardous waste, or more than 1-kg of acutely hazardous waste per month. Small quantity generators generate between 100 kg and 1,000 kg of hazardous waste per month. Conditionally exempt small quantity generators generate less than 100 kg of hazardous waste, or less than 1-kg of acutely hazardous waste per month.
- Engineering Controls Sites List, December 29, 2008 – A listing of sites with engineering controls in place.
- Sites with Institutional Controls, December 29, 2008 – A listing of sites with institutional controls in place.
- Emergency Response Notification System, January 30, 2009 – This database is used to store information on the notification of oil discharges and hazardous substance releases. This report is a compilation of data from 1987 to present.
- Hazardous Materials Information Reporting System, January 30, 2009 – This system contains hazardous material spill incidents reported to DOT.
- DOT, Office of Pipeline Safety Incident and Accident Data, February 24, 2009 – DOT incident and accident data.
- Clandestine Drug Labs, October 31, 2008 – A listing of clandestine drug lab locations. Provided by the U.S. Department of Justice, this listing contains addresses of some locations where law enforcement agencies reported chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites.
- U.S. Brownfields, February 10, 2009 – A listing of Brownfields sites.
- Formerly Used Defense Sites (FUDS), December 29, 2008 – Includes locations of FUDS where the U.S. Army Corps of Engineers is actively working or would take necessary cleanup actions.

- Land Use Control Information Systems, March 9, 2009 – Contains records of land use control information pertaining to the former Navy Base Realignment and Closure properties.
- Superfund Consent Decrees, January 19, 2009 – Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites.
- Record of Decision, December 29, 2009 – Record of Decision documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.
- Toxic Release Inventory System List, September 19, 2008 – The Toxic Release Inventory System List identifies facilities that are required to submit annual reports relative to the estimated release of toxic chemicals to the environment.
- Toxic Substance Control Act (TSCA), February 18, 2009 – TSCA identifies manufacturers and importers of chemical substance included on the TSCA Chemical Substance Inventory list.
- Federal Insecticide, Fungicide, and Rodenticide Act/TSCA Tracking System, December 2007 and December 2008 Files – Federal Insecticide, Fungicide, and Rodenticide Act/TSCA Tracking System tracks administrative cases and pesticide enforcement actions and compliance activities related to an Emergency Planning and Community Right-to-Know Act.
- Biennial Reporting System, February 19, 2009 – The Biennial Reporting System is a national system administered by USEPA that collects data on the generation and management of hazardous waste.
- Facility Index System, December 29, 2008 – The Facility Index System is a historical database that identifies facilities and/or locations that are subject to regulation under certain USEPA programs, due to operations conducted at these sites.
- Section Seven Tracking System, December 12, 2008 – Section 7 of the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, requires all registered pesticide-producing establishments to submit a report to USEPA by March 1 each year. Each establishment must report the types and amounts of pesticides, active ingredients, and devices being produced and those having been produced and sold or distributed in the past year.
- Integrated Compliance Information System, January 12, 2009 – This system supports the information of the national enforcement and compliance program, as well as the unique needs of the National Pollutant Discharge Elimination System.
- PCB Activity Database System, January 2, 2009 – This system identifies generators, transporters, commercial storers, and/or brokers and disposers of PCBs who are required to notify USEPA of such activities.
- Material Licensing Tracking System, December 29, 2008 – This system is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites that possess or use radioactive materials and that are subject to Nuclear Regulatory Commission licensing requirements.
- Radiation Information Database, January 30, 2009 – This database contains information about facilities that are regulated by USEPA regulations for radiation and radioactivity.
- RCRA Administrative Action Tracking System, June 2, 2008 – This system contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by USEPA. For administration actions after September 30, 1995, data entry in the database was discontinued.

- Risk Management Plans, February 16, 2009 – When Congress passed the Clean Air Act Amendments of 1990, it required USEPA to publish regulations and guidance for chemical accident prevention at facilities using extremely hazardous substances. The Risk Management Program Rule was written to implement Section 112(r) of these amendments. The rule is built on existing industry codes and standards, and it requires companies of all sizes that use certain flammable and toxic substances to develop a Risk Management Program that includes a hazard assessment that details the potential effects of an accidental release, an accident history of the last 5 years, and an evaluation of worst-case and alternative accidental releases; a prevention program that includes safety precautions and maintenance, monitoring, and employee training measures; and an emergency response program that spells out emergency health care, employee training measures, and procedures for informing the public and response agencies (e.g., fire department) should an accident occur.

Document and File Review

File reviews also included databases that were not a part of the EDR and were obtained from federal and state agencies concerning past, present, and future enforcement actions that could impact the proposed roadway improvement projects. Useful records in regulatory agency files included compliance inspection reports, enforcement notices, and contamination assessment reports. Other databases used in the evaluation included:

- Enforcement and Compliance History Online – This online database helps determine whether compliance inspections have been conducted by USEPA or state/local governments, if violations were detected or enforcement actions were taken, and if penalties were assessed in response to environmental law violations.
- Clean Water Act Significant Non-Compliance (SNC) – The National Pollutant Discharge Elimination System program uses the term SNC. Examples of events that could result in an SNC code include unauthorized discharges; failure of a Publicly Owned Treatment Works to enforce its approved pretreatment program; failure to meet a construction deadline; failure to file a Discharge Monitoring Report; filing a Discharge Monitoring Report more than 30 days late; or violating any judicial or administrative order. Removal of the SNC designation occurs once the facility's Discharge Monitoring Report reports show a consistent pattern of compliance with permit limits or if USEPA or a state agency issues a formal enforcement order to address the violations that resulted in the SNC and the facility has returned to compliance.
- RCRA SNC is a term used to describe a site determined to cause actual exposure or has a substantial likelihood of causing exposure to a hazardous waste or constituent; is a chronic or recalcitrant violator; or deviates substantially from the terms of a permit, order, or agreement, or from RCRA statutory or regulatory requirements. Under the RCRA program, the SNC is removed when the site is in full physical compliance with statutory and/or regulatory requirements.
- High Priority Violations is a term used in the Clean Air Act program. This is the most serious level of violation noted in USEPA databases.

Previous Studies

Several potential contamination sites (e.g., former landfills) are located within the property boundary of DoD lands and are adjacent to the roadway ROW or proximal to the proposed roadway projects. These sites were investigated due to the potential for contamination migration if there is a need for construction dewatering, possibly drawing contaminants toward the proposed roadway improvements.

The reports and studies completed for the Andersen Air Force Base (AFB) Installation Restoration Program (IRP) Management and the Navy Military Munitions Response Program (MMRP), USEPA, GEPA, and other federal and local environmental regulatory programs were reviewed to obtain information on potential contamination sites that are within DoD lands and are adjacent or proximal to the proposed improvements.

The current DoD ROI on Guam for hazardous materials and waste includes Air Force and Navy properties. Air Force properties include Andersen AFB, comprised of the main base, the munitions storage area, and Northwest Field; Andersen Administration Annex (Andersen South); and the Andersen Communications Annex Barrigada site near the Guam International Airport. Navy properties include Naval Base Guam, Naval Computer and Telecommunications Station (NCTS) Finegayan, Finegayan South Housing Area, NCTS Barrigada Transmitter Site, Naval Hospital area, Nimitz Hill, and the Naval Munitions Site.

In 1986, Congress created the Defense Environmental Restoration Program (DERP). The DERP addresses the identification and cleanup of hazardous substances and military munitions remaining from past activities at DoD lands and FUDS. Within the DERP, the DoD created two program categories: the IRP and the MMRP.

On Guam, the USEPA, DoD, and Government of Guam have ongoing cleanup activities of DERP sites. The DoD and State/Territorial Memorandum of Agreement (DSMOA) established a program where GEPA staff work closely with DoD representatives to discuss and facilitate environmental restoration and cleanup work on Guam. Under the DSMOA program, GEPA maintains regulatory oversight of environmental restoration efforts undertaken on Guam by the DoD to ensure compliance with applicable local and federal laws and regulations. The DSMOA oversees the following three DoD programs:

- Base Realignment and Closure – A cleanup program to ensure the environmental suitability of properties planned for subsequent transfer to the Government of Guam.
- IRP – The IRP focuses on cleaning up releases of hazardous substances that pose risks to the public and/or the environment at active, as well as Base Realignment and Closure and FUDS, military sites owned or used by the DoD. The IRP is the main DoD environmental restoration program that covers on base actions, such as the Orote Landfill at Commander Navy Region Marianas, Construction Battalion Landfill at South Finegayan and Landfills # 1 and #2 at NCTS Finegayan, and Andersen AFB CERCLA actions.
- FUDS – A program managed by U.S. Army Corps of Engineers that is designed to clean up military sites that are no longer owned by the U.S. Government.

Munitions Response Program

In September 2001, the DoD established the MMRP to address hazards associated with munitions and explosives of concern (MEC) within areas no longer used for operational range activities. These training areas that are no longer used as operational ranges are called munitions response areas. Munitions response areas often contain one or more discrete munitions response sites (Andersen AFB 2007a). In December 2001, Congress passed the National Defense Authorization Act. This Act required the DoD to develop an initial inventory of areas not located within operational ranges (i.e., active or inactive ranges) that are known or suspected to contain MEC.

As part of this inventory process, the DoD is coordinating with GEPA to conduct preliminary assessments and site inspections of areas of concern on Guam (GEPA 2009). As a result of these efforts, several munitions response areas on Guam have been identified to date. The munitions response areas include, but are not necessarily limited to, the following locations:

- Naval Magazine Small Arms Range
- Spanish Steps Skeet and Trap Ranges
- Orote Point Rifle and Pistol Range
- Naval Computer and Telecommunications Main Station Finegayan Skeet Range
- Naval Computer and Telecommunications Main Station Small Arms Range

Aerial Photography Review

A desktop review of project roadway plans and aerials was conducted (Google Earth 2009).

Web Site Review

Available information on government Web sites was reviewed (OSHA 2006, GEPA 2007, Navy 2007, Andersen AFB 2009).

Field Reviews

Field reviews were conducted by Parsons Brinckerhoff in March/April 2008 and March 2009 to verify locations of potential contamination sites identified in previous reports, and to identify other potential contamination sites not included in previous studies. Since the EDR database reports did not provide exact sites addresses (only zip codes) the identification of potential contamination sites heavily relied on the field review. Project team members walked the properties, where accessible, to identify potential contamination. The sites were evaluated for possible contamination risks to roadway ROW and potential construction activities. Sites were also researched for evidence of documented contamination, apparent changes to the ground surface and landscaping, ground staining, standing liquids, odors, ventilation pipes, drums and other storage containers, and other indications of current or previous petroleum and hazardous materials use and/or storage. Limited telephone and onsite interviews were also conducted.

Potential petroleum and hazardous material sites adjacent to the proposed roadway improvements were identified and accessed when permission was given by the property owners. Potential contamination sites at DoD lands adjacent to the proposed improvements were observed and documented from the roadway ROW. Except for potential contamination sites within DoD lands or sites proximal to DoD lands, site photographs were obtained from potential petroleum and hazardous material sites that would be adjacent to proposed roadway improvements.

18.2.1.2 Determination of Significance

The determination of significance is based on existing hazardous substance management practices, proposed mitigation measures, and expected or potential impacts and environmental consequences with the planned actions. This determination evaluated the overall ability to mitigate or control environmental impacts and consequences to soils, surface water, groundwater, air, and biota. This determination considers current conditions and potential consequences relative to the anticipated ability of the hazardous substance management infrastructure system to accommodate added hazardous substance demand on the overall system. Specifically, for hazardous substances to be considered a significant impact, the following would have to occur:

- Leaks, spills, or releases of hazardous substances to environmental media (i.e., soils, surface water, groundwater, air, and/or biota) resulting in unacceptable risks to human health or the environment.
- Violation of applicable federal, state, or local laws or regulations regarding the transportation, storage, handling, use, or disposal of hazardous substances.

18.2.1.3 Issues Identified during Public Scoping Process

As part of the analysis, concerns related to hazardous materials and waste that were mentioned by the public, including regulatory stakeholders, during the public scoping meetings were addressed. These concerns included:

- Addressing management practices for hazardous substances, including hazardous wastes, toxic substances, hazardous materials, and MEC;
- Describing the potential overall impacts of hazardous substances from construction and operation of proposed projects;
- Identifying the projected hazardous waste types and volumes;
- Identifying expected hazardous substance storage, disposal, and management plans;
- Evaluating measures to mitigate generation of hazardous waste including pollution prevention;
- Discussing how hazardous substances would be managed;
- Discussing the potential for impacts to environmental media from spills, accidents, and/or releases of hazardous substances; and
- Identifying existing installation restoration sites.

18.2.2 Power

Waste Sites

As described in Volume 2, Section 17.1.3; Volume 9, Appendix G; and shown in the various associated figures in Volume 2, Chapter 17, sites are undergoing characterization and/or restoration under various DoD environmental programs. During the project design phases and before construction begins, careful consideration and attention must be given to avoid overlap with these sites. If it is not possible to relocate proposed construction projects that may overlap with these waste sites, then various Best Management Practices (BMPs) and construction operational protocol must be followed to protect human health and the environment. In addition, special design techniques and methodology would be required to ensure the long-term structural integrity of proposed construction projects.

Explosives Safety Hazards

The proposed expansion areas may contain MEC (Naval Facilities Engineering Command [NAVFAC] Marianas 2010). Naval Ordnance Safety and Security Activity (NOSSA) Instruction 8020.15B establishes the Explosive Safety Submission (ESS) process to provide effective review, oversight, and verification of the explosives safety aspects of munitions responses. To comply with this instruction, an islandwide ESS is being prepared (NAVFAC Marianas 2010). When the ESS has been endorsed by NOSSA and approved by the DoD Explosive Safety Board, Standard Operating Procedures (SOPs) and operational protocol would be developed to address explosive safety hazards of MEC in the proposed construction areas (NAVFAC Marianas 2010).

18.2.2.1 Basic Alternative 1 (Preferred Alternative)

Basic Alternative 1 would recondition existing Combustion Turbines (CTs) and upgrade and install some new Transmission and Distribution (T&D) systems within existing utility corridors and would not require enlargement of the existing footprint of the facilities. This work would be undertaken by the Guam Power Authority (GPA) on its existing permitted facilities. Reconditioning would be made to existing permitted facilities at the Marbo, Yigo, Dededo (two units), and Macheche CTs. These CTs are not currently being used up to permit limits and after reconditioning would be used for peaking and reliability reserve power. T&D system upgrades and new lines would be within existing utility corridors and involve both above ground and underground transmission lines. This alternative supports Main Cantonment Alternatives 1 and 2. Main Cantonment Alternatives 3 and 8 would require additional upgrades to the T&D system.

Direct Impacts. As further discussed in Volume 6, Chapters 2 and 3, implementation of the proposed action would require additional power generation at GPA facilities to meet the power demands of the new base, resulting in potential direct impacts. These potential direct impacts are discussed below in terms of potential direct impacts from (1) hazardous materials; (2) toxic substances; and (3) hazardous waste.

<u>Hazardous Materials</u>

The proposed activities for this alternative would use slightly more hazardous materials, particularly from petroleum, oil, and lubricants (POL)/fuels for heavy equipment, vehicles, generators, and related activities. Operation of the upgraded facilities would require POL/fuels, primarily for replacement, repair, or renovation activities. The conventional power plant fuel would be diesel No. 2 fuel.

It is estimated that about 1,500 pounds (lbs) (681 kg) of hazardous materials would be generated annually from reconditioning/upgrade and operational activities. This estimate was based on professional judgment and Defense Reutilization and Marketing Office (DRMO) Guam hazardous material disposal data.

Land-disturbing activities would trigger the requirement to seek coverage under the construction general permit (CGP). A site-specific Stormwater Pollution Prevention Plan (SWPPP) would be prepared and implemented in accordance with the CGP. The SWPPP would identify site-specific BMPs (Volume 2, Chapter 4, Table 4.2.1) that would be implemented as part of Basic Alternative 1 to reduce the potential for erosion, runoff, sedimentation, and subsequent control of hazardous waste impacts.

BMPs and SOPs would be used to:

- Prevent, contain, and/or clean up spills and leaks to protect the human health and environment.
- Provide personnel training and operational protocol and procedures to protect human health and environment.
- As necessary, expand DRMO's sufficient hazardous materials storage, transportation, and disposal capacity prior to any expected increases.
- Protect overall human health, welfare, and the environment.

This alternative would have the potential to result in significant impacts to human health and the environment (i.e., soils, surface water, groundwater, air, and biota). However, these potential impacts would be less than significant through implementation of BMPs and SOPs (see Volume 7) that would include, but not be limited to, the following:

- Update/implement Hazardous Materials Management Plans (HMMPs).
- Update/implement Facility Response plans.

- Update/implement Spill Prevention, Control, and Countermeasures (SPCC) plans (e.g., training, spill containment and control procedures, cleanup, and notifications).
- Ensure that DoD and subcontractor personnel are trained in proper labeling, container, storage, staging, and transportation requirements for hazardous materials. Ensure personnel are trained in accordance with SPCC methods.
- Implement aggressive hazardous materials minimization plans that substitute non-hazardous materials for hazardous materials.
- As necessary, expand DRMO's sufficient hazardous materials storage, transportation, and disposal capacity prior to any expected increases.
- Verify through surveillance and inspections full compliance with federal, state, and local regulations and adherence to DoD requirements. Implement corrective actions, as necessary.
- Minimize the risk of uncontrolled spills and releases through industry-accepted methods for spill prevention, containment, control, and abatement.
- Minimize the use of contaminated sites for new construction. When new projects are planned on sites where contamination and/or MEC has been identified, ensure that the risk of human exposure to contaminated media is minimized through site-specific health and safety plan, engineering and administrative controls, and appropriate personal protective equipment (PPE). In addition, as appropriate, conduct Phase I and II Environmental Site Assessments prior to construction activities and ensure that designs consider and address contaminated sites.
- Ensure that site planning and activities are conducted in accordance with NOSSA Instruction 8020.15B Explosives Safety Review, Oversight, and Verification of Munitions Responses.

BMPs and SOPs are not considered "mitigation measures." Thus, consequences and mitigation tables within this section state that no proposed mitigation measures are identified.

Table 18.2-1 summarizes potential hazardous material impacts associated with reconditioning/upgrade activities and subsequent operations.

Table 18.2-1. Basic Alternative 1 Hazardous Material Consequences and Mitigation

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Proposed Mitigation Measures*
Hazardous materials use during upgrade projects and subsequent operations	• Increased hazardous materials storage, use, handling, generation, and disposal • Increased fueling and POL operations • Possible use of contaminated site footprints for upgrade projects • Potential increased site runoff	• Spill, leak, or release impacts during construction activities • Impacts and increased risks to human health and/or the environment (soils, surface water, groundwater, or air), including terrestrial and ecosystems • Violations of applicable federal, state, or local laws and regulations or DoD requirements during construction and demolition operations	• No proposed mitigation measures are identified

Legend: DoD = Department of Defense; POL = petroleum, oil, and lubricants.

Toxic Substances

Toxic substances being addressed on Guam regardless of any DoD expansion include asbestos-containing materials (ACM), lead-based paint (LBP), polychlorinated biphenyls (PCBs), and radon gas. LBP and PCBs originating in Guam are transported by licensed transporters and disposed of in permitted facilities in accordance with applicable federal, state, and local regulations and DoD requirements. ACM is disposed of at federal facilities on Guam. Most uses of PCBs were banned by the USEPA in 1979 and LBP was banned in 1978. The CTs proposed for upgrade under Basic Alternative 1 were all installed in the 1990s. Additionally, the reconditioning of the CTs would not involve handling of ACM. Therefore, impacts from those toxic substances are not anticipated. However, in the event that these substances are encountered, licensed contractors would be used to ensure that all DoD, federal, state, and local PCBs, ACM, and/or LBP testing, handling, and disposal protocol, procedures, and requirements are followed. Additionally, the proposed alternative would not require any new structure or facility at the GPA owned facilities and would not require radon resistant construction techniques. Therefore, the impacts from toxic substances would be less than significant.

Hazardous Waste

Expected increases in the generation of hazardous wastes are estimated to be relatively small as a result of these upgrade and operation activities. It is estimated that about 750 lbs (341 kg) of hazardous waste would be generated annually from these activities. These wastes are anticipated to include pesticides, herbicides, adhesives, lubricants, solvents, and corrosive liquids. This estimate was based on professional judgment and DRMO Guam hazardous waste disposal data.

Required BMPs and SOPs (see Volume 7) for handling and disposing of these hazardous wastes include, but are not limited to:

- Personnel training;
- Proper use of spill prevention and control plans;
- Implementation of hazardous waste management plans;
- Implementation of the comprehensive Integrated Pest Management Plan (IPMP);
- Avoidance of known areas of contamination and/or MEC;
- Use of site-specific health and safety plans;
- Use of engineering and administrative controls and appropriate PPE when necessary;
- Use of applicable DoD protocol regarding MEC; and
- Proper execution of existing DRMO hazardous waste handling, transportation, use, storage, and disposal protocol.

Therefore, through the use of these BMPs and SOPs, the impacts from the increase in hazardous waste would be less than significant.

Indirect Impacts. Data provided by GPA indicate that there is sufficient power capacity at power plants to meet the power demands from workforce housing and the associated potential population. Increased power demands may result from the workforce housing and its associated population. The potential types of indirect impacts from construction activities and operations associated with the workforce housing and its population would be similar to those described as potential direct impacts. There may be localized needs for power T&D upgrades among the civilian distribution system, but GPA is positioned to provide this service; thus, indirect impacts to the power utility on Guam are deemed less than significant.

18.2.2.2 Summary of Impacts

Table 18.2-2 summarizes the potential impacts of the Basic Alternative 1. A text summary is provided below.

Table 18.2-2. Summary of Potential Hazardous Materials and Waste Impacts-Power

*Basic Alternative 1**
Soils, Surface Water, Groundwater, Air, and/or Biota Impacts (construction and operations impacts would be the same; direct and indirect impacts would be the same)
LSI • Less than significant impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release

Legend: LSI = Less than significant impact. *Preferred Alternative.

In summary, the proposed increased power upgrade and operations would have the potential to result in increased environmental impacts. These potential impacts would result from increased transportation, handling, use, and disposal of hazardous materials and hazardous wastes. It is expected that the largest increases of hazardous materials would result from the use of POL/fuels. However, as per regulatory requirements, various BMPs and SOPs would be used to prevent unintended releases of these substances. These BMPs and SOPs include, but are not limited to, the following:

- Spill prevention control and countermeasures plans;
- Facility response plans;
- Waste management plans;
- SWPPPs;
- Hazardous material/waste management plans;
- Mandatory personnel hazardous material and hazardous waste training;
- Waste minimization plans;
- Waste labeling, storage, packaging, staging, and transportation procedures;
- Adherence with DoD waste management requirements;
- Compliance with federal and territorial laws and regulations; and
- Guarantee that site planning and activities are conducted in accordance with NOSSA Instruction 8020.15B Explosives Safety Review, Oversight, and Verification of Munitions Responses.

Despite expected increases in hazardous materials and hazardous wastes, less than significant impacts are anticipated as long as the BMPs and SOPs discussed above and in Volume 7 would be implemented and related plans and procedures updated and modified as appropriate to meet the potential increased demand on DRMO regarding hazardous substance transportation, handling, storage, use, and disposal. Also, a Joint Military Master Plan provides specific details regarding several new facilities (e.g., operations and maintenance facilities, bilge and oily wastewater pump station, fuel storage areas, POL storage areas, warehousing facilities, munitions magazine storage facilities, hazardous waste storage facilities, waste storage facilities, hazardous material storage). These new facilities would be required to store, handle, and dispose of the estimated increases in hazardous substances that would occur from the potential DoD unit transfers to Guam. Therefore, Basic Alternative 1 would result in less than significant hazardous materials/hazardous waste impacts.

18.2.3 Potable Water

As discussed in Volume 6, Chapter 2, potable water basic alternatives 1 and 2 are not distinguished as interim or long-term as they meet the requirements for both interim and long-term.

Direct Impacts. Potential direct impacts regarding potable water are discussed below in terms of (1) hazardous materials; (2) toxic substances; and (3) hazardous waste.

Waste Sites

As described in Volume 2, Section 17.1.3 and Volume 9, Appendix G and shown in the various associated figures in Volume 2, Chapter 17, there are sites undergoing characterization and/or restoration under various DoD environmental programs. During the project design phases, careful consideration and attention must be given prior to construction to avoid overlap with these sites. If it is not possible to relocate proposed construction projects that may overlap with these waste sites, then various BMPs and construction operational protocol must be followed to protect human health and the environment. In addition, special design techniques and methodology would be required to ensure the long-term structural integrity of proposed construction projects.

Explosives Safety Hazards

The proposed expansion areas may contain MEC (Naval Facilities Engineering Command [NAVFAC] Marianas 2010). NOSSA Instruction 8020.15B establishes the ESS process to provide effective review, oversight, and verification of the explosives safety aspects of munitions responses. To comply with this instruction, an islandwide ESS is being prepared (NAVFAC Marianas 2010). When the ESS has been endorsed by NOSSA and approved by the DoD Explosive Safety Board, SOPs and operational protocol would be developed to address explosive safety hazards of MEC in the proposed construction areas (NAVFAC Marianas 2010).

18.2.3.1 Basic Alternative 1 (Preferred Alternative)

Basic Alternative 1 would provide additional water capacity of 11.3 MGd (42.8 MLd), which is anticipated to be met by an estimated 22 new wells at Andersen Air Force Base (AFB), rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 2.5 MG (9.5 ML) water storage tanks would be constructed at ground level at NCTS Finegayan. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

Hazardous Materials

The proposed activities for this alternative would use slightly more hazardous materials as compared with existing quantities. These increases are expected particularly from POL/fuels for heavy equipment, vehicles, generators, and related activities. Operation of the upgraded facilities would require POL/fuels, primarily for replacement, repair, or renovation activities, and for emergency generators associated with the water facilities. It is estimated that about 750 lbs (341 kg) of hazardous materials would be generated annually from these activities. This estimate was based on professional judgment and DRMO Guam hazardous material disposal data.

Land-disturbing activities would trigger the requirement to seek coverage under the CGP. A site-specific SWPPP would be prepared and implemented in accordance with the CGP. The SWPPP would identify site-specific BMPs (Volume 2, Chapter 4, Table 4.2.1) that would be implemented as part of Basic

Alternative 1 to reduce the potential for erosion, runoff, sedimentation, and subsequent control of hazardous waste impacts.

BMPs and SOPS would be used to:

- Prevent, contain, and/or clean up spills and leaks to protect the human health and environment.
- Provide personnel training and operational protocol and procedures to protect human health and environment.
- As necessary, expand DRMO's sufficient hazardous materials storage, transportation, and disposal capacity prior to any expected increases.
- Protect overall human health, welfare, and the environment.

This alternative would have the potential to result in significant impacts to human health and the environment (i.e., soils, surface water, groundwater, air, and biota), but through implementation of BMPs and SOPs (see Volume 7), the impacts would be less than significant. BMPs and SOPs that would be used include, but are not limited to, the following:

- Update/implement HMMPs.
- Update/implement facility response plans.
- Update/implement SPCC plans (e.g., training, spill containment and control procedures, cleanup, notifications).
- Ensure that DoD and construction subcontractor personnel are trained in proper labeling, container, storage, staging, and transportation requirements for hazardous materials. Ensure personnel are trained in accordance with SPCC methods.
- Implement aggressive hazardous materials minimization plans that substitute non-hazardous materials for hazardous materials.
- As necessary, expand DRMO's sufficient hazardous materials storage, transportation, and disposal capacity prior to any expected increases.
- Verify through surveillance and inspections full compliance with federal, state, and local regulations and adherence to DoD requirements. Implement corrective actions as necessary.
- Verify that proper erosion control methods are used during construction activities. Implement corrective actions as necessary.
- Minimize the risk of uncontrolled spills and releases through industry-accepted methods for spill prevention, containment, control, and abatement.
- Minimize the use of contaminated sites for new construction. When new projects are planned on sites where contamination and/or MEC has been identified, ensure that the risk of human exposure to contaminated media is minimized through site-specific health and safety plan, engineering and administrative controls, and appropriate PPE. In addition, as appropriate, conduct Phase I and II Environmental Site Assessments prior to construction activities and ensure that designs consider and address contaminated sites.
- Ensure that site planning and activities are conducted in accordance with NOSSA Instruction 8020.15B Explosives Safety Review, Oversight, and Verification of Munitions Responses.

Table 18.2-3 summarizes potential hazardous material impacts associated with these upgrade activities and subsequent operations.

Table 18.2-3. Basic Alternative 1 Hazardous Material Construction Consequences and Mitigation

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Proposed Mitigation Measures*
Hazardous materials use during upgrades and subsequent operations	• Increased hazardous materials storage, use, handling, generation, and disposal • Increased fueling and POL operations • Possible use of contaminated site footprints for new projects • Potential increased site runoff	• Spill, leak, or release impacts during upgrade activities • Adverse impacts and increased risks to human health and/or the environment, including terrestrial and marine ecosystems • Violations of applicable federal, state, or local laws and regulations or DoD requirements during construction and demolition operations • Increased risk of contamination of environmental media	• No proposed mitigation measures are identified

Legend: DoD = Department of Defense; POL = petroleum, oil, and lubricants.

Toxic Substances

The primary toxic substances being addressed on Guam regardless of any DoD expansion include ACM, LBP, PCBs, and radon gas. ACM, LBP, and PCBs are not expected to result in additional impacts because LBPs were banned in 1978, most uses of PCBs banned in 1979, and ACM would not be used in new utilities infrastructure facilities.

Radon gas could seep into facilities and/or structures. However, radon resistant construction techniques would be used and DoD would periodically test facilities constructed in known radon zones to verify that no unacceptable radon gas buildup occurs. As appropriate, radon mitigation measures would be installed. Therefore, the impacts from toxic substances would be less than significant.

Hazardous Waste

Expected increases in the generation of hazardous waste are judged to be negligible as a result of these existing potable water upgrade activities. It is estimated that about 375 lbs (171 kg) of hazardous waste would be generated annually from these upgrade and operational activities. These wastes are anticipated to include pesticides, herbicides, adhesives, lubricants, solvents, and corrosive liquids. This estimate was based on professional judgment and DRMO Guam hazardous waste disposal data. No proposed mitigation measures would be required.

Required BMPs and SOPs (see Volume 7) for these hazardous wastes include, but are not limited to:

- Personnel training;
- Proper use of spill prevention and control plans;
- Implementation of hazardous waste management plans;
- Implementation of the comprehensive Integrated Pest Management Plan (IPMP);
- Avoidance of known areas of contamination and/or MEC;
- Use of site-specific health and safety plans;
- Use of engineering and administrative controls and appropriate PPE when necessary;

- Use of applicable DoD protocol regarding MEC; and
- Proper execution of existing DRMO hazardous waste handling, transportation, use, storage, and disposal protocol.

Therefore, through the use of BMPs and SOPs, the impacts from the increase in hazardous waste would be less than significant.

Indirect Impacts. Increased potable water demands may result from the workforce housing and its associated population and relocation induced civilian population growth. The potential types of indirect impacts from construction activities and operations associated with the upgrades to the civilian water utility to meet the needs of the workforce housing and its population and induced civilian population would be similar to those described as potential direct impacts.

18.2.3.2 Basic Alternative 2

Basic Alternative 2 would provide additional water capacity of 11.7 MGd (44.3 MLd), which is anticipated to be met by an estimated 20 new wells at Andersen Air Force Base (AFB) and 11 new wells at Air Force Base Barrigada, rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 1.8 MG (6.8 ML) water storage tanks would be constructed at ground level at NCTS Finegayan and one 1 MG (3.8 ML) water storage tank would be construction at Air Force Base Barrigada. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

Potential impacts to hazardous materials and waste from implementing Basic Alternative 2 would be similar to those discussed under Alternative 1. Estimated quantities of hazardous materials and waste for Alternative 2 would vary less than 2 percent (%) of the Alternative 1 estimates.

18.2.3.3 Summary of Impacts

Table 18.2-4 summarizes the potential impacts of each action alternative. A text summary is provided below.

Table 18.2-4. Summary of Potential Hazardous Materials and Waste Impacts-Potable Water

*Basic Alternative 1**	*Basic Alternative 2*
Soils, Surface Water, Groundwater, Air, and/or Biota Impacts (construction and operations impacts would be the same; direct and indirect impacts would be the same)	
LSI • Less than significant impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release	LSI • The impacts would be the same as for Basic Alternative 1

Legend: LSI = Less than significant impact. *Preferred Alternative.

In summary, the proposed potable water upgrade project would have the potential to result in increased environmental impacts. These potential impacts would result from increased transportation, handling, use, and disposal of hazardous materials and hazardous wastes. It is expected that the largest increases of hazardous materials would result from the use of POL/fuels. Expected increases in the generation of hazardous waste are judged to be negligible, but could include pesticides, herbicides, solvents, corrosive or toxic liquids, and aerosols.

Various BMPs and SOPs are in place to prevent unintended spills, releases, or leaks of these substances (see Volume 7). These BMPs and SOPs include, but are not limited to:

- Spill prevention control and countermeasures plans;
- Facility response plans;
- Waste management plans;
- SWPPPs;
- Hazardous material/waste management plans;
- Mandatory personnel hazardous material/waste training;
- Waste minimization plans;
- Waste labeling, storage, packaging, staging, and transportation procedures;
- Adherence with DoD waste management requirements;
- Compliance with federal and territorial laws and regulations; and
- Guarantee that site planning and activities are conducted in accordance with NOSSA Instruction 8020.15B Explosives Safety Review, Oversight, and Verification of Munitions Responses.

Despite expected increases in hazardous materials and hazardous wastes, the BMPs and SOPs discussed above and in Volume 7 would be implemented and related plans and procedures would be updated and modified as appropriate to meet the potential increased demand on DRMO regarding hazardous substance transportation, handling, storage, use, and disposal. A Joint Military Master Plan provides specific details regarding several new facilities (e.g., operations and maintenance facilities, bilge and oily wastewater pump station, fuel storage areas, POL storage areas, warehousing facilities, munitions magazine storage facilities, hazardous waste storage facilities, waste storage facilities, hazardous material storage). These new facilities would be required to store, handle, and dispose of the estimated increases in hazardous substances that would occur from the potential DoD unit transfers to Guam. Therefore, less than significant impacts would be caused by hazardous materials/hazardous waste for the proposed potable water alternatives.

18.2.4 Wastewater

Waste Sites

As described in Volume 2, Section 17.1.3 and Volume 9, Appendix G and shown in the various associated figures in Volume 2, Chapter 17, there are sites undergoing characterization and/or restoration under various DoD environmental programs. During the project design phases, careful consideration and attention must be given prior to construction to avoid overlap with these sites. If it is not possible to relocate proposed construction projects that may overlap with these waste sites, then various BMPs and construction operational protocol must be followed to protect human health and the environment. In addition, special design techniques and methodology would be required to ensure the long-term structural integrity of proposed construction projects.

Explosives Safety Hazards

The proposed expansion areas may contain MEC (Naval Facilities Engineering Command [NAVFAC] Marianas 2010). NOSSA Instruction 8020.15B establishes the ESS process to provide effective review, oversight, and verification of the explosives safety aspects of munitions responses. To comply with this instruction, an islandwide ESS is being prepared (NAVFAC Marianas 2010). When the ESS has been endorsed by NOSSA and approved by the DoD Explosive Safety Board, SOPs and operational protocol would be developed to address explosive safety hazards of MEC in the proposed construction areas (NAVFAC Marianas 2010).

18.2.4.1 Basic Alternative 1a (Preferred Alternative) and 1b

Basic Alternative 1 (Basic Alternative 1a supports Main Cantonment Alternatives 1 and 2; and Basic Alternative 1b supports Main Cantonment Alternatives 3 and 8) combines upgrade to the existing primary treatment facilities and expansion to secondary treatment at the Northern District Wastewater Treatment Plant. The difference between Basic Alternatives 1a and 1b is a requirement for construction of a new sewer line from Barrigada housing to Northern District Wastewater Treatment Plant for Basic Alternative 1b.

Direct Impacts. Potential direct impacts regarding wastewater are discussed below in terms of (1) hazardous materials; (2) toxic substances; and (3) hazardous waste.

Hazardous Materials

The proposed activities for this alternative would use slightly more hazardous materials, particularly from POL/fuels for heavy equipment, vehicles, generators, and related activities. Operation of the upgraded facilities would require POL/fuels, primarily for replacement, repair, or renovation activities. It is estimated that about 525 lbs (238 kg) of hazardous materials would be generated annually from these upgrade and operational activities. This estimate was based on professional judgment and DRMO Guam hazardous material disposal data. No proposed mitigation measures would be required.

Land-disturbing activities would trigger the requirement to seek coverage under the CGP. A site-specific SWPPP would be prepared and implemented in accordance with the CGP. The SWPPP would identify site-specific BMPs (Volume 2, Chapter 4, Table 4.2.1) that would be implemented as part of Basic Alternative 1 to reduce the potential for erosion, runoff, sedimentation, and subsequent control of hazardous waste impacts.

BMPs and SOPs would be used to:

- Prevent, contain, and/or clean up spills and leaks to protect the human health and environment.
- Provide personnel training and operational protocol and procedures to protect human health and environment.
- As necessary, expand DRMO’s sufficient hazardous materials storage, transportation, and disposal capacity prior to any expected increases.
- Protect overall human health, welfare, and the environment.

This alternative would have the potential to result in less than significant impacts to human health and the environment (i.e., soils, surface water, groundwater, air, and biota) through implementation of BMPs and SOPs (see Volume 7) that would include, but are not limited to:

- Update/implement HMMPs.
- Update/implement Facility Response plans.
- Update/implement SPCC plans (e.g., training, spill containment and control procedures, cleanup, notifications).
- Ensure that DoD and subcontractor personnel are trained in proper labeling, container, storage, staging, and transportation requirements for hazardous materials. Ensure personnel are trained in accordance with SPCC methods.

- Implement aggressive hazardous materials minimization plans that substitute non-hazardous materials for hazardous materials.
- As necessary, expand DRMO's sufficient hazardous materials storage, transportation, and disposal capacity prior to any expected increases.
- Verify through surveillance and inspection that contractors fully implement federal, local, and DoD regulations including the use, storage, treatment, and disposal of hazardous materials. Verify that proper erosion control methods are used during construction activities. Implement corrective actions as necessary.
- Minimize the risk of uncontrolled spills and releases through industry-accepted methods for spill prevention, containment, control, and abatement.
- Minimize the use of contaminated sites for new projects. When new projects are planned on sites where contamination and/or MEC has been identified, ensure that the risk of human exposure to contaminated media is minimized through the use of a site-specific health and safety plan, engineering and administrative controls, and appropriate PPE. In addition, as appropriate, conduct Phase I and II Environmental Site Assessments prior to construction activities and ensure that designs consider and address contaminated sites.
- Ensure that site planning and activities are conducted in accordance with NOSSA Instruction 8020.15B Explosives Safety Review, Oversight, and Verification of Munitions Responses.

Table 18.2-5 summarizes potential hazardous material impacts associated with these upgrade activities and subsequent operations.

Table 18.2-5. Basic Alternative 1 Hazardous Material Construction

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Proposed Mitigation Measures*
Hazardous materials use during upgrade activities and subsequent operations	• Increased hazardous materials storage, use, handling, generation, and disposal • Increased fueling and POL operations • Possible use of contaminated site footprints for new projects • Potential increased site runoff	• Spill, leak, or release impacts during upgrade activities • Adverse impacts and increased risks to human health and/or the environment, including terrestrial and marine ecosystems • Violations of applicable federal, state, or local laws and regulations or DoD requirements during construction and demolition operations • Increased risk of contamination of environmental media	• No proposed mitigation measures are identified

Legend: LSI = Less than significant impact. *Preferred Alternative.

Toxic Substances

The primary toxic substances being addressed on Guam regardless of any DoD expansion include ACM, LBP, PCBs, and radon. ACM, LBP, and PCBs are not expected to result in additional impacts because LBPs were banned in 1978, most uses of PCBs were banned in 1979, and ACM would not be used in new utilities infrastructure facilities.

Radon could seep into the facilities and/or structures. However, radon resistant construction techniques would be used and DoD would periodically test facilities constructed in known radon zones to verify that no unacceptable radon gas buildup occurs. As appropriate, radon mitigation measures would be installed. Therefore, the impacts from toxic substances would be less than significant.

Hazardous Waste

Expected increases in the generation of hazardous wastes are judged to be small as a result of the proposed wastewater facility upgrades. It is estimated that about 160 lbs (73 kg) of hazardous waste would be generated annually from these activities. These wastes are anticipated to include adhesives, lubricants, solvents, and corrosive liquids. This estimate was based on professional judgment and DRMO Guam hazardous waste disposal data. No proposed mitigation measures would be required.

Required BMPs and SOPs (see Volume 7) for these hazardous wastes include, but are not limited to:

- Personnel training;
- Proper use of spill prevention and control plans;
- Implementation of hazardous waste management plans;
- Implementation of the comprehensive Integrated Pest Management Plan (IPMP);
- Avoidance of known areas of contamination and/or MEC;
- Use of site-specific health and safety plans;
- Use of engineering and administrative controls and appropriate PPE when necessary;
- Use of applicable DoD protocol regarding MEC; and
- Proper execution of existing DRMO hazardous waste handling, transportation, use, storage, and disposal protocol.

Therefore, through the use of BMPs and SOPs, the impacts from the increase in hazardous waste would be less than significant.

Indirect Impacts. Increased wastewater demands would result from the workforce housing and its associated population and induced civilian population growth. The potential types of indirect impacts from construction activities and operations associated with upgrades to the GWA wastewater systems to meet the needs of the workforce housing and its population and increased induced civilian population would be similar to those described as potential direct impacts.

18.2.4.2 Summary of Impacts

Table 18.2-6 summarizes the potential impacts of each basic alternative. A text summary is provided below.

Table 18.2-6. Summary of Potential Hazardous Materials and Waste Impacts-Wastewater

*Basic Alternative 1a**	*Basic Alternative 2a*
Soils, Surface Water, Groundwater, Air, and/or Biota Impacts (construction and operations impacts would be the same; direct and indirect impacts would be the same)	
LSI • Less than significant adverse impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release	LSI • Less than significant adverse impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release

Legend: LSI = Less than significant impact. *Preferred Alternative.

In summary, the proposed wastewater project would have the potential to result in increased environmental impacts. These potential impacts would result from increased transportation, handling, use, and disposal of hazardous materials and hazardous wastes. It is expected that the largest increases of hazardous materials would result from the use of POL/fuels. Expected increases in the generation of hazardous waste are judged to be negligible, but could include solvents, corrosive or toxic liquids, and aerosols. However, various BMPs and SOPs are in place to prevent unintended releases, spills, or leaks of these substances and this would result in less than significant impacts. These BMPs and SOPs (Volume 7) include, but are not limited to, the following:

- Spill prevention control and countermeasures plans;
- Facility response plans;
- Waste management plans;
- SWPPPs;
- Hazardous material management plans;
- Mandatory personnel hazardous material and hazardous waste training;
- Waste minimization plans;
- Waste labeling, storage, packaging, staging, and transportation procedures;
- Adherence with DoD waste management requirements;
- Compliance with federal and territorial laws and regulations; and
- Guarantee that site planning and activities are conducted in accordance with NOSSA Instruction 8020.15B Explosives Safety Review, Oversight, and Verification of Munitions Responses.

Despite expected increases in hazardous materials and hazardous wastes, the BMPs and SOPs discussed above and in Volume 7 would be implemented and related plans and procedures would be updated and modified as appropriate to meet the potential increased demand on DRMO regarding hazardous substance transportation, handling, storage, use, and disposal. A Joint Military Master Plan provides specific details regarding several new facilities (e.g., operations and maintenance facilities, bilge and oily wastewater pump station, fuel storage areas, POL storage areas, warehousing facilities, munitions magazine storage facilities, hazardous waste storage facilities, waste storage facilities, hazardous material storage). These new facilities would be required to store, handle, and dispose of the estimated increases in hazardous substances that would occur from the potential DoD unit transfers to Guam. Therefore, there would be less than significant hazardous materials/waste impacts related to the proposed wastewater alternatives.

18.2.5 Solid Waste

18.2.5.1 Basic Alternative 1 (Preferred Alternative)

The Preferred Alternative would be to continue to use the Navy Landfill at Apra Harbor for municipal solid waste (MSW) until the new GovGuam Layon Landfill at Dandan is available for use. Disposal of other waste streams excluded from Layon Landfill would continue at the Navy Landfill. Construction and demolition (C&D) debris would continue to be disposed at the Navy hardfill. This alternative does not involve any construction activities.

Hazardous Materials

Since there would be no construction activities and operations would not differ from current practice, there would be less than significant potential impact in the generation of hazardous materials. The proposed activities would result in the use of approximately the same quantity of hazardous materials. These would include POL/fuels for heavy equipment used in landfill operations, generators, and related activities. Operation of the facilities would require POL/fuels, primarily for replacement, repair, or renovation activities. It is estimated that about 450 lbs (204 kg) of hazardous materials would be generated annually from these operational activities. This estimate was based on professional judgment and DRMO Guam hazardous material disposal data.

However, BMPs and SOPs would be used to do the following:

- Prevent, contain, and/or clean up spills and leaks to protect the human health and environment.
- Provide personnel training and operational protocol and procedures to protect human health and environment.
- As necessary, expand DRMO's sufficient hazardous materials storage, transportation, and disposal capacity prior to any expected increases.
- Protect overall human health, welfare, and the environment.

This alternative would have the potential to result in impacts to human health and the environment (i.e., soils, surface water, groundwater, air, and biota). However, these potential impacts would be less than significant through implementation of BMPs and SOPs (see Volume 7) that would include, but not be limited to, the following:

- Update/implement HMMPs.
- Update/implement facility response plans.
- Update/implement SPCC plans (e.g., training, spill containment and control procedures, cleanup, notifications).
- Ensure that DoD and subcontractor personnel are trained in proper labeling, container, storage, staging, and transportation requirements for hazardous materials. Ensure personnel are trained in accordance with spill prevention, control, and cleanup methods.
- Implement aggressive hazardous materials minimization plans that substitute non-hazardous materials for hazardous materials.
- As necessary, expand DRMO's sufficient hazardous materials storage, transportation, and disposal capacity prior to any expected increases.
- Verify through surveillance and inspection that contractors fully implement federal, local, and DoD regulations including the use, storage, treatment, and disposal of hazardous materials. Verify that proper erosion control methods are used during construction activities. Implement corrective actions as necessary.
- Minimize the risk of uncontrolled spills and releases through industry-accepted methods for spill prevention, containment, control, and abatement.
- Ensure that site planning and activities are conducted in accordance with NOSSA Instruction 8020.15B Explosives Safety Review, Oversight, and Verification of Munitions Responses (Navy 2009).

Table 18.2-7 summarizes potential hazardous material impacts associated with these operations activities.

Table 18.2-7. Hazardous Material Consequences and Mitigation

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Proposed Mitigation Measures*
Hazardous materials use during operations activities	• Continued use hazardous materials storage, use, handling, generation, and disposal • Continued fueling and POL operations	• Adverse impacts and increased risks to human health and/or the environment, including terrestrial and marine ecosystems • Violations of applicable federal, state, or local laws and regulations or DoD requirements • Increased risk of contamination of environmental media	• No proposed mitigation measures are identified

Legend: DoD = Department of Defense; POL = petroleum, oil, and lubricants.

Toxic Substances

The primary toxic substances being addressed on Guam regardless of any DoD expansion include ACM, LBP, PCBs, and radon. ACM, LBP, and PCBs are not expected to result in additional impacts because LBPs were banned in 1978, most uses of PCBs banned in 1979, and ACM would not be used in new utilities infrastructure facilities.

Radon could seep into facilities and/or structures. DoD would periodically test facilities located in known radon zones to verify that no unacceptable radon gas buildup occurs. As appropriate, radon mitigation measures would be installed. Therefore, the impacts from toxic substances would be less than significant.

Hazardous Waste

It is estimated that about 250 lbs (113 kg) of hazardous waste would be generated annually from these activities. These wastes are anticipated to include adhesives, lubricants, solvents, and corrosive liquids. This estimate was based on professional judgment and DRMO Guam hazardous waste disposal data.

Required BMPs and SOPs (see Volume 7) for these hazardous wastes include, but are not limited to:

- Personnel training;
- Proper use of spill prevention and control plans;
- Implementation of hazardous waste management plans;
- Implementation of the comprehensive Integrated Pest Management Plan (IPMP);
- Avoidance of known areas of contamination and/or MEC;
- Use of site-specific health and safety plans;
- Use of engineering and administrative controls and appropriate PPE when necessary;
- Use of applicable DoD protocol regarding MEC; and
- Proper execution of existing DRMO hazardous waste handling, transportation, use, storage, and disposal protocol.

Therefore, the impacts from the increase in hazardous waste would be less than significant.

18.2.5.2 Summary of Impacts

Table 18.2-8 summarizes the potential impacts of Basic Alternative 1. A text summary is provided below.

Table 18.2-8. Summary of Potential Hazardous Materials and Waste Impacts-Solid Waste

*Basic Alternative 1**
Soils, Groundwater, Surface Water, Air, and Biota (no construction impacts, and direct and indirect impacts would be the same) LSI • Less than significant adverse impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release

Legend: LSI = Less than significant impact. *Preferred Alternative.

In summary, the proposed solid waste alternatives would have the potential to result in increased environmental impacts. These potential impacts would result from increased transportation, handling, use, and disposal of hazardous materials and hazardous wastes. It is expected that the largest increases of hazardous materials would result from the use of POL/fuels. Expected increases in the generation of hazardous wastes are judged to be negligible, but could include solvents, corrosive or toxic liquids, and aerosols. However, various BMPs and SOPs are in place to prevent unintended releases, spills, or leaks of these substances that would result in less than significant impacts. These BMPs and SOPs include, but are not limited to, the following:

- Spill prevention control and countermeasures plans;
- Facility response plans;
- Waste management plans;
- SWPPPs;
- Hazardous material/waste management plans;
- Mandatory personnel hazardous material and hazardous waste training;
- Waste minimization plans;
- Waste labeling, storage, packaging, staging, and transportation procedures;
- Adherence with DoD waste management requirements;
- Compliance with federal and territorial laws and regulations; and
- Guarantee that site planning and activities are conducted in accordance with NOSSA Instruction 8020.15B Explosives Safety Review, Oversight, and Verification of Munitions Responses.

Despite expected increases in hazardous materials and hazardous wastes, the BMPs and SOPs discussed above and in Volume 7 would be implemented and related plans and procedures would be updated and modified as appropriate to meet the potential increased demand on DRMO regarding hazardous substance transportation, handling, storage, use, and disposal. A Joint Military Master Plan provides specific details regarding several new facilities (e.g., operations and maintenance facilities, bilge and oily wastewater pump station, fuel storage areas, POL storage areas, warehousing facilities, munitions magazine storage facilities, hazardous waste storage facilities, waste storage facilities, hazardous material storage). These new facilities would be required to store, handle, and dispose of the estimated increases in hazardous substances that would occur from the potential DoD unit transfers to Guam. Therefore, there would be less than significant hazardous materials/hazardous waste impacts.

18.2.6 Off Base Roadways

The proposed roadway, bridge, and intersection improvements may involve the use of hazardous materials and the generation of hazardous materials and hazardous wastes. Waste can be generated during bridge demolition, bridge construction and painting, roadway pavement markings, wall and fence painting, construction equipment/machinery maintenance and repair, and demolishing of structures acquired from ROW acquisition, and from excavation of materials containing hazardous substances. The following discussion of hazardous materials use and hazardous waste generation applies to all of the action alternatives.

Potential hazardous materials associated with roadway and bridge construction include, but are not limited to, the following:

- Product paint for bridges, poles, fences, walls, and roadway pavement markings
- Penetrating sealer (i.e., Methaylmethacrylate), modified mortar, and litex
- Coal tar epoxy for injecting in cracks
- Painting equipment cleaning solvents
- Diesel fuel contained in aboveground storage tanks to fuel construction equipment
- Unleaded gasoline contained in aboveground storage tanks to fuel vehicles
- Engine solvents and degreasers
- Motor oil, gear oil, and other engine lubricants
- Potentially hazardous dredged material
- Potentially hazardous drill cuttings

Potential hazardous substances generated by roadway and bridge construction include, but are not limited to, the following:

- Excavated underground storage tanks containing POL
- Excavated electrical transformers and capacitors containing PCBs
- Petroleum-contaminated soil and groundwater
- Asbestos and ACMs
- Sandblasting wastes not determined to be hazardous wastes
- Potentially hazardous dredged material not determined to be hazardous wastes
- Potentially hazardous drill cuttings not determined to be hazardous wastes

Potential hazardous wastes that could be generated from roadway and bridge construction include:

- Waste paint
- Paint and sealant removal wastes
- Waste paint cleaning solvents and rags
- Waste fuel removed from machinery
- Waste engine solvents and degreasers
- Used oil and lubricants
- Waste antifreeze

The management, use, and storage of these hazardous materials and hazardous wastes on roadway projects are governed under the provisions of the American Association of State Highway and Transportation Officials (AASHTO) Guidelines for Painting Structures (1997), AASHTO Standard Specifications for Transportation Material and Method of Sampling and Testing (2005), and AASHTO Policy on Geometric Design of Highways and Streets, Maintenance of Traffic Through Construction Areas (2001).

The management, storage, and disposal of hazardous wastes are regulated under the USEPA RCRA and Hazardous and Solid Waste Amendments, and are enforced by the GEPA Hazardous Waste Management Program (USEPA 1997, 2005, 2007, 2008a, 2008b; Andersen AFB 2007b).

Hazardous materials disposal and the disposal of POL, PCBs, ACMs, and other hazardous substances are regulated by GEPA.

With implementation of BMPs and SOPs (see Volume 7), impacts would be less than significant for hazardous materials used and hazardous wastes generated during roadway construction.

Of the 123 potentially contaminated sites on Guam, 17 sites were identified as having known or likely soil and/or water contamination within, or adjacent to, the Guam Road Network (GRN) project areas. The 17 sites were shown by region in figures located in Volume 2, Chapter 17. Detailed information on each of the 123 sites is provided in Volume 9, Appendix G.

To identify the potential environmental impacts from contaminated sites on GRN project construction, the nature of each GRN project activity in the affected area was considered. A key factor in determining the potential for environmental effects was the specific type of roadway project that would occur in a given area where known or likely soil or groundwater contamination may be present.

Each of the four action alternatives would result in construction and operation of a set of individual roadway improvement projects on Guam. Implementation of each alternative would result in construction activities in each of the four geographic regions. Construction activities would consist of intersection improvements, bridge replacements, pavement strengthening, road relocation, road widening, and construction of a new road. While many projects would involve construction work in developed and paved areas, some roadway projects could result in soil intrusion that could encounter areas of contamination. Because all roadway project types would generally require construction activities that would involve the use of heavy construction equipment, the potential for leaks or spills of potentially hazardous materials would be common for all project types. A preliminary screening of project types and potential effects from contaminated soil or groundwater is provided in Table 18.2-9.

Table 18.2-9. Potential Effects from Contaminated Soils for GRN Roadway Project Types

Item	*Project Type*	*Description of Construction Activities*	*Potential Effect from Contaminated Soils*
1	Intersection Improvement (including MAPs)	Installation of new traffic loop sensors, extending lanes through the intersection, striping and paving to include new approach or turn lanes, reconfiguring intersection shapes (i.e., from Y-intersection to T-intersections), combining lanes, creating shared lanes, restriping, signalization modifications or upgrades, and grade separations.	Generally, intersection improvement would not result in contact with subsurface soils. The potential for impacts from contaminated soils would be present only when reconfiguration or grade separations include excavation, trenching, or grading into the subsoil.
2	Bridge and Box Culvert Replacement	Bridge and box culvert replacement would be conducted in phases. The new bridge structure would be lengthened to adequately accommodate the hydraulic flow of the river. The width of the new structure would accommodate more or wider lanes and a median, with sidewalks and barriers on each side. Box culverts would be replaced with new single-cell or multi-cell box culverts.	Bridge and box culvert replacement can include excavation, trenching, or grading into the subsoil. Soils would be affected when foundation work requires excavation beneath the existing bridge structure and utility work would require new trenching. No ROW acquisition would be required because bridges and box culverts would be replaced within their existing footprints.

Item	*Project Type*	*Description of Construction Activities*	*Potential Effect from Contaminated Soils*
3	Pavement Strengthening	Existing asphalt pavement sections would be strengthened by rehabilitating the existing pavement materials in place and placing an asphalt overlay or by reconstructing with new materials. The widened pavement section would be constructed of residual material from the existing pavement rehabilitation, new material, or a combination thereof, and an asphalt overlay. Pavement strengthening would also include matching existing access connections, pavement striping, signing, intelligent traffic systems, and safety lighting. The project would match existing horizontal and vertical alignment as required. Minor realignment of the road may be necessary to accommodate design elements.	Physical disturbance to soils from pavement strengthening would only occur when pavements are widened, new traffic systems or devices are installed, or minor road realignment occurs in previously undisturbed ground. Most activities associated with pavement strengthening would not require soil intrusion. For this reason, the potential for impacts from contaminated sites is considered to be low.
4	Road Relocation (Route 15 only)	Route 15 would be realigned to accommodate the location of military firing ranges. New asphalt pavement would be constructed on the new alignment. The roadway cross section would consist of one lane in each direction, outside shoulders and inside shoulders, with an unpaved median that would accommodate future widening. Bicycles would be accommodated in the outside shoulders of the shared roadway. Alternatively, future widening would be accommodated to the outside, and the roadway cross section would consist of two lanes and outside shoulders with a paved median. Realignment would also include construction of new bridges to grade separate Route 15 and the frontage roads, obliterating existing Route 15 pavement, building removal, connecting to existing roadways or other access roads, utility relocation, pavement striping, signing, property fence, and guardrail installation.	Realignment into previously undisturbed soils may be required to accommodate the design of the roadway. This activity would require building removal and relocation of existing utilities. For this reason, there is a potential for impacts from contaminated sites in the area.
5	Road Widening	New lanes would be added to an existing roadway to accommodate predicted increased traffic volumes and to relieve congestion caused by an increase in traffic volumes due to military relocation activities. Widening would result in rebuilding the entire roadway, including removing the existing roadway segment. A new sub-base, base course, asphalt, and friction course layers would be constructed.	Road widening activities would affect soil when the footprint of the roadway extends into previously undisturbed soils. For this reason, there is a potential for impacts from contaminated sites in the area.
6	Construction of New Road	The Finegayan Connection would be constructed on a new alignment with new asphalt pavement on a compacted base or engineered fill.	New road construction would affect soil when the footprint of the roadway extends into previously undisturbed soils. For this reason, there is a potential for impacts from contaminated sites in the area.

Item	*Project Type*	*Description of Construction Activities*	*Potential Effect from Contaminated Soils*
7	Other	Temporary placement of equipment laydown or construction staging areas may be required.	Equipment laydown or construction staging areas associated with any of the above project types may require clearing and other disturbance of soils. For this reason, there is a potential for impacts from contaminated sites in the area.

Legend: MAP = Military Access Point; ROW = right-of-way.

Potential impacts from hazardous waste contamination in soil or groundwater can be detrimental to roadway construction activities. While it is unlikely that groundwater contamination would lead to direct impacts to roadway construction at the ground level, contaminated soil may require removal or remediation. Direct impacts that result in physical soil loss could occur during construction, while indirect impacts can result from the completed project (e.g., contaminants leach into soils). Based on the anticipated activities associated with each project type, it was determined that:

- Intersection improvements and pavement strengthening projects represent the project types with the lowest potential for impacts from hazardous waste contamination in soil or groundwater. Bridge replacement projects using the same footprint for footings and other structures (i.e., no additional ROW required) would also represent a low potential for impacts. These projects would involve the least amount of physical soil disturbance because most work would occur on existing pavements or developed areas.
- The placement of temporary equipment laydown areas at any of the GRN project work sites would represent a moderate potential for impacts from hazardous waste contamination in soil or groundwater only when the use of previously undisturbed areas are selected. To avoid this impact, previously disturbed (e.g., paved) areas adjacent to the work site would be selected for use as temporary construction staging areas or storage for roadway demolition materials whenever possible. Heavy equipment would be used, and leaks or spills of contaminants could occur at equipment staging areas.
- Road relocation, road widening, and construction of the new road would represent the greatest potential for impacts from hazardous waste contamination in soil or groundwater because these projects would result in the greatest degree of soil intrusion.

Certain proposed roadway improvements in the North and Central Regions would require the acquisition of additional ROW on residential, business, or military land (refer to Volume 6, Chapter 17). The potential for contamination would vary depending on the type of land to be acquired. In some cases, it is possible that the likelihood of contamination may be greater beneath certain business properties than beneath residential properties. The potential for contaminant migration to the roadway ROW would require further assessment after alignment selection to determine the actual presence and/or levels of contamination and the possible need for remedial action. Roadway projects with ROW acquisition may require actions, such as avoidance or minimization during the design phase and before construction.

Indirect impacts from the roadway projects would be associated with contaminants leaching into soils. The potential for contaminants leaching into the soil would be prevented or managed through implementation of spill prevention and emergency spill response procedures.

18.2.6.1 Alternative 1

Roadway projects can be affected by contaminated sites that are in close proximity to the roadway alignments. There are 49 projects that would occur as a result of implementation of Alternative 1. The effects of potentially contaminated sites to these projects are discussed below.

North

Alternative 1 includes 13 projects in the North Region. GRN #8, 10, and 22A are adjacent or proximal to four potentially contaminated sites (Site Nos. 1, 8, 9, and 13). GRN #8 and 22A are pavement strengthening projects, with minimal potential for soil intrusion. Partial ROW acquisition would be required for GRN #22A.

GRN #10 is a road widening project that would require partial ROW acquisition along Route 3. Due to potential contamination from Site No. 8 (Potts Junction Tank Farm), avoidance measures would be required to ensure that construction does not occur on contaminated soil or is managed to avoid ongoing remediation efforts to the maximum extent possible.

Roadway projects in the North Region also include intersection improvements and construction of a new road. Although no known contaminated sites have been identified near any of these projects, some projects may require ROW acquisitions, and temporary construction staging areas may require soil intrusion. Due to the need for ROW acquisition and/or soil intrusion at these project locations, avoidance measures would be required to ensure that construction does not occur on contaminated soil or is managed to avoid ongoing remediation efforts to the maximum extent possible.

Central

Alternative 1 includes 27 projects in the Central Region. GRN #6, 13, 15, 17, and 33 are adjacent or proximal to eight potentially contaminated sites (Site Nos. 14, 25, 33, 44, 47, 57, 58, and 62). All of these GRN projects are pavement strengthening projects with minimal potential for soil intrusion. Partial ROW acquisition would be required for GRN #13, 17, and 33.

Roadway projects in the Central Region also include intersection improvements, bridge replacements, road relocations, and road widening. Although no known contaminated sites have been identified near any of these projects, some projects may require ROW acquisitions, and temporary construction staging areas may require soil intrusion. For these reasons, avoidance measures would be required to ensure that construction does not occur on contaminated soil or is managed to avoid ongoing remediation efforts to the maximum extent possible.

Apra Harbor

Alternative 1 includes five projects in the Apra Harbor Region. GRN # 4 and 26 are adjacent or proximal to five potentially contaminated sites (Site Nos. 111, 113, 114, 117, and 118). GRN #4 and 26 are pavement strengthening projects, with minimal potential for soil intrusion. Partial ROW acquisition would be required for both of these GRN projects.

Roadway projects in the Apra Harbor Region also include intersection improvements that would have a low potential for ground intrusion. No ROW acquisition would be required for any projects in the Apra Harbor Region. Avoidance measures would be required only for temporary construction staging areas to ensure that construction does not occur on contaminated soil or is managed to avoid ongoing remediation efforts to the maximum extent possible.

South

Alternative 1 includes four projects in the South Region. No potentially contaminated sites of concern were identified in the South Region. The roadway projects in the South Region are not located in areas where potentially contaminated sites exist or would have influence on the proposed roadway improvements.

Roadway projects in the South Region are limited to pavement strengthening and intersection improvements that would have a low potential for ground intrusion. No ROW acquisition would be required for any projects in the South Region. Avoidance measures would be required only for temporary construction staging areas to ensure that construction does not occur on contaminated soil or is managed to avoid ongoing remediation efforts to the maximum extent possible.

Proposed Mitigation Measures, BMPs, and SOPs

BMPs and SOPs (Volume 7) to avoid or minimize the impact of hazardous substances and/or MEC to less than significant include, but are not limited to, the following:

- Spill prevention control and countermeasures plans;
- Facility response plans;
- Waste management plans;
- SWPPP;
- Hazardous material/waste management plans;
- Mandatory personnel hazardous material and hazardous waste training;
- Waste minimization plans;
- Waste labeling, storage, packaging, staging, and transportation procedures;
- Adherence with DoD waste management requirements;
- Compliance with federal and territorial laws and regulations; and
- Guarantee that site planning and activities are conducted in accordance with NOSSA Instruction 8020.15B Explosives Safety Review, Oversight, and Verification of Munitions Responses.
- These BMPs and SOPs also include, but are not limited to, the following:
- Roadway construction contractors shall be required to manage, store, and dispose of hazardous wastes in accordance with applicable USEPA RCRA and Hazardous and Solid Waste Amendments requirements.
- Roadway construction contractors shall be required to dispose of all POL, PCBs, ACMs, and other hazardous substances in accordance with GEPA regulations.
- A Phase 2 environmental site assessment may be conducted for ROW acquisition associated with GRN #10 (road widening along Route 3 – NCTS Finegayan to Route 9) to determine potential contamination in the vicinity of the Potts Junction Tank Farm. The construction contractor may be required to implement avoidance measures to ensure that construction (a) does not occur on contaminated soil; and (b) is managed to avoid any ongoing remediation efforts to the maximum extent possible.
- A Phase 2 environmental site assessment may be conducted for roadway projects with ROW acquisitions of non-residential property. Roadway construction shall be conducted in accordance with the recommendations of the Phase 2 environmental site assessment. Depending on the extent of contamination at a specific site, excavation and removal of soil

and/or groundwater contamination may be required before roadway construction can commence.

- Final design of roadway projects may include an evaluation of potential contamination for the following categories: (1) intersection improvements and pavement strengthening projects that require ROW acquisition of non-residential property; (2) intersection improvement projects that require reconfiguration or grade separation involving excavation, trenching, or grading into the subsoil; (3) bridge replacement projects that require excavation, trenching, or grading into the subsoil and exceeds the existing footprint of the bridge structure; (4) pavement strengthening that occurs in previously undisturbed ground; (5) road realignment into previously undisturbed soils or that requires building removal and/or relocation of utilities; (6) road widening activities that require a change or enlargement of the footprint of the roadway or that extends into previously undisturbed soils; (7) new road construction that would affect soil when the footprint of the roadway extends into previously undisturbed soils; and (8) new road construction that extends into previously undisturbed soils or requires ROW acquisition.
- Final roadway design would avoid known contaminated sites and/or MEC wherever possible. Avoidance may involve adjustments to the roadway design to completely avoid a contaminated site. Minimization may involve adjustments of the proposed roadway alignment to reduce the resultant ROW acquisition.
- Final roadway design may include coordination with the responsible party to ensure that roadway construction does not interfere with ongoing remediation activities.
- Temporary equipment laydown or construction staging areas would be located in previously disturbed (e.g., paved) areas.
- To prevent leaks or spills of contaminants, all temporary equipment laydown or construction staging areas would be constructed with secondary containment for storage of any hazardous or petroleum products.

With implementation of the above BMPs and SOPs (Volume 7) for contaminated sites, impacts from hazardous materials and wastes for Alternative 1 would be less than significant.

18.2.6.2 Alternative 2 (Preferred Alternative)

There are 49 projects that would be constructed as a result of Alternative 2. The effects of potentially contaminated sites to these projects are discussed below.

<u>North</u>

Alternative 2 includes 13 projects in the North Region. The effects of potentially contaminated sites are similar to those for the North Region of Alternative 1.

<u>Central</u>

Alternative 2 includes 27 projects in the Central Region. The effects of potentially contaminated sites are similar to those for the Central Region of Alternative 1.

Apra Harbor

Alternative 2 includes five projects in the Apra Harbor Region. The effects of potentially contaminated sites are similar to those for the Apra Harbor Region of Alternative 1.

South

Alternative 2 includes four projects in the South Region. The effects of potentially contaminated sites are similar to those for the South Region of Alternative 1.

Proposed Mitigation Measures, BMPs, and SOPs

Potentially contaminated sites that would be associated with Alternative 2 are the same as those listed for Alternative 1. BMPs and SOPs (Volume 7) used to avoid or minimize the impact of potentially contaminated sites to less than significant would be similar to those identified for Alternative 1.

18.2.6.3 Alternative 3

There are 51 projects in Alternative 3. The effects of potentially contaminated sites to these projects are discussed below.

North

Alternative 3 includes 11 projects in the North Region. The effects of potentially contaminated sites are similar to those for the North Region of Alternative 1.

Central

Alternative 3 includes 31 projects in the Central Region. The effects of potentially contaminated sites are similar to those for the Central Region of Alternative 1, with the exception of Site Nos. 64, 65, and 66 that are associated with GRN #20 and 31.

Apra Harbor

Alternative 3 includes five projects in the Apra Harbor Region. The effects of potentially contaminated sites are similar to those for the Apra Harbor Region of Alternative 1.

South

Alternative 3 includes four projects in the South Region. The roadway projects in the South Region are not located in areas where potentially contaminated sites exist or would have influence on the proposed roadway improvements. The effects of potentially contaminated sites are similar to those for the South of Alternative 1.

BMPs and SOPs

Potentially contaminated sites that would be associated with Alternative 3 are the same as those listed for Alternative 1. BMPs and SOPs (Volume 7) used to avoid or minimize the impact of potentially contaminated sites would be similar to those identified for Alternative 1.

18.2.6.4 Alternative 8

There are 50 projects in Alternative 8. The effects of potentially contaminated sites to these projects are discussed below.

North

Alternative 8 includes 13 projects in the North Region. The effects of potentially contaminated sites are similar to those for the North Region of Alternative 1.

Central

Alternative 8 includes 28 projects in the Central Region. The effects of potentially contaminated sites are similar to those for the Central Region of Alternative 1.

Apra Harbor

Alternative 8 includes five projects in the Apra Harbor Region. The effects of potentially contaminated sites are similar to those for the Apra Harbor Region of Alternative 1.

South

Alternative 8 includes four projects in the South Region. The effects of potentially contaminated sites are similar to those for the South Region of Alternative 1.

BMPs and SOPs

Potentially contaminated sites that would be associated with Alternative 8 are the same as those listed for Alternative 1. BMPs and SOPs (Volume 7) used to avoid or minimize the impact of potentially contaminated sites would be similar to those identified for Alternative 1.

18.2.6.5 Summary of Impacts

Table 18.2-10 summarizes the potential impacts of each alternative.

Table 18.2-10. Summary of Potential Hazardous Materials and Waste Impacts-Roadway Project

Potentially Impacted Resource	*Alternative 1*	*Alternative 2**	*Alternative 3*	*Alternative 8*
Leaks and spills of hazardous materials can leach into soils	LSI	LSI	LSI	LSI
Roadway construction adversely affected by contaminated soil and/or groundwater	LSI	LSI	LSI	LSI

Legend: LSI = Less than significant impact. *Preferred Alternative.

In summary, the proposed roadway projects would have the potential to result in increased environmental impacts. These potential impacts would result from increased transportation, handling, use, and disposal of hazardous materials and hazardous wastes. It is expected that the largest increases of hazardous materials would result from the use of POL/fuels. Expected increases in the generation of hazardous waste would include solvents, sealants, paints, degreasers, corrosive or toxic liquids, and aerosols. However, through the use of BMPs and SOPs discussed in this chapter and in Volume 7, the impacts would be less than significant.

18.2.6.6 Summary of Proposed Mitigation Measures

Table 18.2-11 summarizes the proposed mitigation measures for roadway projects impacts on hazardous materials and waste. BMPs and SOPs are not considered “mitigation measures;” thus, no proposed mitigation measures are identified.

Table 18.2-11. Summary of Proposed Mitigation Measures for Roadway Projects Impacts on Hazardous Materials and Waste

Phase	*Proposed Mitigation Measures*
Construction	No proposed mitigation measures are identified
Operation	No proposed mitigation measures are identified

CHAPTER 19.
PUBLIC HEALTH AND SAFETY

19.1 INTRODUCTION

This chapter discusses the potential effects to public health and safety (i.e., disease, mental illness, traffic incidents, unexploded ordnance [UXO], and power plant fuel sources [i.e., Liquefied Natural Gas, Diesel Fuel No. 2, and/or No. 6 Fuel Oil]) from implementation of the alternatives within the region of influence as they relate to utilities and roadways.

19.2 ENVIRONMENTAL CONSEQUENCES

This chapter discusses the potential effects to public health and safety (i.e., disease, mental illness, traffic incidents, UXO, and fuel sources) from implementation of the alternatives within the region of influence (i.e., on Guam).

19.2.1 Approach to Analysis

19.2.1.1 Methodology

<u>Utilities</u>

Proposed utility projects are considered "related actions" in that they would be implemented as a result of the overall proposed action (i.e., relocation of Marines to Guam [Volume 2], Navy aircraft carrier berthing [Volume 4], and Army Air and Missile Defense Task Force [Volume 5]).

The analysis of potential public health and safety impacts identified for proposed utility improvements are driven primarily by anticipated population increases on Guam; therefore, potential impacts would be the same if any of the alternatives were implemented, and the term "All Alternatives" is used during the presentation of the analysis in this chapter.

The U.S. Department of Defense (DoD) acknowledges the existing sub-standard conditions of utility infrastructure systems on Guam and the desire by many for the DoD to fund improvements to these systems and services. The DoD also recognizes the constraints on the Government of Guam (GovGuam) to be able to address these indirect impacts of the proposed military relocation. The GovGuam has identified the need for $1.3 billion (B) in funding to implement necessary water and wastewater infrastructure improvements that must be accomplished in the first 5 years to accommodate the military relocation. The Council on Environmental Quality has facilitated interagency meetings with the DoD and appropriate federal agencies to identify funding sources to meet this need. The DoD is seeking approximately $580 million from the Government of Japan (GoJ) for water and wastewater improvement projects pursuant to the terms of the Realignment Roadmap Agreement, described in Volume 1. The Economic Adjustment Committee (EAC) is evaluating overall Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD military relocation. As part of this evaluation the EAC is specifically examining federal funding options for water and wastewater infrastructure improvements that may not be funded through GoJ financing.

Potential effects to public safety from implementation of the proposed utility projects were derived based on information detailed in the descriptions of each alternative. Regarding personnel relocation to Guam, public health and safety concerns were addressed based on anticipated changes in the population of

Guam, both from natural increases and from military personnel and their dependents moving to Guam. Average per capita incidents of notifiable diseases, mental illness, and traffic accidents were used to calculate the potential increase in these incidents as a result of the utility projects. Safety of construction workers would be the same as outlined in Volume 2. Proposed construction activities supporting utilities improvements would be conducted in accordance with federal and local safety guidelines to ensure a safe work environment.

With construction activities, there is a potential for standing water and water based vectors, such as mosquitoes and related diseases. Most mosquitoes require standing water or moist soil where flooding occurs to lay their eggs. Removing standing water sources and promoting drainage would eliminate potential breeding sites. In compliance with Guam Code Annotated (10 GCA 36-Mosquito Control), the following Best Management Practices (BMPs) would be implemented: limit standing water at construction sites, stagnant water pools, puddles, and ditches would be drained or filled; containers that catch/trap water (e.g., buckets, old tires, cans) would be removed; and if necessary, pesticide application (e.g., *Bacillus thuringensis*) could be used to help control mosquitoes. Implementing these BMPs would reduce the opportunities for an outbreak of water-related diseases.

Analysis of the public health and safety concerns that are directly associated with the overall proposed action (i.e., relocation of Marines to Guam [Volume 2], Navy aircraft carrier berthing [Volume 4], and Army Air and Missile Defense Task Force [Volume 5]) can be found in those respective Volumes. This chapter analyzes potential health and safety impacts that are specific to proposed utility projects that would be implemented to support the military relocation.

Both direct impacts (i.e., effects from the construction and operation of utilities provided for the new military facilities on base) and indirect impacts (i.e., effects that occur off base from the influx of construction workers and an induced population) are described in this chapter. For more information on direct and indirect impacts, see Volume 6, Chapter 1.

Potential health and safety concerns from direct impacts of proposed utilities projects result primarily from ground-disturbing activities and from demands on public utility systems and their associated operations. Information regarding the possible presence of UXO was obtained from various military (e.g., various Navy and U.S. Army Corps of Engineers UXO records) and public sources (e.g., newspaper accounts). Information specific to the proposed movement of Marines to Guam was obtained from military sources.

Potential health and safety concerns from indirect impacts of proposed utilities projects result primarily from the demands placed on public utility systems and their associated operations from construction workforce housing and from housing and development resulting from the induced population that is expected to migrate to Guam because of the economic growth brought about by the military relocation.

Roadways

Public health and safety concerns associated with the proposed roadway projects were identified based on the potential for the improved roadway network to have the following effects:

- Substantially increase the risk of exposure to air pollutants from increased use of roadways
- Affect the frequency of automobile accidents
- Increase the risk of exposure to UXO

The risk of exposure to air pollutants from vehicular sources that would use the new roadways is a health concern. Impacts of the Guam Road Network (GRN) project on air quality are addressed in Volume 6, Chapter 7. Air pollutant emissions from the GRN project were evaluated in comparison to primary national ambient air quality standards established to protect human health, as well as secondary standards to protect the environment.

19.2.1.2 Determination of Significance

Factors considered in determining whether an alternative would have a significant public safety impact include the extent or degree to which implementation of the utility projects would subject the public to increased risk of contracting a disease or experiencing personal injury. The significance determination evaluated the overall ability to mitigate or control potential public health and safety impacts and consequences from proposed utility infrastructure improvements. Significant impacts that cannot be avoided would be mitigated to less than significant levels to the extent possible.

Public health and safety impacts as a result of the proposed roadway improvement projects are assessed following Federal Highway Administration Guidance for Preparing and Processing Environmental and Section 4(f) Documents (Federal Highway Administration 1987).

19.2.1.3 Issues Identified during Public Scoping Process

The following analysis focuses on possible effects to public health and safety that could be impacted by the proposed utility and roadway projects. As part of the analysis, concerns related to public health and safety that were mentioned by the public, including regulatory stakeholders, during the public scoping meetings were addressed. The following public health and safety concerns were raised during public scoping meetings regarding the proposed relocation of military and civilian personnel to Guam:

- Acquired Immune Deficiency Syndrome
- Cholera
- Dengue
- Hepatitis C
- Malaria
- Measles
- Rubella
- Sexually Transmitted Diseases other than Acquired Immune Deficiency Syndrome
- Tuberculosis
- Typhoid fever
- Potential increases in mental illness
- Potential increases in traffic incidents
- Potential contact with UXO

19.2.2 Power

As discussed in Volume 6, Chapters 2 and 3, implementation of the proposed action would require additional power generation at Guam Power Authority (GPA) facilities to meet the power demands of the new base, resulting in direct impacts.

Direct Impacts. Additional power generation demands from new DoD facilities can be met using current capacities at existing power plants, which are currently permitted under the Clean Air Act to allow for resulting increased emissions. The DoD proposes to recondition existing GPA Combustion Turbines (CTs) that serve as peaking units and as backup facilities to ensure a reliable power supply is available on Guam. No monitoring data for ambient background air quality exists for Guam that could be used to compare against expected changes in air quality from the military relocation. Therefore, the existing background air quality conditions around Guam are defined based on the current ambient air quality attainment status condition applicable for Guam:

- Attainment for all criteria pollutants, except for sulfur dioxide (SO_2)
- Two SO_2 nonattainment areas with a 2.2 mile (3.5 kilometers) radius around the Piti and Tanguisson power plants

Guam is exempt from using fuel with a low sulfur content. Therefore, the power generation facilities' use of fuel with a high sulfur content is anticipated to be the primary cause of the current SO_2 nonattainment designation for the two areas. The Cabras/Piti power plant maintains an automated system to switch to low sulfur fuel when the wind direction is from the west (onshore). Once the wind direction has shifted, the fuel source is switched manually back to high sulfur fuel. There is a stakeholder effort led by the Guam Environmental Protection Agency (GEPA) and U.S. Environmental Protection Agency (USEPA) Region 9 to switch from high sulfur diesel (5,000 parts per million [ppm]) to ultra low sulfur diesel (ULSD) (10 to 15 ppm) for use in diesel vehicles and in CTs on Guam. This move to ULSD would result in cleaner emissions from CTs and other applications using diesel. This effort is supported by the GPA and the DoD. However, several logistics, economics, contracts, and regulatory issues are ongoing and must be resolved before an islandwide switch to ULSD can be accomplished by the end of 2012. The stakeholders are also considering an interim move to low sulfur diesel (500 ppm). Until this happens, this chapter assumes the continued use of high sulfur diesel. This chapter does not include a detailed assessment of the benefits that could be realized to public health from a transition in the type of diesel.

The air quality analysis provided in Volume 6, Chapter 7 indicates that the overall permitted capacity and the reconditioning of the existing CTs at the power plants would not change to meet the increased power demands for the direct or indirect effects of the proposed military relocation. The resulting potential air quality impact would remain the same as the current permitted conditions established previously during each facility permitting process. Power generation requirements would be met by operating existing generation facilities within their current permit limitations. Thus, the air emissions at the power plant facilities would remain as predicted under their current permits. Permitted sources would then remain in compliance with applicable Clean Air Act air quality standards in effect at the time of their most recently issued permits and would result in less than significant air quality impacts. Additionally, Volume 6, Chapter 7 indicates that proposed reconditioning of existing CTs is not expected to result in a change in air emissions above what is currently allowed in the CT permits.

Although power plant and CT operations would result in a less than significant increase in emissions, air pollutants generated during power plant and CT operations could affect the health of some individuals on Guam. Air pollution can harm individuals when it accumulates in the air in high enough concentrations. People exposed to high enough levels of certain air pollutants may experience:

- Irritation of the eyes, nose, and throat
- Wheezing, coughing, chest tightness, and breathing difficulties
- Worsening of existing lung and heart problems
- Increased risk of heart attack

In addition, long-term exposure to air pollution has been linked to certain types of cancer and damage to the immune, neurological, reproductive, and respiratory systems.

Some groups of people are especially sensitive to common air pollutants, such as particulates and ground-level ozone. Sensitive populations include children, older adults, people who are active outdoors, and people with heart or lung diseases, such as asthma. Because air emission increases would be less than significant, it is anticipated that Guam clinics and hospital would have adequate staffing to handle illnesses related to air quality. Therefore, less than significant impacts on health care services would be anticipated as a result of emissions from construction and operational activities.

Indirect Impacts. Data provided by the GPA indicates that there is sufficient power capacity at power plants to meet the power demands from workforce housing and the induced population. Increased power demands and air emissions that may result from the workforce housing and induced population would be the same as described for direct impacts. It is anticipated that Guam clinics and hospitals would have adequate staffing to handle illnesses related to air quality. Therefore, less than significant, indirect impacts on health care services would be anticipated as a result of emissions from power plant operations.

19.2.3 Potable Water

As discussed in Volume 6, Chapter 3, existing off-base GWA water system infrastructure is considered by USEPA Region 9 to be substandard in terms of water quantity, water quality, and overall condition and reliability of the supply and distribution system. In its comments on the Draft Environmental Impact Statement (EIS), USEPA Region 9 stated that Guam's environmental and public health problems exceed those of most U.S. communities, with its population experiencing boil water notices, sewage spills, exposures to waterborne disease, and illegal dumping that can result in public health problems associated with its water supply. Over the last 7 years, USEPA Region 9 has issued fines and enforcement orders to the GovGuam in an effort to address these problems and bring the potable (drinking) water system infrastructure into compliance with federal environmental laws and public health standards.

There have been improvements to the potable water system as a result of these enforcement actions, and boil water notices have declined and water quality has improved in recent years. Still, the GWA potable water system continues to suffer from decades of deferred maintenance and upgrades because of a lack of funding and limits on user fees paid by the customers they service. Not all of GWA's water supply wells and surface water reservoirs are fully operational, resulting in a shortage of available water and an inability to meet basic flow and pressure standards required of public water suppliers. These conditions can result in intermittent loss of water or water pressure to some customers and in microbiological and other contaminants entering the distribution system, potentially resulting in illness. In addition to basic flow and pressure problems, GWA's water distribution system (i.e., water storage tanks, treatment systems, and distribution piping and pumps) is not fully functional because of corrosion, leakage, age, and vandalism. These conditions can potentially lead to unreliable water supply, poor water quality, and ultimately to illness.

19.2.3.1 Potable Water Health Problems

The following text provides a discussion of the types of contaminants and potential health problems related to potable water systems.

Contaminants Affecting Drinking Water. The levels of contaminants in drinking water are seldom high enough to cause acute (immediate) health effects (North Carolina Cooperative Extension Service 1996). Examples of acute health effects are nausea, lung irritation, skin rash, vomiting, dizziness, and even death. Contaminants are more likely to cause chronic health effects (i.e., effects that occur long after repeated exposure to small amounts of a chemical). Examples of chronic health effects include cancer, liver and kidney damage, disorders of the nervous system, damage to the immune system, and birth defects.

Microbial Pathogens. Pathogens in drinking water are serious health risks. Pathogens are disease-producing micro-organisms such as bacteria, viruses, and parasites (such as *Giardia lamblia*). They get into drinking water when surface water sources are contaminated by sewage or animal waste, or when wells are improperly sealed and constructed. Pathogens can cause gastroenteritis, salmonella infection, dysentery, shigellosis, hepatitis, and giardiasis. The presence of coliform bacteria, which is generally harmless, may indicate other contamination to the drinking water system.

Organics. People worry the most about potentially toxic chemicals and metals in water. Only a few of the toxic organic chemicals that occur in drinking water are regulated by drinking water standards. This group of contaminants includes:

- Trihalomthanes, which are formed when chlorine in treated drinking water combines with naturally occurring organic matter.
- Pesticides, including herbicides, insecticides, and fungicides.
- Volatile organic compounds, which include solvents, degreasers, adhesives, gasoline additives, and fuel additives. Some of the common volatile organic compounds are benzene, trichloroethylene, styrene, toluene, and vinyl chloride. Possible chronic health effects include cancer, central nervous system disorders, liver and kidney damage, reproductive disorders, and birth defects.

Inorganics. These contaminants include toxic metals like arsenic, barium, chromium, lead, mercury, and silver. These metals can get into drinking water from natural sources, industrial processes, and the materials used in plumbing systems. Toxic metals are regulated in public water supplies because they can cause acute poisoning, cancer, and other health effects. Nitrate is another inorganic contaminant. The nitrate in mineral deposits, fertilizers, sewage, and animal wastes can contaminate water. Nitrate has been associated with "blue baby syndrome" in infants.

Funding Improvements. The DoD acknowledges the existing sub-standard conditions of utility infrastructure systems on Guam and the desire by many for the DoD to fund improvements to these systems and services. The DoD also recognizes the constraints on the GovGuam to be able to address these indirect impacts of the proposed military relocation. The GovGuam has identified the need for $1.3 B in funding to implement necessary water and wastewater infrastructure improvements that must be accomplished in the first 5 years to accommodate the military relocation. The Council on Environmental Quality has facilitated interagency meetings with the DoD and appropriate federal agencies to identify funding sources to meet this need. The DoD is seeking funding from the GoJ for water and wastewater improvement projects pursuant to the terms of the Realignment Roadmap Agreement, described in Volume 1. The EAC is evaluating overall Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD military relocation. As part of this evaluation the EAC is specifically examining federal funding options for water and wastewater infrastructure improvements that may not be funded through GoJ financing. Because it is doubtful that GWA could fund and implement required upgrades in time for the start of the proposed DoD relocation, public health and safety impacts from increased demand on potable water are anticipated to be significant until the necessary off-base infrastructure improvements could be completed.

Direct Impacts. As described in Volume 6, Chapters 2 and 3, the DoD proposes to supply potable water to new facilities associated with the proposed action by using existing DoD water supplies on Guam, coupled with the installation of new water supply wells on Andersen Air Force Base. These new on-base systems would comply with Safe Drinking Water Act requirements for supply, pressure, and water quality. Therefore, no significant, anticipated, direct public health impacts are expected from these new facilities.

Indirect Impacts. As described in Volume 6, Chapters 2 and 3, the DoD relocation would result in indirect impacts on the off-base GWA water system from the potable water needs of the construction workforce and from the DoD relocation induced population that is expected to migrate to Guam. These indirect effects of the DoD relocation would place an increased demand and strain on the existing GWA water system. In their comments on the Draft EIS, the GWA, USEPA Region 9, GEPA, and various GovGuam agencies raised serious concerns over potential environmental and public health impacts on the already non-compliant GWA system from these indirect off-base demands. GWA must replace much of its infrastructure to meet current demand from the existing Guam population and to meet regulatory requirements imposed through ongoing enforcement actions. Concurrently, GWA must plan for, fund, and execute upgrades to meet new demands that are indirectly brought about by the proposed military relocation. Without these repairs and upgrades, environmental and public health impacts would be significant. Indirect impacts on the potable water system related to the military relocation fall into two broad categories: water quantity and water quality.

Water Quantity: As discussed in Volume 6, Chapter 3, implementation of the overall proposed action could result in shortfalls of off-base potable water in GWA's system from 2010 until 2015. This shortfall would result because the current GWA system cannot supply the amount of water needed for the expected population increase. According to GWA's Water Resources Master Plan (WRMP) (GWA 2007), the existing GWA system has enough capacity in its inventory of wells and surface water sources to meet the current and projected demand, but the failing condition of the systems does not allow for the system to produce its full potential. As described in Volume 6, Chapter 3, this shortfall would be at its highest in the peak construction year of 2014. GWA cannot sustain its current water demands without DoD assistance (currently up to 4 million gallons per day (MGd) (15 million liters per day [MLd]) of water from Fena reservoir is provided to GWA). The GWA water system is already experiencing high chlorides (an indication of over pumping) in some wells and is being encouraged to reduce production in the affected wells by the GEPA.

As described in Volume 6, Chapter 3, the DoD proposes to help mitigate the shortfall of off-base water by providing excess water capacity to GWA from its existing system and from the early installation of proposed new DoD wells. A Memorandum of Understanding is being developed between the DoD and GWA that would address procedures to cooperate in the overall management of the Northern Guam Lens Aquifer, the source of water for the new DoD wells. In addition, a Customer Service Agreement is expected to be created to address the exchange of water between the Naval Facilities Engineering Command, Marianas, and GWA. The best potential sites for future wells in the Northern Guam Lens Aquifer are presumed to be located beneath DoD lands. Meeting future water demands on Guam would require utilizing those water resources under DoD land to benefit all of Guam. In this way, the DoD would mitigate the indirect impacts on water quantity to less than significant.

Water Quality: As discussed in Volume 6, Chapter 3, water quality is related to water treatment and the condition of the water system infrastructure. Increasing the quantity of water alone would not mitigate potential public health impacts associated with low pressure, insufficient treatment, and corrosion of tanks and piping and from failing infrastructures. In the absence of water system repairs and upgrades, the GWA system would continue to be at risk for significant impacts on public health, and the additional demands on the system from the construction workforce and induced population associated with military relocation would make this already significant risk even worse.

19.2.4 Wastewater

Micro-organisms are present in large numbers in sewage treatment plant (STP) effluent, and waterborne disease outbreaks have been associated with sewage-contaminated water supplies or recreational waters. Wastewater discharged from a treatment plant can enter the environment where human exposure may occur through the potable water supply, recreation (e.g., swimming, snorkeling), or eating shellfish.

As discussed in Volume 6, Chapter 3, existing off-base GWA wastewater system infrastructure is considered by USEPA Region 9 to be sub-standard. Problems with the wastewater system include inadequate treatment of sewage at treatment plants, frequent sewage spills and overflows from collection piping and treatment systems, poor quality of water discharged from treatment plants, inadequate wastewater connection service on Guam, and poor condition and reliability of the system. In its comments on the Draft EIS, USEPA Region 9 stated that Guam's environmental and public health problems exceed those of most U.S. communities, with its population experiencing frequent sewage spills, exposures to waterborne disease, and illegal dumping that can result in public health problems associated with its wastewater collection and disposal systems. Over the last 7 years, USEPA Region 9 has issued fines and enforcement orders to the GovGuam in an effort to address these problems and bring the wastewater system infrastructure into compliance with federal environmental laws and public health standards.

There have been some improvements to the wastewater system as a result of these enforcement actions, and at least one treatment plant, the Hagatna Wastewater Treatment Plant (WWTP), has undergone repairs and upgrades. Still, the wastewater system continues to suffer from decades of deferred maintenance and upgrades because of a lack of funding and limits on user fees paid by the customers they service. All of the seven treatment plants are routinely in non-compliance with their discharge permits; many because a significant portion of the treatment processes at individual plants are inoperable. The condition of the sewage collection system is largely unsurveyed and unknown. Piping is suspected to be undersized and broken in much of the system, and pump stations undersized or failing. These issues lead to frequent sewage overflows into streets and neighborhoods, resulting in exposure to micro-biological and other contaminants and leaching of sewage and contaminants into the groundwater aquifer used as a drinking water source, potentially resulting in illness. Lack of maintenance, corrosion, leakage, bypassed treatment processes, age, and vandalism all contribute to the substandard condition of the system.

Direct Impacts. As described in Volume 6, Chapters 2 and 3, the DoD proposes to use the existing GWA Northern District Wastewater Treatment Plant (NDWWTP) to treat and dispose of wastewater directly generated from new DoD facilities in northern Guam and to use the Navy's Apra Harbor WWTP to treat sewage from additional visiting ships at Naval Base Guam.

Northern District Wastewater Treatment Plant. Volume 6, Chapter 3, describes the DoD's proposal to collect and convey sewage from the new DoD facilities in northern Guam to the NDWWTP. The DoD proposes to construct a dedicated force main that would deliver wastewater from the new facilities to the NDWWTP and proposes to upgrade the NDWWTP to bring it into compliance with both current and future flow and treatment requirements. Wastewater flows to the NDWWTP from military and civilian sources are projected to increase to a peak of 12.1 MGd (45.9 MLd) in 2014, which is somewhat more than the design capacity of 12 MGd (45 MLd). Adding chemical coagulants or increasing the surface overflow rate (within the normal design range) of the clarifier would be implemented to improve plant operations so that the primary clarifier would be able to treat the additional 0.1 MGd (0.4 MLd) without adverse effects on the NDWWTP. The DoD would coordinate with GWA to expedite the planned improvements and request for a National Pollutant Discharge Elimination System permit modification to increase the effluent discharge limitation from 6.0 MGd (22.7 MLd) to 12.0 MGd (45.4 MLd), then comply with its modified National Pollutant Discharge Elimination System permit requirements.

The DoD is working to arrange funding for the primary treatment repairs and upgrades to the NDWWTP. These upgrades would significantly improve the quality of wastewater from the plant and reduce the risk to public health from waterborne diseases. While the DoD would continue to coordinate with GWA and USEPA Region 9 to ensure that GWA implements planned Capital Improvements Program (CIP) projects designed to refurbish the existing primary treatment capability of the NDWWTP and expand it to meet the needs associated with the proposed Marine Corps relocation and associated civilian population growth, the ability of GWA to secure necessary funding for the required CIP projects remains a key concern and potential impediment to the Guam military relocation effort and the return of GWA to full compliance with the requirements of the Clean Water Act (CWA). In the underlying agreements with the GoJ covering the relocation of Marine Corps forces from Okinawa to Japan, the GoJ agreed to provide funding to develop facilities and infrastructure on Guam to support the relocation of Marine Corps forces. These agreements further recognize that necessary infrastructure improvements would cover not only improvements on military installations, but also improvements to the civilian infrastructure. Therefore, the U.S. Government, through the DoD, is currently seeking approximately $50 million in Japanese Fiscal Year 2011 funding from the GoJ to cover required CIP projects necessary for refurbishment and expansion of primary treatment capabilities at the NDWWTP. Such funding would allow necessary improvements to be made by the 2013 required date noted in Volume 6, Chapter 2. If the DoD fails to secure the necessary funding from the GoJ, significant human health impacts would occur from improperly treated wastewater. Furthermore, consistent with the Navy's commitment to apply adaptive program management discussed in Volume 7, failure to secure necessary funding would severely impact construction pace and the ability of the Navy to complete required construction to support the Marine Corps relocation.

The USEPA Region 9 denied GWA’s application for a renewed variance from full secondary treatment on September 30, 2009, and concluded that the CWA 301(h) criteria have not been met at the NDWWTP and the Hagatna WWTP. GWA has appealed this ruling, but the results of that appeal are not determined at this time. The NDWWTP discharges into coastal waters on the northwestern shoreline of Guam. The coastal waters in the area of NDWWTP’s new deep ocean outfall are considered “Category M-2 Good” marine waters (USEPA 2009).

The previous outfall discharged effluent directly into the Philippine Sea at 2,160 feet (ft) (655 meters [m]) from shore at a depth of 60 ft (18.2 m), and 545 ft (166 m) beyond the reef line. The total length of the previous outfall was approximately 7,272 ft (2,216 m); including a diffuser that was 422 ft (129 m) long at the terminal end of the outfall. The previous outfall consisted of a 5,500-ft (1,676-m), 30-inch (76.2-centimeter) diameter pipe made mainly of Techite piping encased in concrete. The previous diffuser was oriented north to south and located parallel to the shoreline (USEPA 2009).

The new outfall was completed and went into operation in January 2009. The new outfall currently discharges 1,900 ft (580 m) from shore, and at a depth of 140 ft (42.6 m). A 400-ft (121-m) multiport diffuser was to be added to the end of the outfall; however, the diffuser has not yet been added to the new outfall. Because the proposed discharge would be farther away from shore and at a greater depth, and incorporates additional diffuser ports, the USEPA Region 9 predicts that it would have higher dilution (USEPA 2009).

Based on available information, the USEPA Region 9 has concluded that discharge of primary treated effluent through the new deep ocean outfall would not ensure compliance with the requirements of 40

CFR 125.62(a) through (d). The USEPA Region 9 has determined that the proposed discharge would not comply with all Guam water quality standards; and may not provide for the attainment or maintenance of water quality that would ensure the protection and propagation of a balanced indigenous population of shellfish, fish, and wildlife. Concentrations of lead have been predicted to exceed water quality criteria at the zone of initial dilution (ZID) for the proposed discharge. Furthermore, the USEPA Region 9 has determined that the proposed discharge would not meet water quality criteria for bacteria at the ZID; thus, the proposed discharge may adversely affect recreational activities (USEPA 2009).

Ocean waters near the NDWWTP discharge are not considered a source of public water supply. Drinking water has not been established as a designated use for Category M-2 marine waters of Guam. Currently, drinking water supplies are derived from surface and groundwater sources. Therefore, the USEPA Region 9 has concluded that the WWTP discharge would not affect public water supplies (USEPA 2009).

Apra Harbor WWTP. Volume 6, Chapter 3 describes the DoD's proposal to use the existing Navy-owned Apra Harbor WWTP to treat sewage generated from new visiting ships to Naval Base Guam. The Apra Harbor WWTP is currently in non-compliance for aluminum, copper, and nickel in its discharge; however, the expected flows from the visiting ships are not expected to increase or change the metals concentrations at the treatment plant. Volume 6, Chapter 3 describes the efforts underway to modify the permit to allow for a ZID for this discharge. The plants current permit capacity allows for these additional flows and the resulting ZID is expected to be issued to account for this full permitted flow.

Ocean waters near the Apra Harbor WWTP discharge are not considered a source of public water supply. Drinking water has not been established as a designated use for Category M-2 marine waters of Guam. Currently, drinking water supplies are derived from surface and groundwater sources. Therefore, WWTP discharge would not affect public water supplies.

Indirect Impacts. As described in Volume 6, Chapters 2 and 3, the DoD relocation would result in indirect impacts to the off-base GWA wastewater system from the wastewater collection and disposal needs of the construction workforce and from the induced population that is expected to migrate to Guam. These indirect effects of the DoD relocation would place an increased demand and strain on the existing GWA wastewater system. In their comments on the Draft EIS, the GWA, USEPA Region 9, GEPA, and various GovGuam agencies raised serious concerns over potential environmental and public health impacts on the already noncompliant GWA system from these indirect off-base demands. GWA must repair, replace, and upgrade much of its infrastructure to meet current demand from the existing Guam population and to meet regulatory requirements imposed through ongoing enforcement actions. Concurrently, GWA must plan for, fund, and execute upgrades to meet new demands that are indirectly brought about by the proposed military relocation. Without these repairs and upgrades, environmental and public health impacts would be significant. Pathogens commonly found in wastewater effluent are *Escherichia coli*, Streptococcus, Salmonella, Shigella, mycobacterium, *Pseudomonas aeroginosa*, *Giardia lamblia*, and enteroviruses. Tacnia, Ascaris, and hookworm ova may also be present in raw sewage.

Increased sewage flows in the wastewater collection system may result in more sewage overflows into streets and neighborhoods and more exposure of the population to sewage-borne disease. Additionally, sewage overflows could result in a greater risk of contamination of the groundwater aquifer, which is used as a drinking water source. Increased flows to already failing WWTPs would simply exacerbate an already serious public health problem.

According to GWA's WRMP (GWA 2007), of the seven GWA WWTPs on Guam, four are small onsite plants in the southern portions of the island that are routinely out of compliance and treatment processes are largely bypassed. Some of these smaller plants are non-discharge plants where the plant effluent is dispersed into the soils on site near where people live and recreate. These are the Umatac-Merizo WWTP, the Inarajan WWTP, and Pago Socio WWTP. Since publication of the WRMP (GWA 2007), the very small Pago Socio WWTP was converted to a pumping station sending its wastewater to the Hagatna WWTP. These WWTPs are described in further detail in Volume 6, Chapter 3. The fourth plant, the Baza Gardens WWTP, is a secondary treatment plant that discharges to a small surface water stream. The Agat-Santa Rita WWTP is a secondary treatment plant that discharges to the ocean through an ocean outfall in Tipalao Bay.

Properly designed, installed, and operated, onsite systems can be as effective as municipal WWTPs in reducing the public health risks associated with wastewater; however, contamination of drinking water and surface water caused by onsite systems does occur and people can contract gastrointestinal and other illnesses from drinking groundwater or by coming in contact with surface water affected by wastewater.

In addition to the four remaining small WWTPs in southern Guam, GWA has a large WWTP in the central part of Guam, the Hagatna WWTP. This plant is similar in size and operation to the NDWWTP and is described in Volume 6, Chapter 3. According to GWA's WRMP (GWA 2007) and recent GWA Stipulated Order progress reports, this treatment plant has undergone significant upgrades to address historical compliance problems. The main collection system and pump station for this plant is also slated for upgrades to address chronic problems with sewage overflows. Workforce housing areas are proposed for construction within the collection system of this plant, and induced population is expected to also result in increased flows to this plant. The potential exists for significant public health impacts from the connection of workforce housing and induced population areas to this plant if the upgrades to the collection system and main pump station are not funded.

Likewise, workforce housing areas are proposed for construction within the collection system of the NDWWTP plant. Induced population is expected to also result in increased flows to this plant. The upgrades that are proposed by the DoD to the NDWWTP would mitigate any public health impacts from these additional flows.

The DoD acknowledges the existing sub-standard conditions of key public infrastructure systems and social services on Guam and the desire by many for the DoD to fund improvements to these systems and services. The DoD also recognizes the constraints on the GovGuam to be able to address these indirect impacts of the proposed military relocation. The Council on Environmental Quality has facilitated interagency meetings with the DoD and appropriate federal agencies to identify funding sources to meet this need. The EAC is evaluating overall Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD military relocation. It is anticipated that Guam clinics and hospitals would not be able to increase staffing to meet current health care service ratios and would not be capable of handling a potential increase in wastewater-related illnesses unless the federal inter-agency task force succeeds in finding funding or other assistance to help Guam correct these deficiencies. In the event increases in health care staffing do not occur, the following impacts on medical treatment would likely arise:

- Longer wait/response times for patients
- Fewer or no available providers on island for chronic or acute issues
- Complications or death from delayed treatment
- Requirements for patients to travel off island to receive adequate treatment

Therefore, at this time, significant impacts on health care services would be anticipated as a result of potential increased wastewater treatment and discharge activities.

19.2.5 Solid Waste

The DoD would continue to use the Navy Landfill at Apra Harbor for municipal solid waste (MSW) until the new GovGuam Layon Landfill at Dandan is available for use. Disposal of other waste streams excluded from Layon Landfill would continue at the Navy Landfill. Construction and demolition (C&D) debris would continue to be disposed at the Navy hardfill.

The Layon Landfill is being constructed in compliance with federal Resource Conservation and Recovery Act Subtitle D requirements. Because this landfill would be compliant with Resource Conservation and Recovery Act Subtitle D, no impacts to public health and safety are anticipated from the increase in solid waste disposal on Guam.

The Navy Sanitary Landfill is unlined; therefore, leachate has the potential to affect the underlying groundwater. Studies are currently underway to assess whether or not the underlying groundwater has been affected by leachate. Initial conclusions of these studies show that further evaluation may be required.

19.2.6 All Alternatives

19.2.6.1 Construction Phase

Construction activities for all of the proposed utility projects would not be expected to have a significant impact on public health and safety. BMPs would be implemented to control work site safety, waterborne disease increases, and other potential impacts on public health and safety. No DoD construction activities would occur for solid waste management activities. During construction, there would be a less than significant impact on public health and safety.

19.2.6.2 Notifiable Diseases

Volume 2, Chapter 2, Section 2.18 analyzes the potential increase in notifiable disease cases based on the population increase that would result from the implementation of the overall proposed action as well as the related actions, such as the proposed utility projects. The DoD acknowledges the existing sub-standard conditions of health services on Guam and the desire by many for the DoD to fund these services. The DoD also recognizes the constraints on the GovGuam to be able to address these indirect impacts of the proposed military relocation. The Council on Environmental Quality has facilitated interagency meetings with the DoD and appropriate federal agencies to identify funding sources to meet this need. The EAC is evaluating overall Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD military relocation. Based on the potential for an increase in notifiable diseases, a significant impact on health care services is anticipated unless the federal inter-agency task force succeeds in finding funding or other assistance to help Guam correct health care service deficiencies.

19.2.6.3 Mental Illness

Analysis of potential impacts on mental illness is provided in Volume 2. Utility related issues by themselves should not result in additional mental illness; thus, there should be no impacts from proposed utility actions on mental illness.

19.2.6.4 Traffic Incidents

Analysis of potential increases in traffic incidents is provided in Volume 2. Based on the small potential for increase in traffic incidents, a less than significant impact on the health and safety of the citizens of Guam is anticipated.

19.2.6.5 UXO

The island of Guam was an active battlefield during World War II. As a result of the invasion, occupation, and defense of the island by Japanese forces and the assault by Allied/American forces to retake the island, unexploded military munitions still remain. Excavation for foundations, underground utilities, and other infrastructure could encounter unexploded military munitions in the form of UXO, discarded military munitions, and/or materials potentially presenting an explosive hazard. Exposure to these munitions and explosives of concern (MEC) could result in the death or injury to workers or to the public.

To reduce the potential hazards related to exposure to MEC, in accordance with DoD Directive 6055.9 (DoD Ammunition and Explosive Safety Standard) and Naval Ordnance Safety and Security Activity Instruction 8020.15B, Explosives Safety Submission documentation would be prepared that outlines specific measures that would be implemented to ensure the safety of workers and the public. BMPs that would be implemented include having qualified UXO personnel perform surveys to identify and remove potential MEC prior to initiation of ground-disturbing activities, as necessary. Additional safety precautions would include providing UXO personnel supervision during earth-moving activities, and providing MEC awareness training prior to and during ground-disturbing activities to construction personnel who are involved in grading and excavations. These safety precautions would ensure that potential impacts are minimized; therefore, implementation of the proposed utility projects would result in less than significant impacts to public health and safety (from UXO).

19.2.7 Proposed Mitigation Measures

Mitigation measures for potable water would be a combination of the DoD providing excess water capacity to meet increased demands for water resulting from workforce and induced populations off base and for the federal inter-agency task force to succeed in finding funding and/or other assistance to help Guam repair their potable water distribution system. The combination of these actions would provide proper water pressure and leak control, reduce sewer overflows, and reduce the potential increase in potable water–related disease among the civilian population.

The Navy would continue to coordinate with GWA and USEPA Region 9 to ensure that GWA implements planned CIP projects. The CIP projects are designed to refurbish the existing primary treatment capability of the NDWWTP and expand it to meet needs associated with the proposed Marine Corps relocation and associated civilian population growth. However, the ability of GWA to secure necessary funding for the required CIP projects remains a key concern and potential impediment to the Guam military relocation effort and the return of GWA to full compliance with the requirements of the CWA.

In the underlying agreements with the GoJ covering the relocation of Marine Corps forces from Okinawa to Japan, the GoJ agreed to provide funding to develop facilities and infrastructure on Guam to support the relocation of Marine Corps forces. These agreements further recognize that necessary infrastructure improvements would cover not only improvements on military installations, but also improvements to the civilian infrastructure. Therefore, the U.S. Government, through the DoD, is currently seeking approximately $50 million in Japanese Fiscal Year 2011 funding from the GoJ to cover required CIP projects necessary for refurbishment and expansion of primary treatment capabilities at the NDWWTP. Such funding would allow necessary improvements to be made by the 2013 date noted in Volume 6, Chapter 2. As with refurbishment and expansion of primary treatment, the ability of the GWA to secure necessary funding for CIP projects required to achieve secondary treatment at the NDWWTP remains a concern and potential impediment to the Guam military relocation effort and the return of the GWA to full compliance with the requirements of the CWA. As with efforts to secure funding for required primary treatment refurbishment and expansion, the DoD is working to secure necessary funding, including funding from the GoJ.

Implementation of mitigation measures for the other WWTPs on Guam are not within the control of the DoD. The DoD acknowledges the existing sub-standard conditions of utility infrastructure systems on Guam and the desire by many for DoD to fund improvements to these systems and services. The DoD also recognizes the constraints on the GovGuam to be able to address these indirect impacts of the proposed military relocation. The GovGuam has identified the need for $1.3 B in funding to implement necessary water and wastewater infrastructure improvements that must be accomplished in the first 5 years to accommodate the military relocation. The Council on Environmental Quality has facilitated interagency meetings with the DoD and appropriate federal agencies to identify funding sources to meet this need. The DoD is seeking approximately $580 million from GoJ for water and wastewater improvement projects pursuant to the terms of the Realignment Roadmap Agreement, described in Volume 1. The EAC is evaluating overall Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD military relocation. As part of this evaluation the EAC is specifically examining federal funding options for water and wastewater infrastructure improvements that may not be funded through GoJ financing. Mitigation measures for providing adequate public health resources would also be for the federal inter-agency task force to succeed in finding funding and/or other assistance to help Guam upgrade their capacity to care for and help prevent increased incidence of illnesses.

19.2.8 Summary of Impacts

Table 19.2-1 summarizes the potential impacts of all alternatives. A text summary is provided below.

Table 19.2-1. Summary of Potential Public Health and Safety Impacts

Potentially Impacted Resource	*Construction for All Alternatives (direct and indirect identical)*	*Operations for All Alternatives (direct with indirect in parentheses)*
Power	LSI	LSI (LSI)
Potable Water	LSI	LSI (SI)
Wastewater	LSI	LSI (SI)
Solid Waste	NI	NI (NI)
Notifiable Diseases	LSI	SI (SI)
Mental Illness	NI	NI (NI)
Traffic Incidents	LSI	LSI (LSI)
UXO	LSI	NI (NI)

Legend: LSI= Less than significant impact; NI= No impact; SI = Significant impact; UXO = unexploded ordnance.

Based on the increased population of Guam (natural and military increases), requirements for power production, potable water generation, and wastewater treatment could result in an increase in illness from airborne contaminants and water- and wastewater-related diseases. The DoD acknowledges the existing sub-standard conditions of social services on Guam and the desire by many for the DoD to fund improvements to these systems and services. The DoD also recognizes the constraints on the GovGuam to be able to address these indirect impacts of the proposed military relocation. The Council on Environmental Quality has facilitated interagency meetings with the DoD and appropriate federal agencies to identify funding sources to meet this need. The EAC is evaluating overall Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD military relocation. It is anticipated that Guam clinics and hospitals would not be able to increase staffing to meet current health care service ratios and would not be capable of handling potential increases in utility-related illnesses unless the federal inter-agency task force succeeds in finding funding and/or other assistance to help upgrade the deficiencies in health care. In the event health care staffing increases do not occur, the following impacts on medical treatment would likely arise:

- Longer wait/response times for patients
- Fewer or no available providers on island for chronic or acute issues
- Complications or death from delayed treatment
- Requirements for patients to travel off island to receive adequate treatment

Therefore, significant impacts on health care services would be anticipated. No impacts are anticipated from increased solid waste disposal.

The potential impact on Guam health care services from increases in disease occurrences as a result of the proposed utility projects would be significant. There is no potential impact on Guam health care services from increases in mental health occurrences as a result of the proposed utility projects. The potential increase in the number of traffic accidents and fatalities would be minimal, resulting in a less than significant impact on the health and safety of Guam citizens.

Excavation for underground utilities and other infrastructure could encounter unexploded military munitions. To reduce the potential hazards related to the exposure to MEC, qualified UXO personnel would perform surveys to identify and remove potential items of MEC prior to the initiation of ground-disturbing activities. UXO supervision during earth-moving activities and providing MEC awareness training to construction personnel prior to and during ground-disturbing activities would also be undertaken. The identification and removal of MEC prior to initiating construction activities and training construction personnel regarding hazards associated with MEC would ensure that potential impacts would be minimized and would be less than significant. During operations, the potential exposure to MEC would be essentially non-existent, so no impacts would result.

19.2.9 Roadways

Construction activities would consist of intersection improvements, bridge replacements, pavement strengthening, road relocation, road widening, and construction of a new road. Typical activities associated with each of these types of projects are described in Volume 6, Chapter 2. Most projects would involve construction work in developed and paved areas, and some roadway projects require work in undeveloped locations. Construction activities would occur during a 7-year period from 2010 through 2016, with the peak roadway construction year of 2013/2014.

The proposed GRN project and associated construction haul roads would be designed in accordance with the American Association of State Highway and Transportation Officials standards and guidelines, with particular focus on improving safety and reducing traffic congestion. Construction of roadway segments and bridge replacement projects would require the use of temporary detours, limited road closures, and alternate routes that would be established during localized road work. These temporary routes would represent alternate ways of reaching destinations. While such detours may be perceived as an inconvenience to the public, temporary roadways would be established with safety measures, such as proper signage and reduced speed limits, as appropriate for temporary construction zones. With implementation of these protective measures, potential impacts to public health and safety would be reduced to a less than significant level.

Potential impacts to public health and safety can occur during roadway construction activities (i.e., cut and fill operations, removal of vegetation, and use of heavy equipment) and as a result of leaks and spills onto soils during construction. Impacts from potential exposure to contaminated soil, use of hazardous materials, and generation of hazardous waste can also result in a public health concern (see Volume 6, Chapter 18). Direct impacts that result in physical injury could occur during construction, while indirect impacts can result from the completed project (e.g., accidents and injuries that would occur in the future). To evaluate the potential public health and safety impacts of roadway improvement projects, physical activities associated with each project type were identified as shown in Table 19.2-2.

Table 19.2-2. Activities Associated with GRN Roadway Project Types

Item	*Project Type*	*Temporary Detours*	*Temporary Storage of Contaminants*	*Exposure to Unexploded Ordnance*
1	Intersection Improvement (including military access points)	●	●	●
2	Bridge Replacement	●	●	●
3	Pavement Strengthening	●	●	●
4	Road Relocation (Route 15 only)	●	●	●
5	Road Widening	●	●	●
6	Construction of New Road	●	●	●
7	Temporary placement of equipment laydown areas or storage areas for road demolition material		●	●

Based on the anticipated activities associated with each project type, it was determined that:

- Each of the roadway improvement project types would have the same degree of exposure to possible increased hazards from use of temporary road detours during the construction period. Temporary road detours would generally be required for all road work.
- The placement of temporary equipment laydown areas at any of the GRN project work sites would represent a moderate potential for impacts to public health and safety due to the potential storage of fuels, oils, and lubricants that would be used during the construction period. The health risk associated with this activity would only occur if the spill or leak is not addressed, contaminants leached into the soil, and petroleum products were to enter any drinking water supply. To avoid this impact, proper containment and use of these potential contaminants would be required at temporary construction staging areas. The potential for contaminants leaching into the soil would be prevented or managed through implementation of spill prevention and emergency spill response procedures. These procedures would reduce the possibility for leaks or spills of contaminants to occur at equipment staging areas.
- Contaminated soils may be present in the roadway work area. Exposure to contaminated soils may pose a health risk for construction workers. To avoid this impact, roadway design may include an evaluation of potential contamination. Final roadway design would avoid known

contaminated sites wherever possible and may include coordination with the responsible party to ensure that construction does not interfere with any ongoing remediation activities. These procedures would reduce the possibility for exposure to areas of contamination.
- Each of the roadway improvement project types would have the same degree of potential exposure to possible hazards from encountering UXO during the construction period. To avoid this impact, qualified UXO specialists would perform surveys to identify and remove potential ordnance from the work site prior to the start of construction. This procedure would reduce the possibility for public exposure to UXO.

Indirect impacts during operation of the new GRN roadway could also occur. These safety hazards would be limited to those associated with the lack of familiarity to the road system, the effects of improper maintenance, and the potential for contaminants leaching into the soil.

- Safety hazards from initial use of the new roadway network could occur if there is a lack of familiarity with the road system. Because the GRN project would result in a 7-year process of roadway improvements, safety hazards would not be expected because of improved signalization, signage, and lighting that would be installed on the existing roadway configuration. Pavement improvements to reduce accidental skidding would also improve safety. The GRN project includes only one roadway relocation (Route 15) and one new roadway (Finegayan Connection). The new GRN system would include comprehensive improvements designed to prevent accidents or injury and improve congestion management. With ongoing and planned traffic safety programs, the new GRN system would not be expected to affect the frequency of automobile accidents. The new roadway network would be expected to result in a decrease in safety hazards.
- Improper maintenance can lead to road deterioration from erosion and pavement damage that can result in localized safety hazards. The maintenance of roads on Guam would continue to be the responsibility of the Guam Department of Public Works.
- The potential for spills of fuels, oils, and lubricants that could occur on the new roadway network would be increased due to the number of additional heavy vehicles that would use the new roads and bridges. The health risk associated with this activity would only occur if the spill were not contained, contaminants were leached into the soil or water body, and contaminants were to enter a drinking water supply or water body that is used for edible fish. To avoid this impact, spill prevention and emergency spill response procedures would be implemented.

Projects with the most potential for increased vulnerability to safety hazard would be those located in areas of high liquefaction potential and those in or near karst geological formations (nearest to known sinkholes or caves). In general, the potential vulnerability to effects from seismic activity is consistent throughout the island because of the presence of known and inferred earthquake faults that transect Guam. The potential for safety hazard due to geologic considerations would be addressed by proper roadway or bridge design, as discussed in the geology and soils chapter in Volume 6.

19.2.9.1 Alternative 1

Alternative 1 would result in direct potential impacts to public health and safety during the construction period as a result of exposure to possible increased hazards from the use of temporary road detours and possible hazards from encountering UXO. Impacts on geological resources could include soil disturbance and soil loss, localized erosion, and particulate emissions. Ground disturbance for roadway improvements would be conducted in accordance with standard construction BMPs, general requirements in accordance with the GovGuam Soil Erosion and Sediment Control Regulations, and associated permit conditions, including applicable stormwater pollution prevention plans. With implementation of BMPs, impacts to public health and safety would be less than significant.

North

GRN projects in the North Region would be designed and constructed with safety principles to ensure that exposure to hazards is prevented or minimized. With implementation of BMPs, impacts to public health and safety would be less than significant.

Central

GRN projects in the Central Region would be designed and constructed with safety principles to ensure that exposure to hazards is prevented or minimized. As stated in the geology and soils chapter, roadway improvements near known caves and sinkholes would be designed in accordance with recommendations of the site-specific geotechnical investigation. With implementation of BMPs, impacts to public health and safety would be less than significant.

Apra Harbor

GRN projects in the Apra Harbor Region would be designed and constructed with safety principles to ensure that exposure to hazards is prevented or minimized. With implementation of BMPs, impacts to public health and safety would be less than significant.

South

GRN projects in the South Region would be designed and constructed with safety principles to ensure that exposure to hazards is prevented or minimized. With implementation of BMPs, impacts to public health and safety would be less than significant.

Proposed Mitigation Measures

No mitigation measures would be required. In addition to the proposed mitigation measures identified for Hazardous Materials and Waste (see Volume 6, Chapter 18), the following BMPs would be implemented for activities that could impact public health and safety in the project area:

- Design and construct individual roadway projects in accordance with American Association of State Highway and Transportation Officials standards and guidelines.
- Ensure that contaminants (i.e., oils, greases, lubrication fluids for heavy equipment) are properly stored at the work site and at temporary construction staging areas to avoid spills and leaks.
- Ensure that emergency response plans are in place for responding to leaks or spills of construction contaminants.
- Conduct surveys by qualified UXO specialists before construction starts to identify and remove potential ordnance from the work site. As an added precaution, UXO personnel would conduct munitions and explosives training of construction crews, and be assigned to monitor earthmoving activities.

19.2.9.2 Alternative 2 (Preferred Alternative)

North

Impacts would be similar to Alternative 1.

Central

Impacts would be similar to Alternative 1.

Apra Harbor

Impacts would be similar to Alternative 1.

South

Impacts would be similar to Alternative 1.

Proposed Mitigation Measures

No mitigation measures would be required. BMPs would be identical to Alternative 1.

19.2.9.3 Alternative 3

North

Impacts would be similar to Alternative 1.

Central

Impacts would be similar to Alternative 1.

Apra Harbor

Impacts would be similar to Alternative 1.

South

Impacts would be similar to Alternative 1.

Proposed Mitigation Measures

No mitigation measures would be required. BMPs would be identical to Alternative 1.

19.2.9.4 Alternative 8

North

Impacts would be similar to Alternative 1.

Central

Impacts would be similar to Alternative 1.

Apra Harbor

Impacts would be similar to Alternative 1.

South

Impacts would be similar to Alternative 1.

Proposed Mitigation Measures

No mitigation measures would be required. BMPs would be identical to Alternative 1.

2013/2014 (Peak Construction)

The year 2013/2014 represents the roadway network without any future plans for improvements for the military relocation. While no construction associated with the planned military relocation would occur, the GovGuam would have initiated construction of road segment and intersection improvement projects along segments of Routes 1, 7, 10A, and 27 (extension), and the Tiyan Parkway, as identified in Volume 6, Chapter 2.

2030

The year 2030 represents the roadway network without any future plans for improvements for the military relocation. While no construction associated with the planned military relocation would occur, the GovGuam would have completed construction of road segment and intersection improvement projects along segments of Routes 1, 2, 4, 7A, 16, 25, and 26, as identified in Volume 6, Chapter 2.

19.2.9.5 Summary of Impacts

Table 19.2-3 summarizes the potential impacts of each interim alternative. An analysis of long-term alternatives was not developed because the alternatives are not ready for project-specific analysis. A text summary is provided below.

Table 19.2-3. Summary of Potential Impacts to Public Health and Safety-Roadway Project

Potential Impacts	*Alternative 1*	*Alternative 2**	*Alternative 3*	*Alternative 8*
Temporary Detours – Exposure of public to traffic hazards during roadway construction.	LSI	LSI	LSI	LSI
Exposure to contaminants that have leached into the soil.	LSI	LSI	LSI	LSI
Increased exposure to hazards from UXO.	LSI	LSI	LSI	LSI
Improper maintenance resulting in road deterioration from erosion and pavement damage.	LSI	LSI	LSI	LSI

Legend: LSI = Less than significant impact; UXO = unexploded ordnance. *Preferred Alternative.

Construction activities would consist of intersection improvements, bridge replacements, pavement strengthening, road relocation, road widening, and construction of a new road. Each type of roadway construction project would require the use of temporary road detours. Improper storage of construction materials could result in spills or leaks that could result in contaminants leaching into the soil and water bodies. There would be a potential for encountering UXO in the construction zone. For these reasons, specific BMPs would be implemented to avoid or minimize these potential effects on public health and safety. Roadways and bridges would be designed in accordance with specific geotechnical considerations to prevent risk from geologic hazards. The proposed GRN project would not be expected to subject the public to an increased risk of personal injury from automobile crashes or from exposure to UXO. With implementation of BMPs for roadway construction, potential impacts to public health and safety would be less than significant.

19.2.9.6 Summary of Proposed Mitigation Measures

No mitigation measures above those of identified BMPs and Standard Operating Procedures are proposed for roadway projects impacts to public health and safety.

CHAPTER 20.
ENVIRONMENTAL JUSTICE AND THE PROTECTION OF CHILDREN

20.1 INTRODUCTION

This chapter focuses on the potential for racial and ethnic minorities, low income populations, or children to be disproportionately affected by project-related impacts. Normally, an analysis of environmental justice is initiated by determining the presence and proximity of these segments of the population relative to the specific locations that would experience adverse impacts to the human environment. The situation on Guam is unique because racial or ethnic minority groups (as defined by the United States [U.S.]) comprise a majority of the Guam population. Plus, the proportions of people living in poverty or who are under 18 years of age are also substantially higher than in the general U.S. population.

The analysis is further complicated because Guam is a relatively small and isolated island, and certain types of impacts would be experienced islandwide. Accordingly, the analysis of environmental justice described in this chapter acknowledges the unique demographic characteristics of the island population and assumes that the project effects could disproportionately affect low-income populations and children. Proposed mitigation measures would be expected to effectively mitigate potential environmental justice impacts. If a resource area did not have significant impacts, or if the impact was mitigable to less than significant, as analyzed in each individual chapter in Volume 6, then the resource was not further analyzed in this chapter. These resources are geology and soils, water resources, air quality, airspace, land use, recreation, biological resources, cultural resources, visual resources, marine transportation, and hazardous materials and waste.

For a description of the affected environment with respect to environmental justice, refer to Volume 2, Chapter 19. This chapter focuses on potential disproportionate impacts to racial minorities, low-income populations, and children from the construction and operation of utilities and roadways associated with the military relocation on Guam. For an analysis of potential islandwide impacts to these populations, see Volume 6, Chapter 17.

20.2 ENVIRONMENTAL CONSEQUENCES

20.2.1 Approach to Analysis

20.2.1.1 Methodology

Volume 6 of this Final Environmental Impact Statement (EIS) examines the potential impacts that each alternative would potentially have on various environmental and human resources. Based on the conclusions reached in each resource chapter, the analysis of environmental justice sought to identify the adverse impacts that would disproportionately affect racial minorities, children, and/or low-income populations, based on the following assumptions:

- Environmental Justice and Protection of Children policies require a federal agency to analyze whether its proposed action would adversely affect a minority, low-income, and child population disproportionately to the rest of the community. The island of Guam is unique because a majority of the population of Guam meets the criteria for being an Asian Pacific minority group in the context of the overall U.S. population. As a result, where the EIS identifies significant impacts for a particular resource, there would be a corresponding, islandwide adverse effect to minority populations on Guam, compared to the U.S. population. However, because of international agreements that require the proposed action to focus on Guam and not other locations within the U.S., the evaluation of environmental justice would be on whether there are disproportionate adverse effects within the context of alternatives for facility location on Guam. Because of this, it would be impossible for there to be a disproportionate effect from an identified adverse impact based solely on the impact affecting a minority population. Therefore, the analysis for environmental justice on Guam must consider whether there is a disproportionate adverse effect on a low-income population or children. For example, if a low-income population is being affected by a potential reduction in Public Health and Social Services, that impact would be considered a significant impact because the population, as a given, is a minority population and it is being disproportionately affected because it is a low-income population. As a result, some resource areas may have effects on a minority population, but because they do not impact a low-income or child population in a disproportionate manner, they will not be considered as causing an environmental justice adverse effect.

- The region of influence (ROI) is defined as the area in which the principal effects arising from the proposed construction of utilities and roadways are likely to occur. Those who may be affected by the consequences of utilities and roadway construction and operation are often those who reside or otherwise occupy areas immediately adjacent to the project locations.
- Because the proposed actions are related either to construction or operations, impacts to the ROI would likely be either “spill over” effects that extend beyond an installation’s boundary line into the surrounding community, or impacts that directly affect minority populations in the ROI.

The analysis applied the three tiers of criteria to assess the environmental justice implications for each significant impact identified in the relevant resource chapters. In some cases if the analysis shows that the requirements for the specific criteria have not been met, then a discussion on the next tier may not be required. For instance, if an applicable disadvantaged group is not disproportionately affected in Tier 2, then a discussion on significant effects under environmental justice would not be warranted.

- Tier 1: Are there any racial minorities, low-income, or child populations adjacent to the proposed action site?
- Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed actions?
- Tier 3: Would the disproportionate adverse effects be significant?

20.2.1.2 Determination of Significance

According to Section 1508.27 of the Council on Environmental Quality Regulations for Implementing National Environmental Policy Act (Council on Environmental Quality 1979), determining the level of significance of an environmental impact requires that both context and intensity be considered. These terms are defined in Section 1508.27 as follows:

- “Context. This means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant.”

- "Intensity. This refers to the severity of the impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. The following should be considered in evaluating intensity:
  - Impacts that may be both beneficial and adverse. A significant effect may exist even if the federal agency believes that on balance the effect would be beneficial.
  - The degree to which the proposed action affects public health or safety.
  - Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.
  - The degree to which the effects on the quality of the human environment are highly uncertain or involve unique or unknown risks.
  - The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.
  - Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.
  - The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.
  - The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined critical under the Endangered Species Act of 1973.
  - Whether the action threatens a violation of federal, state, or local law or requirements imposed for the protection of the environment."

Federal Highway Administration (FHWA) Guidance for Preparing and Processing Environmental and Section 4(f) Documents (FHWA 1987) addresses the assessment of roadway projects and their potential for disproportionately affecting any social group and mitigation measures to address those impacts. This document's guidance has been followed to assess the roadway projects for the proposed alternatives relative to environmental justice.

20.2.1.3 Issues Identified during Public Scoping Process

Issues related to environmental justice that were raised during the public scoping process are discussed in Volume 2, Chapter 19. Also discussed in Volume 2, Chapter 19 are public involvement efforts that were undertaken during the development of the EIS to ensure that racial and ethnic minority and low-income populations had the opportunity to provide comments on the military relocation to Guam.

20.2.2 Power

As discussed in Volume 6, Chapter 3, Section 3.2.2, the predicted direct Department of Defense (DoD) and indirect population growth on Guam induced by the proposed DoD relocation would increase demands on the electrical system, with the peak year being 2014. Potential environmental justice impacts related to this increased demand would be associated with the following:

- Changes in air emissions
- Changes to electrical customer user fees
- Changes in the reliability of Guam Power Authority's (GPA) power supply islandwide

These three areas are assessed below for each power alternative.

20.2.2.1 Basic Alternative 1 (Preferred Alternative)

Basic Alternative 1 would utilize existing GPA baseload power facilities to meet the increased power demands, recondition up to five existing Combustion Turbines (CTs) for required peaking and reserve power, and upgrade Transmission and Distribution (T&D) systems. No new construction or enlargement of the existing footprint of the facilities would be required. These reconditioned CTs would have the necessary reliability to serve as reserve capacity to ensure reliable operation of the Island-Wide Power System (IWPS). They would serve as peaking and reserve units. This work would be undertaken by the GPA on its existing permitted facilities and would potentially utilize an SPE to obtain funds, recondition the CTs, install the T&D upgrades, and operate the CTs for a fee to enable repayment of the financing. Reconditioning would be made to existing permitted facilities at the Marbo, Yigo, Dededo (2 units), and Macheche CTs. These CTs are not currently being used up to permit limits. T&D system upgrades would be on existing aboveground and underground transmission lines. This alternative supports Main Cantonment Alternatives 1 and 2 and Main Cantonment Alternatives 3 and 8 would require additional upgrades to the T&D system.

Changes in Air Emissions

Reconditioning existing CTs would result in the existing permitted CTs being available for use as peaking and standby units. Their use would be expected to not exceed 500 hours per year per CT total increase from the baseline as discussed in Volume 6, Chapter 7. Currently, these units are not routinely used except for intermittent periods and emergencies. This alternative would result in more pollutants emitted into the air than experienced today because the CTs would be used for intermittent periods and reserve requirements. Other existing generating units, known as baseload units, would be operated for longer periods of time than the current baseline. All generating units would be operated within constraints of their current permits. The current air permits for the islandwide power generating facilities allow for some level of pollutants to be emitted; these allowable levels are based on U.S. Environmental Protection Agency's National Ambient Air Quality Standards. National Ambient Air Quality Standards protect public health, including the health of "sensitive" populations such as children, asthmatics, and the elderly. They also protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

Because the overall permitted capacity and the operational scheme for the islandwide generating facilities would not change, the resulting potential air quality impact would remain the same as the current permitted conditions established previously during each facility permitting process, which are protective of human health and sensitive populations. Because Basic Alternative 1 would not result in an increase of air emissions at these facilities under the permitted condition, reconditioning these CTs and utilizing the islandwide permitted sources complies with applicable Clean Air Act air quality standards and would result in less than significant air quality impacts. Therefore, Basic Alternative 1 would not result in any disproportionately high and adverse effects on low-income populations or children.

Changes to Electrical Customer Fees

As discussed in Volume 6, Chapter 17, potential effects on electrical customers are unknown at this time. However, under power Basic Alternative 1, only existing power generation facilities owned and operated by GPA would be reconditioned and new T&D lines installed. Cost to bring these existing GPA assets into peaking and reserve service could be arranged by the DoD or provided directly by the GPA, with reimbursement via a new utility service contract, which would replace the existing customer service agreement between the GPA and DoD. The DoD-increased demand would result in a cost share across a much larger user base than currently exists, and would likely result in unchanged or lower user fees for all power customers than might occur in the absence of the proposed DoD relocation. Basic Alternative 1 would not result in adverse impacts to electrical customer fees and therefore would not cause disproportionately high and adverse effects on children or low-income populations related to electrical fees.

Changes to Power Supply Reliability

As discussed in Volume 6, Chapter 3, reconditioning the GPA's CTs would increase the reliability of the IWPS and provide reliable sources of power generation to support the existing and future off base populations. Mitigation measures described in Volume 6, Chapter 3 include efforts to jointly plan for system upgrades to ensure that the reliability of the IWPS would not be degraded to the detriment of all users. Mitigation measures also include the availability of new 5-plus megawatt of capability at Marine Base Finegayan that could be used to shave peak power during daily high-demand periods, if requested by the GPA. Mitigation measures also include force flow reductions and/or adaptive program management of construction procedures described in Volume 7, which would reduce population increases and thus reduce power demand increases. These proposed mitigation measures may not be necessary for power, but could be used should unexpected power issues develop. Significant impacts to power supply are not expected, and therefore would be no disproportionately high and adverse effects on low-income populations or children related to power supply reliability.

20.2.3 Potable Water

20.2.3.1 Basic Alternative 1 (Preferred Alternative)

Basic Alternative 1 would provide additional water capacity of 11.3 MGd (42.8 MLd), which is anticipated to be met by an estimated 22 new wells at Andersen Air Force Base (AFB), rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 2.5 MG (9.5 ML) water storage tanks would be constructed at ground level at NCTS Finegayan. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint. These actions would increase availability of the DoD potable water for the DoD facilities, and their implementation is considered a direct impact.

The actions would also generate construction-related noise and traffic that may adversely affect the villages of Dededo and Yigo, which lie adjacent to Andersen AFB. Heavy construction equipment would be used for at least 6–9 months during construction. This would generate some noise. However, Volume 6, Chapter 8, does not anticipate that the noise would be loud enough off base to have a significant effect on the surrounding community. Noise would also be generated by construction vehicles along Routes 9, 1, and 15, but with the implementation of mitigation measures in Volume 6, Chapter 8, the impact would be reduced to less than significant. The impact is not assessed further in this chapter.

Construction-related travel and the transport of materials and equipment are anticipated to increase traffic along Routes 9, 1, and 15, which provide access to Andersen AFB. According to Volume 6, Chapter 4, implementation of the proposed actions would not increase traffic to the level of unacceptable Levels of Service by 2014. Therefore, the impact would be less than significant and is not assessed further in this chapter.

Indirect impacts would be experienced by the GWA water system because of the construction workforce required to implement the proposed action, induced civilian population growth, and anticipated regular civilian growth. These impacts would be significant to the overall population, but specific locations of the impacts are difficult to determine because the information available to the DoD is not comprehensive or detailed enough to allow the specific affected areas on Guam to be identified.

Tier 1: *Are there any racial minorities, low-income, or child populations adjacent to the proposed action site?*

With 15 percent (%) or less of their populations being Caucasian, Dededo and Yigo both have high levels of racial and ethnic minorities. The poverty rates in Dededo and Yigo are similar to those of other villages on Guam. Dededo and Yigo have high percentages of children (U.S. Census Bureau 2000).

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

Low-income populations and children of low-income families living in Yigo and Dededo near Andersen AFB, as well as those living in other villages supplied by the GWA, may experience disproportionate impacts related to potable water supply because these groups are likely to be more susceptible to the consequences of potable water supply impacts. Children in general would not be disproportionately affected.

Tier 3: *Would the disproportionate adverse effects be significant?*

During the operational period, the planned DoD water system would fully meet the projected future DoD demand as discussed in Volume 6, Chapters 2 and 3. Also, the Northern Guam Lens Aquifer would be able to meet the total demand. Therefore, the proposed military relocation would have less than significant direct impacts on the potable water supply.

Indirect impacts would be experienced during the operational period by the GWA water system because of the water demands of the overall construction workforce required to implement the proposed action, induced civilian population growth, and anticipated regular civilian growth. Low-income populations would experience significant impacts from projected water supply shortfalls in the GWA system considering the existing supply and the planned well expansion defined in GWA's draft Capital Improvement Plan for 2010-2014 (GWA 2009). The increased demand of the construction workforce and induced civilian growth would occur fairly rapidly and would require the GWA to implement their expansion plans in a very short time without any water supply sources from the DoD. If potable water shortfalls occur in the GWA system, water outages or low pressure conditions could result in parts of the water system. Water outages or low water pressure can result in microbiological and other contaminants entering the distribution system, potentially resulting in illness. Water outages or low water pressure can potentially prevent effective fire fighting and degrade the basic sanitary needs of the population. Water rationing may be implemented. The adverse public health and health care services impacts would fall disproportionally on low-income populations, including children of low-income families, and would be significant.

Proposed Mitigation Measures

To mitigate significant indirect potable water supply impacts, the DoD and the GovGuam would implement measures discussed in Volume 6, Chapter 3. The DoD could transfer excess water production capacity to the GWA to offset water shortfalls during the construction time frame. The DoD proposes to construct water distribution lines to facilitate transfer of water from DoD sources to the GWA islandwide distribution system. Volume 7, Chapter 2, describes two additional mitigation measures: force flow reduction and adaptive program management of construction. Implementing either or both of these mitigation measures could further reduce indirect impacts to the potable water utility by lowering peak population levels during construction and slowing the permanent population increases, allowing more time for GWA to improve and upgrade their water system. The DoD acknowledges the existing sub-standard conditions of infrastructure and public health services on Guam and the desire by many for the DoD to fund improvements to these systems and services. The DoD also recognizes the constraints on the GovGuam to be able to address these indirect impacts of the proposed military relocation. The Council on Environmental Quality has facilitated interagency meetings with the DoD and appropriate federal agencies to identify funding sources to meet this need. The DoD is seeking approximately $580 million from the Government of Japan (GoJ) for water and wastewater improvement projects pursuant to the terms of the Realignment Roadmap Agreement, described in Volume 1. The Economic Adjustment Committee (EAC) is evaluating overall Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD military relocation. As part of this evaluation the EAC is specifically examining federal funding options for water and wastewater infrastructure improvements that may not be funded through GoJ financing.

Although the construction noise impacts are considered less than significant, construction Best Management Practices are specified in Volume 6, Chapter 8.

20.2.3.2 Basic Alternative 2

Basic Alternative 2 would provide additional water capacity of 11.7 MGd (44.3 MLd), which is anticipated to be met by an estimated 20 new wells at Andersen Air Force Base (AFB) and 11 new wells at Air Force Base Barrigada, rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 1.8 MG (6.8 ML) water storage tanks would be constructed at ground level at NCTS Finegayan and one 1 MG (3.8 ML) water storage tank would be construction at Air Force Base Barrigada. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint. Villages that lie adjacent to Andersen AFB are Dededo and Yigo; villages located adjacent to Navy Barrigada include Barrigada and Mangilao.

New wells, rehabilitation of existing wells, T&D system upgrades, interconnection with the GWA, and construction of the additional water storage tanks would increase overall potable water availability for DoD use. Therefore, direct impacts would be less than significant.

Construction-related noise and traffic may have adverse impacts on the surrounding communities. Construction-related traffic on Routes 9, 1, and 15 may increase, as well as Routes 8, 16 and 15 that provide access to Navy Barrigada. Heavy construction equipment would be used for at least 6–9 months during construction. This equipment would generate some noise. However, Volume 6, Chapter 8, concludes that the noise would not be loud enough off base to have a significant effect on the surrounding community. Noise would also be generated by construction vehicles along Routes 9, 1, and 15, which provide access to Andersen AFB, and along Routes 8, 16, and 15, which provide access to Navy Barrigada. However, with the implementation of noise abatement measures in Volume 6, Chapter 8, the impact would be reduced to less than significant and is not assessed further in this chapter.

Construction-related travel and the transport of materials and equipment are anticipated to increase traffic along Routes 9, 1, and 15, which provide access to Andersen AFB, and along 8, 16, and 15, which provide access to Navy Barrigada. According to Volume 6, Chapter 4, implementation of the proposed actions would not increase traffic along Route 9, 1, and 15 in northern Guam to the level of unacceptable Levels of Service by 2014. Therefore, the impact would be less than significant and is not assessed further in this chapter.

Tier 1: *Are there any racial minorities, low-income, or child populations adjacent to the proposed action site?*

With 15% or less of their populations being Caucasian, Dededo and Yigo both have high levels of racial and ethnic minorities. The poverty rates in Dededo and Yigo are similar to those of other villages on Guam. Dededo and Yigo have high percentages of children (U.S. Census Bureau 2000).

Barrigada and Mangilao have high percentages of racial minorities. Mangilao's poverty rate is consistent with other Guam villages, while Barrigada's is slightly lower. Barrigada and Mangilao have similar percentages of children.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

Low-income populations and children of low-income families living in Yigo and Dededo near Andersen AFB, as well as those living in other villages supplied by the GWA, may experience disproportionate impacts related to potable water supply because these groups are likely to be more susceptible to the consequences of potable water supply impacts. Children in general would not be disproportionately affected.

Low-income populations, and children who live or attend school near the construction sites or near Routes 9, 1, and 15 for Andersen AFB and Routes 8, 16, and 15 for Navy Barrigada would experience disproportionate construction-related noise and traffic impacts.

Tier 3: *Would the disproportionate adverse effects be significant?*

Direct and indirect impacts on the DoD and GWA water systems, respectively, under Basic Alternative 2 would be similar to those described for Basic Alternative 1.

Significant indirect impacts to the GWA system would occur because of the demands of the overall construction workforce required to implement the proposed action, induced civilian population growth, and anticipated regular civilian growth. Adverse public health and health care services impacts would fall disproportionally on low-income populations, including children of low-income families, and would be significant. However, with the implementation of the proposed actions, traffic along Routes 15 and 16 in central Guam that service Navy Barrigada are anticipated to increase to unacceptable Levels of Service. For more information, see Volume 6, Chapter 4. which uses a volume to capacity (v/c) ratio to determine the anticipated level of traffic congestion by 2014. If a v/c ratio is greater than 1, the increased traffic is anticipated to reach a level that would be unacceptable. The v/c ratios of Routes 15 and 16 in central Guam are projected to be greater than 1 by 2014. Therefore, there would be a significant traffic impact along these routes. However, with the implementation of the mitigation measures in Volume 6, Chapter 4, these impacts would be reduced to less than significant.

Proposed Mitigation Measures

Measures that could be taken by the DoD and GovGuam to mitigate potable water supply impacts are discussed in Volume 6, Chapter 3. To mitigate indirect water shortfall impacts, the DoD could transfer excess water production capacity to the GWA, if requested. Volume 7, Chapter 2, describes two additional mitigation measures: force flow reduction and adaptive program management of construction. Implementing either or both of these mitigation measures could further reduce indirect impacts to the potable water utility by lowering peak population levels during construction and slowing the permanent population increases, allowing more time for the GWA to improve and upgrade their water system.

Although the construction noise impacts are considered less than significant, construction Best Management Practices and mitigation measures are specified in Volume 6, Chapter 8. Traffic-reduction measures are described in Volume 6, Chapter 4.

20.2.4 Wastewater

20.2.4.1 Basic Alternative 1a (Preferred Alternative) and 1b

Basic Alternative 1a combines the upgrade to the existing primary treatment facilities and the expansion to secondary treatment at the Northern District Wastewater Treatment Plant (NDWWTP). When the proposed treatment facility upgrades/expansion are complete, the surrounding area would benefit from the increased sewer treatment capacity. However, short-term increased wastewater flows would slightly exceed the design capacity of the plant during this time. The difference between Alternatives 1a, which supports Main Cantonment Alternatives 1 and 2, and Alternative 1b, which supports Main Cantonment Alternatives 3 and 8, is the requirement for a new sewer line from Barrigada housing to NDWWTP for Alternative 1b.

Tier 1: Are there any racial minorities, low-income, or child populations adjacent to the proposed action site?

Racial minorities, low-income populations, and children of north and central Guam are present within the areas affected by the facility upgrades/expansion, the increased wastewater flows from the proposed military relocation, and the indirect effects of increased construction worker and induced civilian populations.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

Implementation of Basic Alternative 1a, which is the Preferred Alternative, would accomplish the required refurbishment of the NDWWTP primary treatment system to accept the projected increase in wastewater flows such that there would be no impact on the NDWWTP ability to physically handle the increased wastewater flows directly resulting from the military relocation. However, permit modifications would be required and short-term increased wastewater flows would slightly exceed the design capacity of the plant during this time. Thus, the direct impact to the NDWWTP from the proposed DoD relocation is deemed less than significant because of the proposed upgrades, permit modifications, and alterations of operations when the flow exceeds the design capacity, but would ultimately result in long-term beneficial impacts by providing improved wastewater treatment and improved water quality at the plant discharge site.

The DoD also commits to assist the GWA in securing funding for the primary treatment repairs and upgrades. This funding would significantly improve the quality of wastewater from the plant and reduce the risk to public health from waterborne diseases. The DoD also funded and has completed a detailed engineering study that identifies the specific repairs and upgrades needed at the plant for primary treatment and the expansion to secondary treatment. This study was fully coordinated with the GWA and U.S. Environmental Protection Agency, and is discussed in Volume 6, Chapter 3.

As described in Volume 6, Chapters 2 and 3, the relocation would result in indirect impacts to the off base GWA wastewater system from the wastewater collection and disposal needs of the overall construction workforce required to implement the proposed action and from the induced population that is expected to migrate to Guam. These indirect effects of the relocation would place an increased demand and strain on the existing GWA wastewater system.

According to GWA's Water Resources Master Plan (GWA 2007), of the seven sewage treatment plants on Guam, four are small onsite plants in the southern portions of the island where systems are routinely out of compliance and treatment processes largely bypassed. These smaller plants are either non-discharge plants where the plant effluent is dispersed into the soils onsite near where people live and recreate, or are plants where effluent is discharged into small surface water streams. Increased flow to the wastewater treatment plants and collection system overflows would result from natural population increases as well as the increase in military personnel. Based on the increased population of Guam, issues associated with wastewater discharges on Guam and the use of onsite treatment systems could result in an increase in the number of wastewater-related illnesses. Therefore, at this time, significant impacts to health and health care services would be anticipated as a result of potential increased indirect wastewater treatment and discharge activities. While many populations on Guam would experience the aforementioned impacts on health and health care services, these impacts would disproportionately affect low-income populations, including children of low-income families, on Guam because such groups are more susceptible to the consequences of impacts on health and health care services. Children in general would not be disproportionately affected by these impacts.

Tier 3: Would the disproportionate adverse effects be significant?

With the implementation of proposed upgrades to the NDWWTP, adverse impacts to wastewater treatment capacity and water quality associated with the direct impact of the military population would be less than significant. Therefore, disproportionate adverse effects would be less than significant. When the secondary treatment upgrades would be implemented, the action would have beneficial effects.

However, if the other GWA wastewater treatment facilities are not upgraded prior to the construction period, the increased wastewater flows associated with the indirect effects of increased construction worker and civilian populations are expected to result in significant impacts on wastewater utilities and associated public health and health care services. The adverse impacts on public health and health care services would fall disproportionally on low-income populations, including children of low-income families, and would be significant.

Proposed Mitigation Measures

There would be no direct significant adverse impacts associated with the operational period of Basic Alternative 1a that would disproportionately or adversely affect low-income populations or children, and no mitigation measures are needed.

Mitigation measures for significant indirect impacts are outlined in Volume 6, Chapter 3. Volume 7, Chapter 2, describes two additional mitigation measures (i.e., force flow reduction and adaptive program management of construction) that could reduce indirect impacts to the wastewater utility by lowering peak population levels during construction and slowing the permanent population increases, allowing more time for GWA to improve and upgrade their wastewater systems. The DoD acknowledges the existing sub-standard conditions of infrastructure and public health services on Guam and the desire by many for the DoD to fund improvements to these systems and services. The DoD also recognizes the constraints on the GovGuam to be able to address these indirect impacts of the proposed military relocation. The Council on Environmental Quality has facilitated interagency meetings with the DoD and appropriate federal agencies to identify funding sources to meet this need. The DoD is seeking approximately $580 million from GoJ for water and wastewater improvement projects pursuant to the terms of the Realignment Roadmap Agreement, described in Volume 1. The EAC is evaluating overall Guam civilian hard (e.g., facilities) and soft (e.g., manpower, operations & management) infrastructure needs, including those associated with the proposed DoD military relocation. As part of this evaluation the EAC is specifically examining federal funding options for water and wastewater infrastructure improvements that may not be funded through GoJ financing.

20.2.4.2 Basic Alternative 1b

Under Basic Alternative 1b, the existing primary treatment system at NDWWTP would be refurbished and upgraded to accept additional wastewater flow and load from both central and northern Guam and would include new sewer lines and lift pump stations to convey wastewater generated from the proposed DoD Barrigada housing to the NDWWTP in support of Main Cantonment Alternatives 3 and 8.

This alternative includes refurbishing primary treatment capability at NDWWTP and installing a collection system from Finegayan. It also includes installing a sewer collection system from Barrigada to NDWWTP.

The proposed new sewer line would extend from NDWWTP adjacent to Route 25 and then south adjacent to Route 16 to Navy Barrigada. Construction of the sewer line would result in a construction-related traffic increase along Routes 25 and 16 south toward Navy Barrigada. The roadways section in Volume 6, Chapter 4, does not anticipate that traffic along Route 16 would reach unacceptable Levels of Service by 2014 as a result of the proposed action. However, congestion along Route 25 would reach unacceptable Levels of Service. However, with the implementation of the traffic mitigation measures in Volume 6, Chapter 4, the level of congestion would be reduced and impacts would be less than significant and therefore are not assessed further regarding environmental justice and protection of children.

Tier 1: Are there any racial minorities, low-income, or child populations adjacent to the proposed action site?

Racial minorities, low-income populations, and children of north and central Guam are present within the areas affected by facility upgrades/expansion, increased wastewater flows from the proposed military relocation, and the indirect effects of increased construction worker and induced civilian populations.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

The impacts of Basic Alternative 1b would be the same as Basic Alternative 1a.

Tier 3: Would the disproportionate adverse effects be significant?

The impacts of Basic Alternative 1b would be the same as Basic Alternative 1a.

Proposed Mitigation Measures

Mitigation measures to reduce disproportionate adverse effects for Basic Alternative 1b would be the same as Basic Alternative 1a.

20.2.5 Solid Waste

20.2.5.1 Basic Alternative 1 (Preferred Alternative)

The Preferred Alternative would be to continue to use the Navy Landfill at Apra Harbor for municipal solid waste (MSW) until the new GovGuam Layon Landfill at Dandan is available for use. Disposal of other waste streams excluded from Layon Landfill would continue at the Navy Landfill. Construction and demolition (C&D) debris would continue to be disposed at the Navy hardfill.

No disproportionate adverse impacts are anticipated with this action.

Proposed Mitigation Measures

There are no disproportionate impacts anticipated; therefore, mitigation measures are not needed.

20.2.6 Off Base Roadways

The proposed action includes 58 Guam Road Network (GRN) improvement projects for off base roadways. While descriptions of these individual projects can be found in Volume 6, Chapter 2, the improvements proposed for the GRN would result in strengthened roadways, bridge replacements, increased roadway capacity, roadway realignment (Route 15), new access, and enhanced roadway safety on Guam as a response to construction for the military relocation and growth.

20.2.6.1 Alternative 1

The roadway projects for Alternative 1 include those listed in Volume 6, Chapter 2, with the exception of the following GRN projects: #38, #39, #41, #47, #48, #49, #49A, #63, and #74.

North

The FHWA traffic study uses a v/c ratio to determine the anticipated level of traffic congestion by 2014. If a v/c ratio is greater than 1, the increased traffic is anticipated to reach a level that would cause congestion. Because of the aforementioned and other construction activities in the north, the FHWA traffic study projects that by 2014 the following northern roadways and intersections will have a v/c ratio greater than 1:

1. The portion of Route 3 south of the Residential Gate and between Route 28 and Main Gate in both the morning and afternoon
2. The intersection of Routes 3, 3A, and 9 in the morning

Tier 1: Are there any racial minorities, low-income, or child populations adjacent to the proposed action site?

Over 90% of the local population in Dededo and Yigo are racial minorities (refer to Volume 2, Chapter 19). Both Dededo and Yigo have a high poverty rate, although some villages in Guam have higher poverty rates. Both Dededo and Yigo have a high percentage of children (refer to Volume 2, Chapter 19).

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

The racial minorities, low-income populations, and children in residences, schools, and parks in northern Dededo and northern Yigo near Routes 3 and 9 would experience increased traffic congestion because of their proximity to the roadways. Construction-related impacts include increased traffic, noise, and air pollutant emissions typically associated with localized use of construction equipment and vehicles. These impacts would be temporary. When construction is complete, roadways would have increased capacity, which would result in both greater traffic volumes and improved traffic flow. The improved roadway infrastructure would have a beneficial impact on the surrounding community by providing better traffic flow and safer travel. For these reasons, no substantial negative environmental consequences would occur near the roadway project areas. Therefore, no disproportionate adverse impacts on low-income populations or children would occur.

Central

According to the FHWA traffic study, by 2014 the implementation of Alternative 1 is projected to result in a v/c ratio greater than 1 along Route 3, Route 10 north of Route 32 to Route 8, Route 15 at its intersection with Route 10, Route 16, Route 25, Route 26, and Route 28.

Tier 1: Are there any racial minorities, low-income, or child populations adjacent to the proposed action site?

The villages that would be affected by actions proposed in the central region include Mangilao and Barrigada. These village populations all have a majority of racial minorities. Mangilao also has a high poverty rate (refer to Volume 2, Chapter 19). These villages do not have high percentages of children relative to the other villages on Guam (refer to Volume 2, Chapter 19).

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

The racial minorities, low-income populations, and children living near these roads would experience the traffic increase. Construction-related impacts include increased traffic, noise, and air pollutant emissions typically associated with localized use of construction equipment and vehicles. These impacts would be temporary. When construction is complete, roadways would have increased capacity, which would result in both greater traffic volumes and improved traffic flow. The improved roadway infrastructure would have a beneficial impact to the surrounding community by providing better traffic flow and safer travel. For these reasons, no substantial negative environmental consequences would occur. Therefore, no disproportionate adverse impact to low-income groups or children would occur.

Apra Harbor

The construction resulting from the U.S. Marine Corps' actions at Naval Base Guam would increase traffic along Route 1. However, only two facilities would be constructed, which is not a large enough action alone to increase traffic to significant levels. This statement is supported by the FHWA traffic study, which does not project that traffic would increase along the major roadways near Apra Harbor (Routes 1, 2A, and 11) to unacceptable Levels of Service by 2014. Therefore, no significant impact in the Apra Harbor region would occur.

South

The FHWA traffic study projects that by 2014, the v/c ratio along Route 5 would be greater than 1, which indicates that traffic would increase to unacceptable Levels of Service.

Tier 1: Are there any racial minorities, low-income, or child populations adjacent to the proposed action site?

Route 5 runs through the village of Santa Rita, which, while still having a high percentage of racial minorities, people in poverty, and children, has one of the lowest poverty rates in Guam. Santa Rita has a relatively high population of children relative to other villages on Guam (refer to Volume 2, Chapter 19).

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

The racial minorities, low-income populations, and children living near Route 5 would experience the increase in traffic. Construction-related impacts include increased traffic, noise, and air pollutant emissions typically associated with localized use of construction equipment and vehicles. These impacts would be temporary. When construction is complete, roadways would have increased capacity, which would result in both greater traffic volumes and improved traffic flow. The improved roadway infrastructure would have a beneficial impact on the surrounding community by providing better traffic flow and safer travel. For these reasons, no substantial negative environmental consequences would occur. Therefore, no disproportionate adverse impact on low-income populations or children would occur.

20.2.6.2 Alternative 2 (Preferred Alternative)

The roadway projects for Alternative 2 include those listed in Volume 6, Chapter 2, with the exception of the following GRN projects: #38A, #39A, #41A, #47, #48, #49, #49A, #63, and #74.

North

Tier 1: Are there any racial minorities, low-income, or child populations adjacent to the proposed action site?

Same as for Alternative 1.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

Same as for Alternative 1.

Central

Tier 1: Are there any racial minorities, low-income, or child populations adjacent to the proposed action site?

Same as for Alternative 1.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

Same as for Alternative 1.

Apra Harbor

Same as Alternative 1.

South

Tier 1: Are there any racial minorities, low-income, or child populations adjacent to the proposed action site?

Same as for Alternative 1.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

Same as for Alternative 1.

20.2.6.3 Alternative 3

The roadway projects for Alternative 3 include those listed in Volume 6, Chapter 2, with the exception of the following GRN projects: #20, #31, #38A, #39A, #41, #41A, and #124.

North

Tier 1: Are there any racial minorities, low-income, or child populations adjacent to the proposed action site?

Same as for Alternative 1.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

Same as for Alternative 1.

Central

Tier 1: Are there any racial minorities, low-income, or child populations adjacent to the proposed action site?

Same as for Alternative 1.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

Same as for Alternative 1.

Apra Harbor

Same as Alternative 1.

South

Tier 1: Are there any racial minorities, low-income, or child populations adjacent to the proposed action site?

Same as for Alternative 1.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

Same as for Alternative 1.

20.2.6.4 Alternative 8

The roadway projects for Alternative 8 include those listed in Volume 6, Chapter 2, with the exception of the following GRN projects: #38, #39, #41, #47, #48, #49, #63, and #74.

North

Tier 1: Are there any racial minorities, low-income, or child populations adjacent to the proposed action site?

Same as for Alternative 1.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

Same as for Alternative 1.

Tier 3: Would the disproportionate adverse effect(s) be significant?

Same as for Alternative 1.

Central

Tier 1: Are there any racial minorities, low-income, or child populations adjacent to the proposed action site?

Same as for Alternative 1.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

Same as for Alternative 1.

Apra Harbor

Same as Alternative 1.

South

Tier 1: Are there any racial minorities, low-income, or child populations adjacent to the proposed action site?

Same as for Alternative 1.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

Same as for Alternative 1.

20.2.6.5 Alternative 2 Constrained

The DoD, FHWA, and GovGuam continue to work cooperatively to develop a funding plan for the off base roadway and intersection capacity projects. As of February 2010, a limited number of off base roadway projects had been identified as having funding or reasonable expectation of being funded. Additional traffic analysis was completed for the 17 roadways and 42 intersections, assuming that only a limited number of projects would be funded. These projects are either DAR-certified or determined to be DAR-eligible at this time (see Volume 6, Chapter 1, Section 1.1.4, Project Location, Funding, and Setting). The evaluation of the remaining road projects for DAR eligibility and certification is continuing. The additional analysis that was performed for Alternative 2 (the Preferred Alternative) included only the following off base roadway and intersection projects:

- Route 3, Route 28 to Route 9; widen to five lanes
- Route 9, Route 3 to Andersen AFB North Gate; widen to five lanes
- Route 9, Andersen AFB to Route 1; widen to three lanes
- Route 1/3 Intersection
- Route 1/8 Intersection
- Route 1/11 Intersection
- Route 3/3A Intersection
- Military Access Points as described for the Preferred Alternative (Alternative 2)

The purpose of analyzing the impacts of only these roadway improvements is to determine the impact of the housing and additional military base traffic on Guam roadways with only a select number of roadway improvement projects (Table 20.2-1). Because the majority of the relocated military population would reside in the Finegayan area, the roadways adjacent to this area, Routes 3 and 9, would receive the majority of the new traffic. The majority of the roadway projects that are expected to be funded are in the Finegayan area.

Table 20.2-1. Summary of Potential Impacts – Comparison of Alternative 2 and Alternative 2 Constrained**

*Alternative 2**	*Alternative2 Constrained*
Construction (direct and indirect impacts are the same)	
NI • No disproportionately high and adverse effects on low-income populations and children related to temporary traffic, noise, and air quality impacts during construction.	• Same impacts as Alternative 2.
Operation (direct and indirect impacts are the same)	
BI • Beneficial impact to low-income populations and children due to improved, safer roadway infrastructure after construction is completed.	SI • Significant disproportionately high and adverse effects to low-income populations and children due to traffic congestion associated with additional housing and base activities.

Legend: BI = Beneficial impact; LSI = Less than significant impact; SI = Significant impact; *Preferred Alternative; **Assumes only limited number of off base roadway widening and intersection improvement projects are constructed.

<u>Comparison of Alternative 2 and Alternative 2 Constrained – Limited Roadway Improvements</u>

The analysis for Alternative 2 Constrained, with limited roadway improvements showed that there would be significant congestion resulting from traffic associated with the additional housing and base activities without the full recommended off base roadway improvements. Alternative 2 Constrained would involve less construction activity than proposed for Alternative 2. As a result, construction emissions and air quality emissions for Alternative 2 Constrained are expected to be lower than those predicted for Alternative 2.

Tier 1: Are there any racial minorities, low-income, or child populations adjacent to the proposed action site?

Over 90% of the local population in Dededo and Yigo are racial minorities (refer to Volume 2, Chapter 19). Both Dededo and Yigo have a high poverty rate although some villages in Guam have higher poverty rates. Both Dededo and Yigo have a high percentage of children (refer to Volume 2, Chapter 19).

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

Impacts from increased traffic would affect all groups living in or using the roadways of Dededo and Yigo in the same manner. However, low-income populations and children living or present near the roadway would likely be more susceptible to the adverse effects of traffic congestion and would experience disproportionate impacts from traffic increases associated with additional housing and base activities during roadway construction and after construction is complete.

Tier 3: Would the disproportionate adverse effect(s) be significant?

Disproportionately high and adverse effects on low-income populations and children from traffic increases would be significant.

Proposed Mitigation Measures

Proposed mitigation measures described in Chapter 4 of Volume 6 would reduce the significant impacts on low-income populations and children.

20.2.7 No-Action Alternative

Under the no-action alternative, no utility or roadway upgrades or improvements associated with the proposed actions would occur and existing operations at the proposed project areas would continue. There would be no noise or traffic impacts related to construction and no increase in military population. Anticipated beneficial effects of increased utility and roadway capacity would not be realized. The no-action alternative would have no adverse environmental justice impacts on the villages of Dededo, Barrigada, and Mangilao in particular or the island of Guam in general.

20.2.8 Summary of Impacts

This section summarizes the potential environmental justice impacts associated with the proposed action alternatives for each major component – power, potable water, wastewater, solid waste, and off base roadways.

Table 20.2-2 summarizes the potential impacts of the power alternative. The power alternative would have the beneficial impact of increasing capacity. The alternative was evaluated for disproportionate environmental justice effects regarding changes in air emissions, changes to electrical user fees, and changes in reliability of the islandwide power supply. As shown in the table, no impacts would occur with regard to air emissions, user fees, or system reliability. No significant disproportionate adverse impacts to low-income populations or children would occur under any of the alternatives.

Table 20.2-2. Summary of Potential Impacts: Power Alternatives

*Basic Alternative 1**
Construction and Operation Impacts
NI • No environmental justice impacts to low-income populations or children related to air emissions.
NI • No environmental justice impacts to low-income populations or children related to electrical user fees.
NI • No environmental justice impacts to low-income populations or children related to power supply reliability.

Legend: LSI = Less than significant impact; NI = No impact; * Preferred Alternative.

Table 20.2-3 summarizes the potential impacts of each potable water alternative. Under Alternative 1, indirect impacts would be experienced by the GWA water system during the construction period because of the overall construction workforce required to implement the proposed action, induced civilian population growth, and anticipated regular civilian growth. These impacts would be significant to the overall population; therefore, the indirect impact would have significant disproportionate impacts on low-income populations and children of low-income families.

Table 20.2-3. Summary of Potential Impacts: Potable Water Alternatives

Basic Alternative 1	*Basic Alternative 2*
Construction Impacts (direct with indirect in parentheses)	
NI (NI) • No disproportionately high and adverse effect on low-income populations or children from construction.	NI(NI) • No disproportionately high and adverse effect on low-income populations or children from construction.
Operation Impacts (direct with indirect in parentheses)	
NI (SI) • The water system would be upgraded to serve increased DoD demand. (Water shortages and associated public health and safety and health care services impacts with increased demand of construction workforce and induced civilian population growth.)	NI (SI) • The water system would be upgraded to serve increased DoD demand. (Water shortages and associated public health and safety and health care services impacts with increased demand of construction workforce and induced civilian population growth.)

Legend: DoD = Department of Defense; LSI = Less than significant impact; NI = No impact; SI = Significant impact.

Table 20.2-4 summarizes the potential impacts of each wastewater alternative. Direct operational impacts associated with wastewater discharges that would flow to the upgraded NDWWTP would be less than significant. However, without upgrades to other wastewater treatment facilities on Guam being implemented prior to the construction period, the increased wastewater flows associated with the indirect effects of increased construction worker and civilian populations are expected to result in significant impacts to wastewater treatment facilities and associated impacts on public health problems and health care services that would disproportionately affect low-income populations and children of low-income families.

The sewer upgrades proposed in Basic Alternatives 1a and 1b would not have any adverse environmental impacts during the construction period.

Table 20.2-4. Summary of Potential Impacts: Wastewater Alternatives

*Basic Alternative 1a**	*Basic Alternative 1b*
Construction Impacts (direct with indirect in parentheses)	
NI(NI) • No disproportionately high and adverse effect low-income populations or children from construction.	NI(NI) • No disproportionately high and adverse effect on low-income populations or children from construction.
Operation Impacts (direct with indirect in parentheses)	
NI (SI) • The NDWWTP would be upgraded to include required sewer improvements to serve increased DoD demand; therefore, no impacts on low-income populations or children. (Significant indirect wastewater impacts and associated heath and health care services impacts on low-income populations, including children of low-income families with increased demand of construction workforce and induced civilian population growth).	NI (SI) • Same as Basic Alternative 1a.

Note: Potential impacts under Long-term Alternatives 1-4 would be analyzed under future National Environmental Policy Act documentation; potential impacts listed herein are general and not final.
Legend: DoD = Department of Defense; LSI = Less than significant impact; NDWWTP = Northern District Wastewater Treatment Plant; NI = No impact; SI = Significant impact; * Preferred Alternative.

As shown in Table 20.2-5, no impacts associated with environmental justice or protection of children are anticipated under the Preferred Alternative for solid waste.

Table 20.2-5. Summary of Potential Impacts: Solid Waste

Basic Alternative 1 (Preferred Alternative)
Construction and Operation Impacts
NI

Legend: NI = No impact.

Table 20.2-6 summarizes the potential impacts of each off base roadway alternative. Proposed roadway projects include intersection improvements, bridge replacements, pavement strengthening, relocation of Route 15, roadway widening, and the construction of a new road (the Finegayan Connection). Roadway projects would occur in all Guam villages except the southern Guam villages of Yona, Agat, Talofofo, Inarajan, Umatac, and Merizo. While the low-income populations and children living or present near the roadway projects would experience impacts from temporary traffic increases during the construction period, these impacts would be mitigated by the proposed phased project schedule. When construction is complete, the improved roadway infrastructure would have a beneficial impact on the surrounding community. Therefore, no disproportionally high and adverse effects on low-income populations or children would occur.

20.2.9 Summary of Proposed Mitigation Measures

Table 20.2-7 summarizes proposed mitigation measures for each component of the proposed action.

Table 20.2-6. Summary of Roadway Project Impacts

Alternative 1	*Alternative 2**	*Alternative 3*	*Alternative 8*
Construction (direct and indirect impacts are the same)			
NI • No disproportionately high and adverse effects on low-income populations or children from construction.	• Same impacts as Alternative 1.	• Same impacts as Alternative 1.	• Same impacts as Alternative 1.
Operation (direct and indirect impacts are the same)			
NI • No disproportionately high and adverse effects on low-income populations or children related to roadway infrastructure after construction is completed. BI • Beneficial impact to low-income populations and children due to improved, safer roadway infrastructure after construction is completed.	• Same impacts as Alternative 1.	• Same impacts as Alternative 1.	• Same impacts as Alternative 1.

Legend: LSI = Less than significant impact; BI = Beneficial impact; *Preferred Alternative.

Table 20.2-7. Summary of Proposed Mitigation Measures

Power Alternatives	*Potable Water Alternatives*	*Wastewater Alternatives*	*Solid Waste Alternatives*	*Off Base Roadway Alternatives*
Utilities				
• No mitigations needed.	• The DoD would implement the mitigation measures in Volume 6, Chapter 3 and Volume 7, Chapter 2.	• The DoD would implement the mitigation measures in Volume 6, Chapter 3 and Volume 7, Chapter 2.	• No mitigations needed.	• No mitigations needed.
Public Health and Safety				
• No mitigations needed.	• The DoD would implement the mitigation measures in Volume 6, Chapter 3 and Volume 7, Chapter 2.	• The DoD would implement the mitigation measures in Volume 6, Chapter 3 and Volume 7, Chapter 2.	• No mitigations needed.	• No mitigations needed.

Legend: DoD = Department of Defense; EIS = Environmental Impact Statement.

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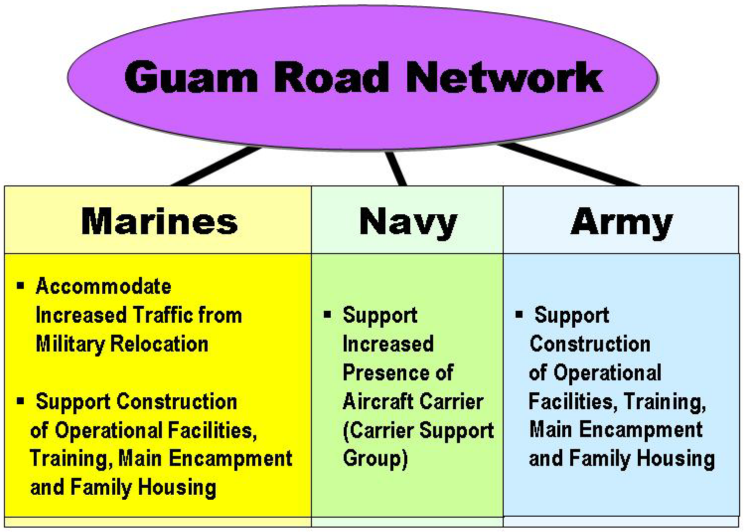
CHAPTER 21.
SECTION 4(F) AND SECTION 6(F)EVALUATION

21.1 PROPOSED PROJECT

The roadway projects are encompassed within the Guam Road Network (GRN), which comprise the non-military roadway system on the island of Guam. Construction of the GRN projects is required to accommodate three proposed military actions (Figure 21.1-1). First, increased traffic from the military relocation of approximately 8,600 Marines of the III Marine Expeditionary Force and their dependents from Okinawa by 2014 needs to be addressed. Aviation and waterfront operations, training, main cantonment, family housing and associated utilities, and infrastructure improvements comprise the scope of activities to be conducted in support of Marine Corps projects on the island. Roadway improvements are needed to support construction of the facilities and the ensuing traffic related to the proposed military relocation on Guam. Roadway improvements are also connected to construction of operational facilities, training, main cantonment, and family housing on Guam to support the defensive mission of the Marine Corps.



Source: Parsons

Figure 21.1-1. Connectivity of the Guam Road Network

Second, the roadway improvements are connected to Navy initiatives associated with an increase in aircraft carrier presence to support engagement and deterrence consistent with the global shift of trade and transport. A new deep-water wharf at Apra Harbor is needed to support the increased Navy presence and port visits associated with a Carrier Strike Group.

Third, the roadway improvements are also connected to construction of operational facilities, training, main cantonment, and family housing on Guam to support the Army Ballistic Missile Defense Task Force (BMDTF) and its defensive mission.

Improvements to the roadway network on Guam are needed to allow efficient and safe access to military lands for construction of facilities and to accommodate military-related and projected organic (ongoing) traffic growth on Guam. The existing roadways connecting the population centers and Department of Defense (DoD) lands on Guam are shown in Figure 21.1-2.

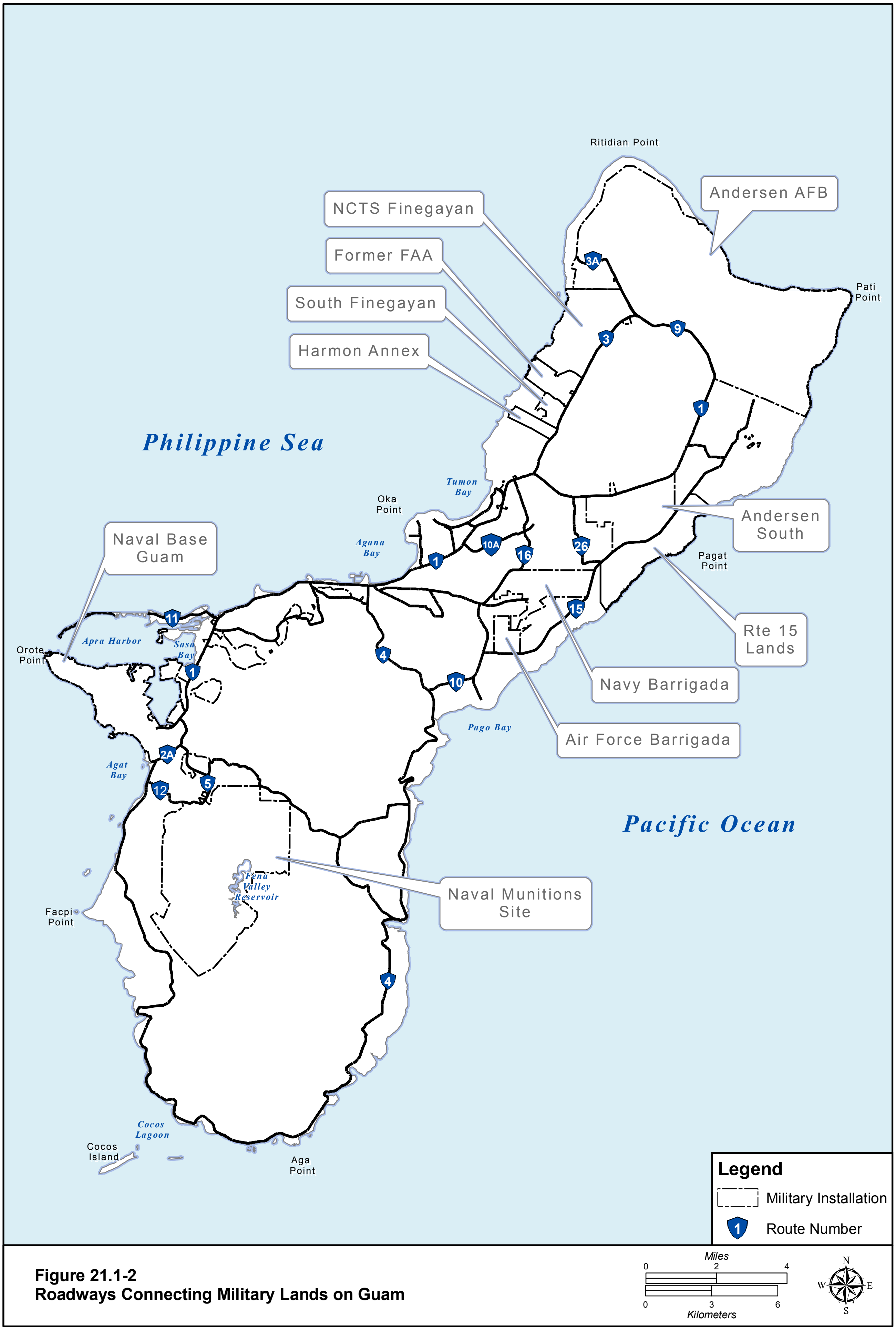


Figure 21.1-2
Roadways Connecting Military Lands on Guam

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The proposed construction of roadway improvements would be located on the island of Guam, which is geographically part of the Mariana Islands archipelago. Guam is a territory of the United States (U.S.). The setting for the project encompasses the primary roadway network for the entire island of Guam, comprising 20 federal-aid roadways and one local road totaling approximately 66 miles (106 kilometers).

21.1.1 Purpose and Need

While a complete discussion of the purpose and need for the project is provided in Volume 6, Chapter 1, basically, an improved network of roads on Guam is needed as part of the mission-critical infrastructure to support planned relocation of Marines and their dependents, as well as to accommodate ongoing growth on the island in accordance with the 2030 Guam Transportation Plan. The island of Guam is experiencing roadway problems that include inadequate bridges; flooding roads; poor lane visibility, as a result of tight corners, poor lane striping, lighting, and lane geometry; high accident locations; landslides; eroding embankments; and inadequate intersections because of the absence of traffic signals. To meet these needs, the proposed GRN projects would include roadway widening, improvements to existing intersections and new intersections that would serve as military access points, bridge replacements, pavement strengthening at specific locations islandwide, the realignment of Route 15, and a new Core Bus System. These improvements are needed to resolve traffic congestion during the construction period from 2010 through 2016, with peak construction and peak population in 2014, and to accommodate the ensuing traffic increase from full military relocation combined with projected organic growth. The transportation network would become an integral component for fulfilling the U.S. defense strategy and alliance requirements and would provide an enhanced capability to defend critical military assets on Guam through the Army BMDTF.

21.1.2 Project Alternatives

A complete discussion of the project alternatives is provided in Volume 6, Chapter 2. There were four build alternatives that were carried forward. All the build alternatives use the Agana Bridge #1 equally to the same extent. The Agana Bridge #1 is the only Section (§) 4(f) property used, other than the *de minimus* park uses.

21.1.2.1 Alternative 1

Alternative 1 includes utilizing Naval Computer and Telecommunications Station (NCTS) Finegayan (809 acres [ac] [327 hectares (ha)]), South Finegayan (290 ac [117 ha]), acquisition or long-term leasing of the Former Federal Aviation Administration (FAA) parcel (680 ac [275 ha]), and acquisition or long-term leasing of land in the Harmon Annex (326 ac [132 ha]) for a total of 2,105 ac (852 ha). A detailed view of the Main Cantonment configuration associated with this alternative is presented in Volume 6, Chapter 2, Figure 2.5-9 (Alternative 1 Housing and Cantonment).

The Main Cantonment would include housing facilities, base operations and support facilities, various headquarters and administrative support facilities, Quality of Life (QOL) facilities (e.g., shops, schools and recreation), training areas, and open space. Military personnel, including Army BMDTF, and their dependents would generally live, work, recreate, and shop in the north to northwest part of Guam.

Most ground training activities (non-firing and firing) would occur on the east coast of Guam; the principal battalion-level training area would be on the island of Tinian, which is north of Guam. Waterfront activities would be at Apra Harbor, but most Marine Corps vehicle traffic would be in the northern half of the island, except during embarkation when Marines would be at Apra Harbor in preparation for training deployment. Amphibious Readiness Group embarkation and berthing would be at contiguous wharves, but the U.S. Coast Guard would need to be relocated to Oscar/Papa Wharves. Under this alternative, the new deep-draft aircraft carrier berth would be at the Former Ship Repair Facility. The water and wastewater proposals under this alternative provide the greatest capacity and benefit to populations outside of the military relocation. The existing Northern District Wastewater Treatment Plant would be upgraded with secondary treatment capacity. Upgrades and improvements to the existing Guam Power Authority system would be funded, but no new power generation capacity would be provided. Solid waste would be managed on DoD lands.

The roadway projects that would be required for Alternative 1 are all projects listed in Volume 6, Chapter 2, Table 2.5-1, with the exception of the following GRN projects: #38, #39, #41, #47, #48, #49A, #63, and #74.

21.1.2.2 Alternative 2 (Preferred Alternative)

Alternative 2 is the preferred alternative and includes utilizing NCTS Finegayan (1,230 ac [498 ha]), South Finegayan (290 ac [117 ha]), and acquisition or long-term leasing of the Former FAA parcel (680 ac [275 ha]) for a total of 2,200 ac (890 ha). A detailed view of the Main Cantonment configuration associated with this alternative is presented in Volume 6, Chapter 2, Figure 2.5-10 (Alternative 2 Housing and Cantonment).

The roadway projects that would be required for Alternative 2 are all projects listed in Volume 6, Chapter 2, Table 2.5-1, with the exception of the following GRN projects: #38A, #39A, #41A, #47, #48, #49, #49A, #63, and #74.

21.1.2.3 Alternative 3

Alternative 3 includes utilizing NCTS Finegayan (1,230 ac [498 ha]), South Finegayan (290 ac [117 ha]), with portions of military housing and QOL services at Air Force Barrigada and Navy Barrigada (420 ac and 377 ac, respectively [174 ha and 153 ha, respectively]), for a total of 2,327 ac (942 ha). A detailed view of the Main Cantonment configuration associated with this alternative is presented in Volume 6, Chapter 2, Figure 2.5-11 (Alternative 3 Housing and Cantonment).

The roadway projects that would be required for Alternative 3 are all projects listed in Volume 6, Chapter 2, Table 2.5-1, with the exception of the following GRN projects: #20, #31, #38A, #39A, #41, #41A, and #124.

21.1.2.4 Alternative 8

Alternative 8 includes NCTS Finegayan 809 ac [327 ha]), acquisition or long-term leasing of the Former FAA parcel (680 ac [275 ha]), and South Finegayan (290 ac [117 ha]), with portions of military housing and QOL services at Air Force Barrigada (430 ac [174 ha]), for a total of 2,209 ac (894 ha). A detailed view of the Main Cantonment configuration associated with this alternative is presented in Volume 6, Chapter 2, Figure 2.5-7 (Alternative 8 Housing and Cantonment).

The roadway projects that would be required for Alternative 8 are all projects listed in Volume 6, Chapter 2, Table 2.5-1, with the exception of the following GRN projects: #38, #39, #41, #47, #48, #49, #63, and #74.

21.1.3 Other Alternatives Considered but Eliminated

For discussion of other alternatives considered but eliminated, refer to Volume 2, Chapter 2.

21.2 SECTION 4(F) EVALUATION

21.2.1 Purpose

§ 4(f) of U.S. Department of Transportation Act of 1966 (49 U.S. Code [U.S.C.] § 303 et seq.) declares that:

(a) It is the policy of the United States Government that special effort should be made to preserve the natural beauty of the countryside and public park and recreation lands, wildlife and waterfowl refuges, and historic sites.

(b) The Secretary of Transportation shall cooperate and consult with the Secretaries of the Interior, Housing and Urban Development, and Agriculture, and with the States, in developing transportation plans and programs that include measures to maintain or enhance the natural beauty of lands crossed by transportation activities or facilities.

(c) Approval of programs and projects.--Subject to subsection (d), the Secretary may approve a transportation program or project (other than any project for a park road or parkway under section 204 of title 23) requiring the use of publicly owned land of a public park, recreation area, or wildlife and waterfowl refuge of national, State, or local significance, or land of an historic site of national, State, or local significance (as determined by the Federal, State, or local officials having jurisdiction over the park, area, refuge, or site) only if:

> (1) there is no prudent and feasible alternative to using that land; and
>
> (2) the program or project includes all possible planning to minimize harm to the park, recreation area, wildlife and waterfowl refuge, or historic site resulting from the use.

Likewise, under 49 U.S.C. 303 (d) "The Administration [Federal Highway Administration (FHWA)] can determine that the use of the property, including any measure(s) to minimize harm (such as avoidance, minimization, mitigation, or enhancement measures) committed to by the applicant, would have a 'de minimus' impact on the property." See also 23 Code of Federal Regulations [CFR] 774.3(b)).

The regulations interpreting § 4(f) state that "The potential use of land from a § 4(f) property shall be evaluated as early as practicable in the development of the action when alternatives to the proposed action are under study" (23 CFR 774.9(a)). The use of § 4(f) resources occurs when (1) land from a § 4(f) site is permanently incorporated into a transportation facility; (2) there is a temporary occupancy of § 4(f) land that is adverse in terms of the statute's preservation purpose, or (3) when a "constructive use" of a § 4(f) property is determined. "A constructive use occurs when the transportation project does not incorporate land from a Section 4(f) property, but the project's proximity impacts are so severe that the protected activities, features, or attributes that qualify the property for protection under Section 4(f) are substantially impaired" (23 CFR 774.15(a)).

The term "historic site" includes any prehistoric or historic district, site, building, structure, or object included in or eligible for inclusion in the National Register of Historic Places (NRHP) (23 CFR 774.17). § 4(f) does not apply to archaeological sites on or eligible for the NRHP when the FHWA concludes that the archaeological resource is important chiefly because of what can be learned by data recovery and has minimal value for preservation in place (23 CFR 774.13(a)(1)). Constructive use does not occur when compliance with the requirements of Section 106 of the National Historic Preservation Act (16 U.S.C. § 470) and related regulations defining proximity impacts of a proposed project on an NRHP site results in "an agreement of no historic properties affected" or "no adverse effect" (23 CFR 774.15(f)(1)).

§ 4(f) further requires consultation with the U.S. Department of the Interior and, as appropriate, the involved offices of the U.S. Department of Agriculture and the U.S. Department of Housing and Urban Development in developing transportation projects and programs that use properties protected by § 4(f).

Because the Guam roadway projects would involve the use of § 4(f) properties, this evaluation identifies the significant § 4(f) resources in the project area, describes the nature and extent of the use of these significant properties, evaluates alternatives that would avoid the use of § 4(f) resources, and describes measures to minimize harm to the affected resources.

21.2.2 Section 4(f) Properties

21.2.2.1 Public Parks

Please refer to Volume 6, Chapter 11, for full discussion of public parks and recreation areas potentially affected by the GRN projects.

Route 1 provides the principal access to recreational opportunities in the western segment of the Central Region (i.e., Piti, Asan, Hagatna, Mongmong, and Tamuning). Proposed improvements along Route 1 include pavement strengthening, intersection improvements, bridge replacement, and military access points. Recreational opportunities along the western segment of the Central Region largely comprise beaches, trails, public parks, and scenic vistas. Portions of Route 1 are located immediately adjacent to or near these areas.

The three parks that could be affected by the GRN projects include Guam Seal Park, Dededo Buffer Strip Park, and Chinese Park.

21.2.2.2 Wildlife Refuges

On the northernmost part of the island, the Guam National Wildlife Refuge (GNWR) was established in 1993 with the Ritidian Unit, which was relinquished by the Navy. Most of the refuge, approximately 22,500 ac (9,105 ha), including the area potentially affected by the GRN, is an "Overlay Refuge" on lands administered by the Air Force and the Navy. Pursuant to the Memorandum of Understanding executed in 1993 among the Government of Guam, the Air Force, the Navy, and U.S. Fish and Wildlife Service, the primary purpose of Air Force and Navy lands within the GNWR is to support the national defense mission of the Air Force and the Navy. The military mission has priority on these lands; however, the U.S. Fish and Wildlife Service helps protect native species and habitats.

Given the military mission precedence on the GNWR Overlay lands, wildlife protection is not the major purpose; therefore, it is not determined to be subject to the protective provisions of § 4(f).

Historic Sites

Figure 21.2-1 shows known historic sites in relation to the Area of Potential Effect established for the GRN projects. The Area of Potential Effect was identified in consultation with the Guam State Historic Preservation Office (SHPO) in December 2008 (see Volume 6, Chapter 14). The sites included are sites previously determined eligible for or listed on the NRHP.

Since circulation of the Draft Environmental Impact Statement (EIS), including Figure 21.2-2 referenced above, Agana Bridge #1, which conveys both east and westbound lanes on Route 1, has been reconsidered by the Guam SHPO and found eligible for inclusion in the NRHP. The bridge is of a single-span reinforced concrete box construction and highlighted with stylized parapets. The bridge was originally built in 1945 near the village of Hagatna, as part of the U.S. military reconstruction of Guam following Japanese occupation during World War II. The bridge was eventually expanded to six lanes, but data on the precise dates of the widening and the extent of modifications are not available because most government records detailing the bridge's evolution were destroyed in a typhoon. Upon a field visit and discussion with Guam SHPO, the bridge was determined to be eligible for listing in the NRHP under Criterion A at the local level for its association with events that have made a significant contribution to the broad patterns of Hagatna's history and its role in the War in the Pacific. However, only the parapets are considered original and character-defining elements. The FHWA requested formal concurrence by the Guam SHPO in this determination of eligibility, by letter dated April 15, 2010, and the Guam SHPO verbally concurred (see Attachment 1). Figure 21.2-2 is a contemporary photograph of Agana Bridge #1 with a perspective of two parapets.

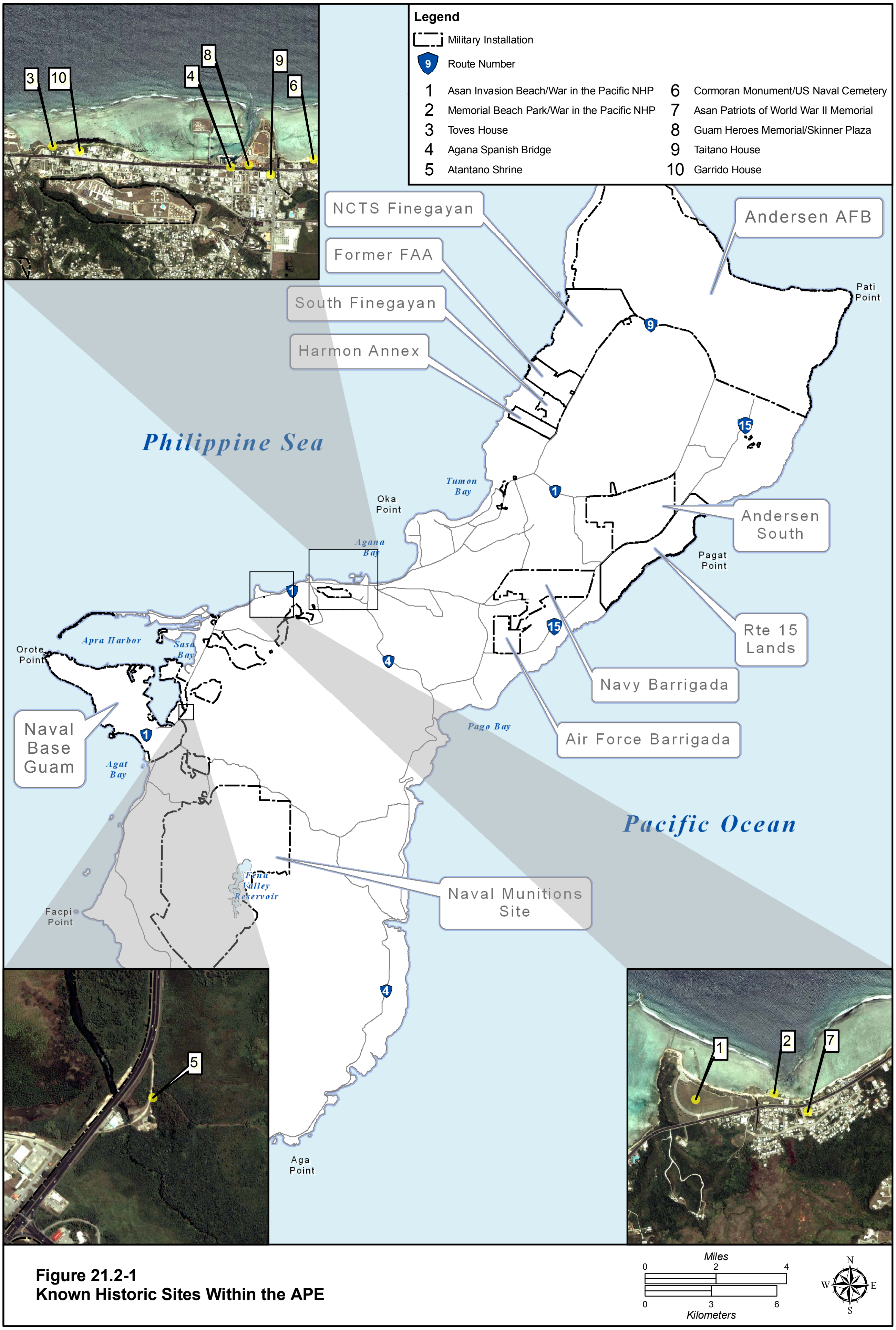

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Figure 21.2-1
Known Historic Sites Within the APE

Figure 21.2-2. Agana Bridge #1

21.2.3 Impacts on Section 4(f) Properties

All the build alternatives use the Agana Bridge #1 equally to the same extent. The Agana Bridge #1 is the only § 4(f) property used, other than the *de minimus* park uses.

21.2.3.1 Public Parks

Based on preliminary engineering design information, minor right-of-way (ROW) acquisition or temporary use would be required at three parks located along Route 1, as described below.

Photo 21.2-1. Limits of Potential Impact at Guam Seal Park

- **Guam Seal Park** would be affected by GRN #3 (Agana Bridge #1 Replacement). GRN #3 is included under all alternatives. The location of Guam Seal Park is shown on Figure 21.2-3). The bridge replacement activity would not, in itself, require permanent acquisition of land in the park. However, there would be a temporary impact during construction, limiting access to the area of the park near the bridge abutment and Agana River as shown in Photo 21.2-1. Access would be temporarily restricted at the northeast corner of the intersection of Routes 1 and 4. Access from other entrances to the park, as well as access to the walking trail within the park, would continue to be available during the construction period for the bridge replacement.

- **Dededo Buffer Strip Park** would be affected by GRN #7 and GRN #6 intersection widening at Routes 1 and 27, and Routes 1 and 26. GRN #7 and GRN #6 are part of all alternatives. The location of Dededo Buffer Strip Park is shown on Figure 21.2-4. While the widening currently depicted in Photo 21.2-2 can likely be adjusted to avoid most of the linear impact, at the intersection with Route 27 the existing roadway appears to encroach on the park ROW by using a narrow strip along Route 1, which totals approximately 500 square feet (46 square meters).

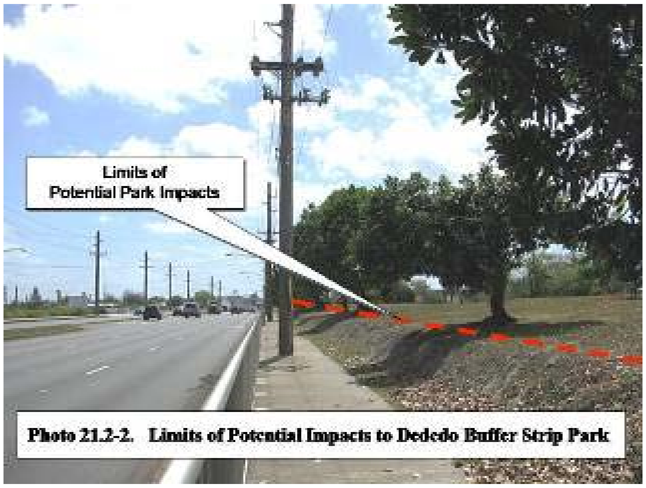

Photo 21.2-2. Limits of Potential Impacts to Dededo Buffer Strip Park

- **Chinese Park** would be affected by the GRN #33 intersection widening at Routes 1 and 14, which is part of all alternatives. The location of Chinese Park is shown in Figure 21.2-5. The existing ROW parcel line appears to indicate that the existing roadway is built partially inside the park ROW. Approximately 15,900 square feet (1,477 square meters) of land in the park, consisting of a triangular sliver located on a steep grade in the southeast corner of the park, would need to be acquired to correct this situation and to allow the intersection improvements. The area of encroachment is shown on Photo 21.2-3. Based on field observations, the potentially affected area slopes approximately 45 degrees and appears to be unusable for park purposes.

Photo 21.2-3. Limits of Potential Impact at Chinese Park

The above information is subject to change during the detailed engineering design phase. Some design adjustment could also minimize impacts to the existing parklands to ensure the project does not adversely affect important park features, attributes, or activities. After public review and comment on the Draft EIS and § 4(f) Evaluation, FHWA coordinated with respective park officials to determine whether the project would adversely affect the protected activities, features, or attributes of the park. That coordination is described below (under Section 21.2.5, § 4(f) Coordination), and it led respective park officials to concur with FHWA in the determination that the project would have a “de minimus” (of minimum importance) impact to the park. Because construction of the proposed improvement projects would be centered on the existing roadway corridor and intersections, no park closure is anticipated during the peak construction year.

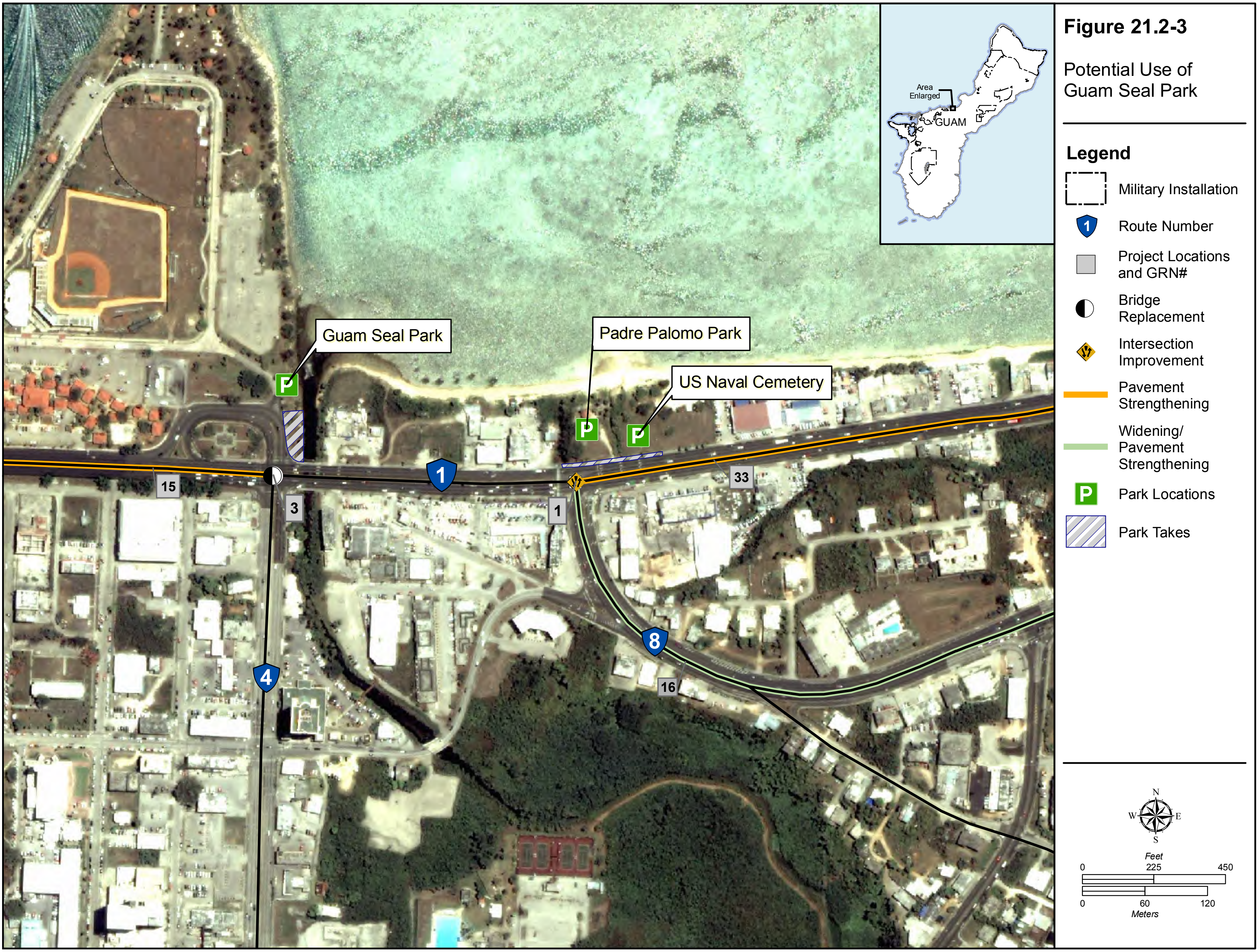

Figure 21.2-3

Potential Use of Guam Seal Park

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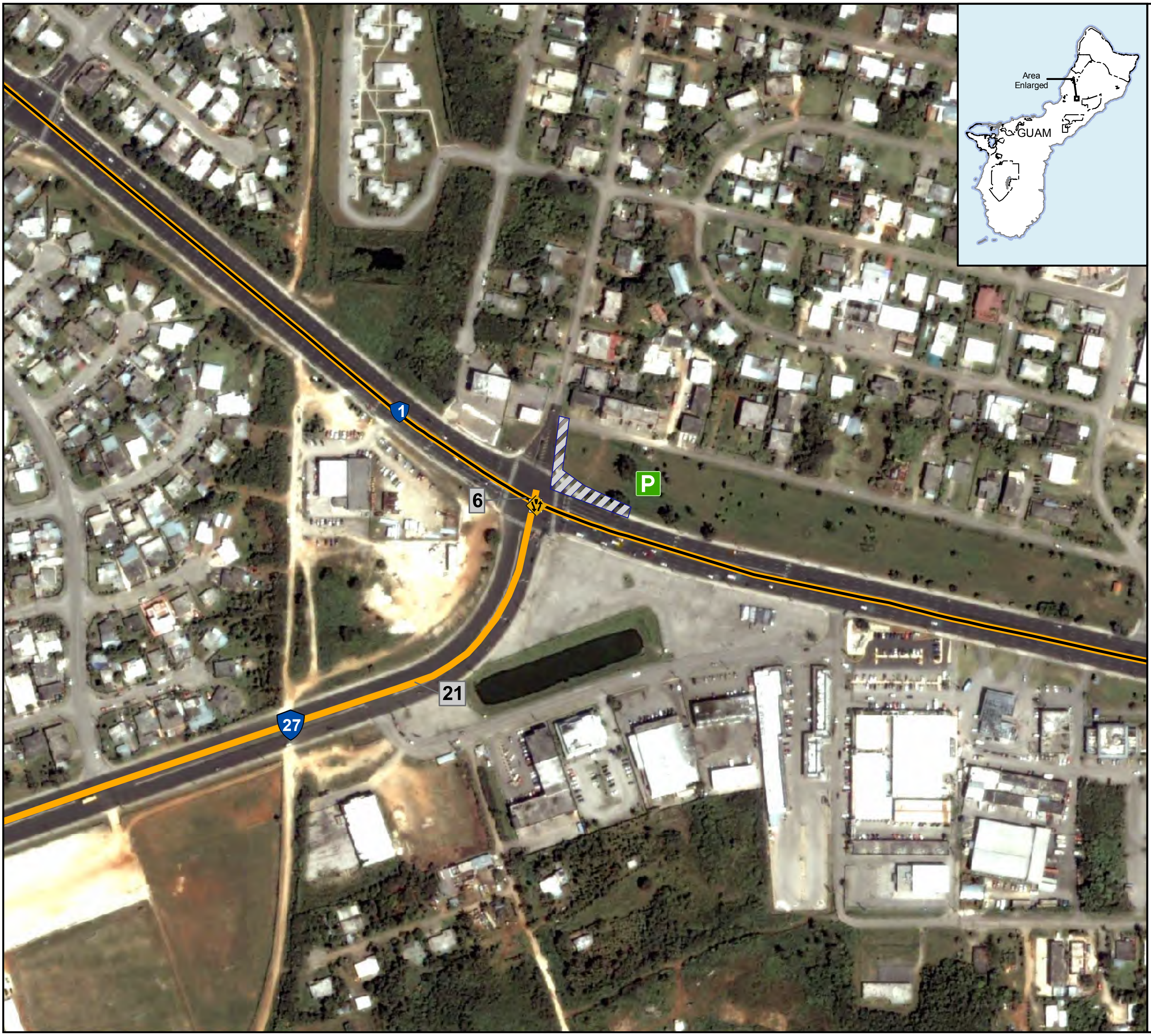

Figure 21.2-4

Potential Use of Dededo Buffer Strip Park

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Figure 21.2-5

Potential Use of Chinese Park

Historic Sites

Refer to Volume 6, Chapter 14, for a full discussion of the historic sites potentially affected by the GRN projects. Effects on known historic sites are summarized in Table 21.2-1. These effects are essentially the same for all four build alternatives. Table 21.2-1 lists known historic sites in relation to GRN projects. The table excludes potential impacts to archaeological sites that are not considered § 4(f) resources. The War in the Pacific National Historic Park straddles Route 1 within GRN #13. It includes both Asan Invasion Beach and Memorial Beach. All three sites are historic properties.

Table 21.2-1. Effects of All Alternatives on Known Historic Sites

GRN Number	*Historic Sites*	*Section 106 Effect*
1	Cormoran Monument, U.S. Naval Cemetery Fortification	The Cormoran Monument would not be affected. This is a pavement strengthening project; therefore, the improvements do not extend beyond the existing roadway.
3	Agana Bridge #1	Project 3 would replace the NRHP-eligible Agana Bridge #1. As such, it would constitute an Adverse Effect. Guam SHPO has indicated that the bridge parapets are its sole significant character-defining (eligible) features.
13	Asan Invasion Beach, Memorial Beach Park, War in the Pacific National Historical Park	No historic properties affected.
14	Asan World War II Memorial	No historic properties affected.
15	San Nicholas Bridge, Agana Spanish Bridge, Guam Heroes Memorial and Skinner Plaza, Taitano House, Garrido House, Toves House	No historic properties affected.
24	Atantano Shrine	No historic properties affected.

Legend: SHPO = State Historic Preservation Office; GRN = Guam Road Network; NRHP = National Register of Historic Places; U.S. = United States.

21.2.4 Measures to Minimize Harm to Section 4(f) Properties

21.2.4.1 Public Parks

§ 4(f) requires all possible planning to minimize harm if a non–de minimus use occurs. Accordingly, to minimize the park encroachment on recreational land at Chinese Park, the Guam Department of Public Works (GDPW) would evaluate the feasibility of constructing a retaining wall, which would be approximately 20 feet (6.1 meters) high; aesthetic treatment could be used to minimize the visual effect of the wall. Measures to further minimize park use at Guam Seal Park and Dededo Buffer Strip Park would also be considered during the detailed engineering design phase.

To ensure maintenance of access to public parks, the GDPW would develop a Traffic Management Plan for implementation during construction activities. The Traffic Management Plan would identify and provide alternate traffic detour routes, construction materials hauling routes, bus stops, transit routes and operation hours, pedestrian routes, and residential and commercial access routes to be used during the construction period.

The GDPW would also develop an outreach program to keep residents, tourists, businesses, and any service providers within the area informed, and to inform surrounding communities about the project construction schedule, areas affected by traffic, the Traffic Management Plan, and other relevant project information.

21.2.4.2 Historic Sites

GRN #3 would replace the NRHP-eligible Agana Bridge #1. A Memorandum of Agreement (MOA) is being developed pursuant to Section 106 among FHWA, Guam SHPO, and GDPW to resolve this adverse effect. The MOA stipulations will include incorporating into the new bridge's structural design parapets emulating the architectural style of the original parapets to reflect the character and feel of the historic bridge.

As described in Volume 6, Chapter 14, FHWA would be responsible for further work, including any sub-surface testing to identify historic properties, where necessary. Data recovery measures, if required, would be implemented, where appropriate, as determined through Section 106 consultation with the Guam SHPO and other cultural resources stakeholders. Monitoring may be required for some GRN projects.

21.2.5 Section 4(f) Coordination

Public notice and an opportunity for review and comment concerning the project's effects on protected activities, features, or attributes of § 4(f) properties must be provided (per 23 CFR §774.5(2)(i)). FHWA has satisfied this coordination requirement because the Draft EIS was released to the public on November 20, 2009, for a 90-day period. During the 90-day period, the public was encouraged to review and submit comments on the Draft EIS. Four public hearings were held on Guam to provide an opportunity for the community to submit both oral and written comments regarding the Draft EIS. Two written comments pertaining to parkland impacts and one comment regarding the GNWR were received. The responses to the comments were as follows:

- The first comment stated that the affected parkland should be replaced prior to the roadway construction. FHWA clarified that the required acquisition of the parkland would be minimal and no parkland replacement would be needed.
- The second comment stated that the federal government should pay for the retaining wall construction near Chinese Park because the proposed roadway improvement is a part of the military action. FHWA responded that funding for the design and construction of the retaining wall would be requested through the Defense Access Road program. Maintenance costs would be the responsibility of the GDPW because they would own the facility.
- The third comment stated that § 4(f) applies to the preservation of wildlife and waterfowl refuges and by encroaching on the GNWR, the DoD would potentially cause harm to wildlife and waterfowl protected in that area, and that the proposed military actions would directly negatively affect wildlife outside the GNWR; therefore, the Final EIS should treat the GNWR as subject to § 4(f). FHWA responded that § 4(f) only applies to those publicly owned lands for which the officials having jurisdiction determine that the "major purpose" is to function as a park, recreation area, or refuge. Wildlife protection is not the major purpose of the GNWR Overlay. The officials that have jurisdiction over administering this property, the DoD, recognized and codified in the agreement with the U.S. Fish and Wildlife Service that the military needs of the agency take precedence and shall receive priority consideration over the mission of the U.S. Fish and Wildlife Service.

A meeting between FHWA, GDPW, and Guam Department of Parks and Recreation (GDPR) was held on January 12, 2010, to discuss the three parks affected by the GRN projects. Four GDPR representatives attended the meeting: Joseph Duenas (Director), Jose Quinata, Jose Garrido, and William Hernandez. The meeting included discussions about each of the potentially affected parks and FHWA's intent to issue a *de* *minimus* impact finding for each of the properties. The GDPR representatives did not express any issues with the projects or their potential effects on the parks at the time of the meeting. The meeting was documented in a letter from FHWA to GDPR dated April 11, 2010 (see Attachment 3), which included a request for GDPR's written concurrence that the proposed GRN projects would not adversely affect protected activities, features, or attributes of Guam Seal Park, Dededo Buffer Strip Park, and Chinese Park, thus allowing the FHWA to issue a *de minimus* impact finding for each of these three properties. The GDPR concurrence letters are attached (see Attachment 4).

Section 106 coordination with the Guam SHPO is ongoing. Guam SHPO representatives are visiting each project site to assist with National Historic Preservation Act § 106 compliance efforts (see Volume 6, Chapter 14, for full § 106 coordination details). A full list of historic properties and potential effects was submitted to the Guam SHPO and consultation is ongoing (see Attachment 1). Some historic properties may not be discovered through archival research and surface surveys. An MOA is being developed between FHWA and Guam SHPO to govern these situations. Segments of roadway would be designated by their potential to hold historic properties. This assessment would be compiled using previous archaeological investigations, historic maps, interviews, ethnohistoric accounts and an understanding of post-depositional site formation processes. These evaluations would be completed in consultation with the Guam SHPO and the National Park Service (NPS).

21.2.6 Section 4(f) Determination

21.2.6.1 Public Parks

For each of the three affected public parks (Guam Seal Park, Dededo Buffer Strip Park, and Chinese Park), the use is considered *de minimus* when, after taking into consideration appropriate mitigation measures and both public and official comments, it has been determined that:

- The GRN use of the three properties, each considered on an individual basis, with avoidance, minimization, enhancement or mitigation actions incorporated into the project plans, would not adversely affect the activities, features, and attributes that qualify the properties for protection under § 4(f),
- The officials with jurisdiction over the park properties (GDPR) have agreed, in writing, that the use will not adversely affect the features and attributes of the properties, and they have been informed by FHWA of their intent to make a *de minimus* finding based on that agreement, and
- The public has been provided an opportunity to review and comment on the effects of the project on the protected activities, features, and attributes of the § 4(f) properties.

FHWA has considered each of these resources on an individual basis and agrees that a *de minimus* determination is appropriate and therefore fulfills all § 4(f) requirements for the affected park resources.

21.2.6.2 Historic Sites

FHWA has determined that there is no feasible and prudent alternative to the use of the NRHP-eligible Agana Bridge #1 based on the analysis conducted. This determination was made in consultation with the Guam SHPO, resulting in an MOA to be executed including stipulations that amount to measures to minimize harm. FHWA has therefore determined that the bridge replacement activity meets the applicability criteria as set forth in the Nationwide Programmatic § 4(f) Evaluation and Approval for FHWA Projects that Necessitate the Use of Historic Bridges, dated July 5, 1983. The programmatic § 4(f) Evaluation is attached hereto (see Attachment 5).

21.3 SECTION 6(F) EVALUATION

21.3.1 Purpose

A separate law that sometimes also relates to § 4(f) is § 6(f) of the Land and Water Conservation Fund Act (LWCFA) of 1965 (16 U.S.C. § 4601-4). § 6(f) established a funding source for matching grants to state and local governments for recreation planning, acquisition and development, and acquisition of land, waters, or wetland areas. § 6(f), administered by the Department of Interior's NPS, prohibits any project that proposes impacts to, or the permanent conversion of, outdoor recreation property acquired or developed with these grants unless alternatives are assessed and steps are taken to identify, evaluate, and supply replacement parkland. In addition, the Secretary of the Department of Interior, acting through the NPS, must grant approval for the conversion and replacement parkland.

Relevant information regarding the following is a prerequisite for conversion:

- All practical alternatives have been evaluated;
- The fair market value of the replacement property is at least equal to that of the converted property;
- The replacement property is at least as useful and of similar location as the converted property;
- The replacement property has met the eligibility requirements for LWCF assisted acquisition as outlined in 36 CFR 59.3(b)(4)(i-iv);
- All other relevant agency coordination has been completed, including compliance with § 4(f); and
- The proposed conversion and replacement is in accordance with the Statewide Comprehensive Outdoor Recreation Plan, which identifies public recreation trends and provides strategies for improving outdoor recreation within the state.

Because both laws can overlap the same properties, § 4(f) and § 6(f) are often discussed in the same context because it is not uncommon for recreational resources and parklands to receive LWCFA funding, thereby making § 6(f) at times integral to the § 4(f) process.

Because the Guam roadway project would potentially involve the conversion of a § 6(f) resource, this chapter identifies the affected parkland resources in the project area and describes measures to meet the federal conversion requirements.

21.3.2 Section 6(f) Properties

Two parks within the proposed GRN projects received Land and Water Conservation Fund Act grants, Chinese Park and Dededo Buffer Strip Park, and are thus lands protected under § 6(f). After a review of the § 6(f)(3) boundary maps were conducted, it was determined that § 6(f) only applied to Chinese Park. The area to be acquired for the roadway project from the Dededo Buffer Strip Park is outside of the § 6(f)(3) boundary map for the park.

All project alternatives would require acquisition of a portion of Chinese Park, which is both a § 4(f) and 6(f) property, because Chinese Park would be affected by the GRN #33 intersection widening at Route 1 and 14A. The above information is subject to change during the detailed engineering design phase. Some design adjustment could also minimize impacts to the existing parklands to ensure the project does not adversely affect important park features, attributes, or activities. After public review and comment on the Draft EIS and § 4(f) Evaluation, FHWA coordinated with respective park officials to determine whether the project would adversely affect the protected activities, features, or attributes of the park. That coordination is described in Section 21.2.5, § 4(f) Coordination. Additional coordination will be conducted with Guam Department of Parks and Recreation and the NPS when more detailed information is known regarding the amount of park land required.

21.3.3 Impacts on Section 6(f) Properties

Two parks within the proposed GRN projects area are covered under § 6(f): Chinese Park and Dededo Buffer Strip Park. After a review of the § 6(f)(3) boundary maps were conducted, it was determined that § 6(f) only applied to Chinese Park. The area to be acquired for the roadway project from the Dededo Buffer Strip Park is outside of the § 6(f)(3) boundary map for the park. For Chinese Park, only a portion of land at Chinese Park would require acquisition by the proposed project and would be converted to non-park use.

21.3.4 Measures to Minimize Harm to Section 6(f) Properties

To mitigate impacts caused by the project's required acquisition and conversion of an outdoor recreation park covered under § 6(f), namely Chinese Park, all efforts will be made to minimize the amount of land needed for the project during the planning and design process. While the precise proposed replacement parkland has not yet been identified, the property to replace the affected lands would comply with the policies outlined in the LWCF State Assistance Program Manual, which requires that the replacement property be of reasonably equal recreation value, location, and usefulness.

21.3.5 Section 6(f) Coordination

On June 10, 2010, FHWA received a letter from the Department of the Interior regarding the applicability of § 6(f) of the LWCF Act to the three parks affected under § 4(f), among other things. The DOI letter indicated that FHWA and the Navy should coordinate with the Director of GDPR to identify impacts to properties protected by § 6(f) and the required mitigation measures. The letter also indicated that the NPS must approve conversions of § 6(f) properties. FHWA then requested the § 6(f)(3) boundary maps for the said parks from GDPR and determined that only land to be acquired from Chinese Park is protected under § 6(f). As design progresses, FHWA and GDPW will coordinate with GDPR and the NPS to request approval of the potential park property conversion and any proposed replacement property. Upon identification of the intended replacement property, an independent appraisal value for both the affected property and the replacement property will be provided to the NPS for their review and approval.

Attachment 1. FHWA April 15, 2010 Letter to Guam SHPO

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U.S. Department of Transportation
Federal Highway Administration

Hawaii Federal-Aid Division

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Honolulu, HI 96850
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April 15, 2010

In Reply Refer To:
HDA-HI

RECEIVED
APR 16 2010
4:05pm
Guam Historic
Resources Division

Lynda Aguon
State Historic Preservation Office
Guam Historic Resources Division
490 Chalan Palasyo
Agana Heights, 96910

Dear Ms. Aguon,

The Federal Highway Administration (FHWA) is planning the subject projects, which are being studied in the Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) entitled "Guam and CNMI Military Relocation – Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force." As federal undertakings, the project will comply with Section 106 of the National Historic Preservation Act (NHPA). The FHWA has made an effort to consider potential impacts to historic properties, defined as cultural resources deemed eligible for nomination to the National or Guam Register of Historic Places (NRHP/GRHP), and to afford the Guam State Historic Preservation Office (SHPO) opportunity to comment on the undertaking. Please review this letter, and provided you concur with the determinations provided in the tables and maps, please sign and date at the end of this letter, and return to me.

Project Description
The intent of these projects is to improve the existing roadway network due to the anticipated military build-up. The improvements would result in strengthened roadways, bridge replacements, increased roadway capacity, roadway realignment, new or modified intersections to military bases, and enhanced roadway safety. While there are many individual projects, they fall into one of six categories:

- **Pavement Strengthening** projects may apply seals or overlays to existing roadways or replace existing asphalt and base. Construction is generally limited to existing pavement. These projects have little to no potential to effect historic properties.

- **Intersection Improvements** add turn lanes or realign intersections. These projects have may minor impact outside of existing Right-of-Way.

- **Bridge Replacement** projects would replace bridges over stream or river crossings. There would be ground disturbance over a relatively small area beside and beneath the bridge.

- **Widening** projects will add lanes to existing roads, and increase the width of existing pavement. These projects require new Right-of-Way

- **New Construction** projects propose re-aligning a segment of Route 15 on to Department of Defense (DoD) land, and a new route between the Route 1 and 16 intersection to South Finegayan. This would create a new roadway.

- **Access Points** would provide access to military land. They would have impacts beyond existing pavement and may exceed Right-of-Way.

Statement of APE
The project team met with staff from the Guam SHPO on December 5, 2008, to discuss the projects, and to determine the Area of Potential Effect (APE). As a result of this meeting, it was determined that the APE shall be one parcel adjacent to a project roadway for non-archaeological properties, and 30 feet from edge of construction for archaeological properties. APEs are marked on the GRN project map book, provided to Guam SHPO on February 24 2010.

Section 106 Consultation
For the Guam Roads Network, consultation with Guam SHPO included several meetings and field visits. These are listed below.

<u>December 5, 2008</u>
Attendees: Vic April (Guam SHPO), Patrick Lujan (Guam SHPO), Fred Otte (PB), Jason Bright (PB).
Discussion: The purpose of this meeting was to discuss the Guam Roads Network, and consult with Guam SHPO regarding the area of potential effect, work effort, and expectations for each project. Jason Bright outlined the number of types of projects associated with the Haul Road Network (HRN) EIS, and summarized them by project type, and by those that do, and do not, exceed existing right-of-way.

<u>February 26, 2009</u>
Attendees: Sandy Yee (IARII), Vic April (Guam SHPO)
Discussion: Field visit with Guam SHPO to project sites. During that visit, a determination of No Effect to historic properties was made for many of the roadway areas. Enclosure A lists the GRN road projects and identifies findings of effect. It also identifies the archaeological actions to be taken in road projects for which there is a possibility of historic sites remaining.

<u>October 22, 2009</u>
Attendees: Jason Bright (PB), Fred Otte (PB), Lynda Aguon (Guam SHPO), William Hernandez (Guam SHPO).
Discussions. This teleconference with Guam SHPO discussed the projects, and Section 106 consultation thus far. It covered locations, project descriptions, and the status of probability areas already developed.

<u>February 23, 2010</u>
Attendees: Sandy Yee (IARII), Leslie Lahndt (PTG), Jose Garrido (Guam SHPO), William Hernandez (Guam SHPO), Jason Bright (PB).
Discussion: This meeting toured project locations with project staff and staff from Guam SHPO. It covered historic properties along project roadways, and potential for undocumented properties. Hagåtña (Agana) Bridge (GRN project #4) was visited, discussed and photographed. Areas of potential effect were also discussed.

February 26, 2010
Attendees: Richelle Takara (FHWA), William Hernandez (Guam SHPO), Lynda Aguon (Guam SHPO), Jason Bright (PB), Sandra Cruz-Miller (Guam AG office).
Discussion: This meeting to discuss several FHWA projects covered potential mitigation for effects to the Hagåtña (Agana) Bridge.

Historic Properties
Evaluation of the project's potential to impact historic properties included consulting a number of sources. These include:

1) GIS files of historic site locations on Guam
2) *Soil Survey of the Territory of Guam* in 1988 by the U.S. Department of Agriculture
   Research Design/Work Plan For Archaeological Survey, Testing, and Monitoring Related to Island Wide Road Improvements for the Haul Road Network and Guam Road NEPA, Island of Guam by, IARII
3) Existing literature regarding archaeology, history, ethnography and ethnohistory of the island, including a field inspection of some of the routes included in this project.
4) Two field visits with Guam SHPO staff.

Many of the project roadways, and surrounding terrain, have been inventoried in the past. Yee and Tonamari-Tuggle (2009) summarize previous research and inventory. The diverse sources of data listed above indicate that 20 historic properties, including one historic district, have been identified within the APE of a project roadway. These are described in Table 1.

Only one of these is a new determination. The new determination is the Hagåtña (Agana) Bridge, which is in both east and westbound lanes on Route 1. The bridge is essentially a box culvert with stylized concrete parapets. The bridge was originally built in 1945, during the American rehabilitation of Hagåtña after World War II. It was originally a two lane bridge, then was widened to a four lane bridge[1]. It was widened to six lanes in 1977, but data regarding the dates of these widenings, and the extent of modifications, are not available, as most details were destroyed in a typhoon. Figure 1 is a 1945 aerial photograph of Hagåtña, and shows Marine Corps Drive as a two-travel lane facility. Because it has been widened on at least two occasions, the structure probably lacks integrity. In the field it, appeared as though the box structure was relatively young. Only the white parapets along the bridge appear original, but even this observation cannot be substantiated. Upon a field visit and discussion with Guam SHPO, the bridge was found to be eligible for nomination to the National Register of Historic Places under criterion A, for its association with events that have made a significant contribution to the broad patterns of Hagåtña's history. However, only the parapets were considered original and contributing elements.

FHWA is aware that there may be undocumented properties in some locations, such as subsurface archaeological sites, or properties hidden in dense vegetation. For this reason, the FHWA has associated each roadway with a series of probability statements, capturing the likelihood of encountering undocumented cultural resources. Roadways are characterized as (1) No/Low Probability Areas, (2) Medium Probability Areas, or (3) High Probability Areas, defined as follows:

- No/Low Probability Areas: These areas contain no surface sites and include reclaimed fill lands or heavily disturbed areas. No/Low Probability Areas are also areas that have been previously tested and were found not to contain subsurface resources and are areas not likely to contain subsurface materials based on known social practices or history of the area.

- Medium Probability Areas: These areas have not been surveyed and may have the potential to contain sites or are areas that contain no surface sites but have the potential to encounter subsurface historic resources based on known social practices or history of the area.
- High Probability Areas: These areas contain known surface and/or subsurface sites or are areas where old maps, documents, or legends indicate former villages, towns, or other types of activity area.

Effects to known historic properties are discussed below. In addition, potential impact undocumented resources, is considered.

Findings of Effect

There are 20 historic properties within the APEs of the road projects (see Enclosure A for all road projects and Section 106 findings). Only seven projects have known historic properties within their APEs. Effects to those 20 known resources are summarized in Table 1, and explained below.

Table 1: Historic Properties identified within APE.

Historic Property	Description	Finding of Effect
Cormoran Monument,	The Cormoran Monument is a monument to the sailors lost aboard the *Cormoran*. It is located within the U.S. Naval Cemetery. It was listed on the GRHP July 24, 1974.	No effect (No Historic Properties Affected)
U.S. Naval Cemetery	The U.S. Naval Cemetery in Agana is listed on the NRHP and GRHP.	No Adverse Effect
Aspaalas #675	Archaeological site	No effect (No Historic Properties Affected)
War in the Pacific National Historic Park.	This property includes several units, including Memorial Beach Park and Asan Invasion Beach along Route 1.	No effect (No Historic Properties Affected)
Memorial Beach Park	Memorial Beach Park is listed on the NRHP and GRHP. It is the site of the U.S. invasion, July 21, 1944. It is included within the War in the Pacific NHP.	No effect (No Historic Properties Affected)
Asan Invasion Beach	Asan Invasion Beach is listed on the NRHP and GRHP. It is the site of the U.S. invasion, July 21, 1944. Part of this property is included within the War in the Pacific National Historic Park (NHP).	No effect (No Historic Properties Affected)
Adelup RT Burial	Archaeological site/Burial	No effect (No Historic Properties Affected)
Asan WWII Memorial	Asan Patriots of World War II Memorial is listed on the GRHP, and it is eligible for listing on the NRHP.	No effect (No Historic Properties Affected)
Asan archaeological site #1S3	Archaeological site	No effect (No Historic Properties Affected)
Toves House	Built in 1950, architecturally significant as an example of the Pacific Spanish colonial vernacular architecture	No effect (No Historic Properties Affected)
Agana Spanish Bridge (San Antonio Bridge)	Listed on the NRHP and GRHP. Stone arch bridge ca. 1800.	No effect (No Historic Properties Affected)
San Nicholas Bridge	San Nicholas Bridge is located on an adjacent parcel.	No effect (No Historic Properties Affected)
Hagåtña (Agana) Bridge	The bridge was built in 1945, during the	Adverse Effect, mitigated to No

	rehabilitation of Hagåtña after World War II.	Adverse Effect.
Guam Heroes Memorial	Eligible for the NRHP/GRHP.	No effect (No Historic Properties Affected)
Skinner Plaza	Eligible for the NRHP/GRHP.	No effect (No Historic Properties Affected)
Taitano House	Eligible for the NRHP/GRHP.	No effect (No Historic Properties Affected)
Battle of Finegayan Battlefield	3 August 1944 Battle between American and Japanese troops. Private First Class Frank Peter Witek received the Medal of Honor for his actions during this battle. NRHP/GRHP eligible.	No effect (No Historic Properties Affected)
Garrido House	Listed on the GRHP in 1984.	No effect (No Historic Properties Affected)
Agana-Hagatna Pillbox	Listed on the NRHP and GRHP. Japanese coastal defense fortifications.	No effect (No Historic Properties Affected)
Hagåtña (Agana) Historic District	9,000 square meter area consisting of 5 structures, crosses a project roadway.	No effect (No Historic Properties Affected)
Atantano Shrine	Listed on the NRHP and GRHP. This shrine marks the location where Piti villagers honored 18th century Spanish Governor Felipe Cerain for constructing a road that connected the southern half of the island with the capital of Hagåtña.	No effect (No Historic Properties Affected)
Unnamed prehistoric site	Archaeological site	Adverse Effect

Project 1 is a pavement strengthening project past the US Naval Cemetery and Cormoran Monument. Although the improvements do not extend beyond the existing roadway, the geographic information system right-of-way (ROW) parcel line appears to indicate that the existing roadway is built partially inside the cemetery ROW. Approximately 600 square feet (ft2) (56 square meters [m2]) of land would need to be acquired to correct this situation. Because the project will not impact any burials or elements contributing to the cemementery's eligibility but will require a small piece of land, FHWA finds that the project would have **No Adverse Effect** on the cemetery. The monument will not be affected at all.

Project 3 would replace the Hagåtña (Agana) Bridge. As such it would constitute an Adverse Effect. However, it is likely that the bridge has lost its integrity and associations with its historic past through at least two widenings. Moreover, Guam SHPO has indicated that the parapets along the bridge are the only contributing historic elements worth preserving. An MOA is currently being developed to mitigate adverse effects. Stipulations will include providing new parapets in the style of the existing parapets, in order to preserve the look and feel of the historic bridge. HAER documentation and archival-quality photos will also be completed. Because the project will reconstruct the bridge in its historic location, and mitigation will preserve the only remaining historic attributes and features contributing to the bridge's NRHP eligibility, FHWA finds that, **with mitigation**, the project would have **No Adverse Effect** on Hagåtña (Agana) Bridge.

Project 13 is a pavement strengthening project along Route 1 from Route 11 to the Asan River, with no widening or impacts outside the roadway prism. Aspaalas #675, Memorial Beach Park, and Asan Invasion Beach are all adjacent to Route 1 in this segment. Because the project would not leave the existing roadway, the project will have no effect on these historic properties.

Project 14 is a pavement strengthening project along Route 1 from the Asan River to Route 6, with no widening or impacts outside the roadway prism. Adelup RT Burial #300, Asan WWII Memorial, and Asan archaeological site #153 are all adjacent to Route 1 in this segment. Because the project would not leave the existing roadway, the project will have no effect on these historic properties.

Figure 1. 1945 aerial photo of Hagåtña looking west. North is to the right. Routes 1, 4 and 8 intersect in the lower right, and the Hagåtña River can be seen below center. Plaza de Espana is visible left of center.

Project 15 is a pavement strengthening project along Route 1 from Route 6 to Route 4, with no widening or impacts outside the roadway prism. Toves House, Agana Spanish Bridge (San Antonio Bridge), San Nicholas Bridge, and the Guam Heroes Memorial, are all adjacent to Route 1 in this segment. Because the project would not leave the existing roadway, the project will have no effect on these historic properties.

Project 16 crosses portions of the Hagåtña (Agana) Historic District walking tour/path. It includes widening of Route 8, no individual historic properties would be impacted. Therefore, the project will have no effect on historic properties.

Project 18 is a pavement strengthening project that extends towards the Battle of Finegayan Battlefield. The precise boundaries of the battlefield are uncertain but likely extend into the APE. The site is not currently listed on the NRHP or GRHP, but Guam SHPO staff indicated it is eligible during the February 23, 2010 field visit. Because the project would not leave the existing roadway, the project will have no effect on this historic property.

Project 24 is a pavement strengthening project along Route 1 from Route 11 to Route 2A, with no widening or impacts outside the roadway prism. The Atantano Shrine is located on a parcel adjacent to Route 1, but the shrine itself is located more than 270 feet from the road. Because the project would not leave the existing roadway, the project will have no effect on this historic property.

Project 36 proposes to re-align Route 15 on to Department of Defense property inland from its current location. This area has been subject to pedestrian inventory. One unnamed archaeological site is located within the APE. The proposed re-alignment would cut through the site. Therefore, the project would have an **Adverse Effect** on the archaeological site. An MOA is currently being developed to mitigate adverse effects.

In addition to known historic properties, FHWA has made an effort to consider potential impacts to undocumented properties. To do so, each roadway is associated with a probability statement, as described in Historic Properties above. Enclosure 1 provides a list of all GRN projects and project-specific Section 106 findings of Effect.

No further review under Section 106 would be required for areas designated as No/Low Probability Areas. Medium Probability Areas would be subject to inventory, monitoring, or testing. Prior to any disturbance or excavation, work plans would be developed and reviewed by the appropriate Guam SHPO. In High Probability Areas, sites would be avoided if possible. If sites are impacted, a mitigation plan would be developed and concurred upon by the Guam SHPO. For these reasons FHWA has found that for all roadways designated **No/Low Probability** the appropriate finding of effect is **No Historic Properties Affected**. For **Medium and High Probability** Areas, the appropriate finding is **No Adverse Effect**. These assessments are included in Enclosure A.

All evaluations would be completed in consultation with the Guam SHPO and appropriate cultural resources stakeholders. The PA would also provide stipulations for treatment in case of emergency discoveries, the review process, and report requirements.

Summary

The appropriate finding of effect for the projects as a whole is Adverse Effect, as Project 36 would impact an archaeological site. The GRN projects would not have an Adverse Effect to any other known historic properties. FHWA requests written concurrence on the determination of eligibility for Hagåtña (Agana) Bridge, and all findings of effect listed above. Because some areas will need cultural resources monitoring to check for undocumented resources, FHWA will continue to coordinate with GHPO to develop a monitoring plan, and to report findings.

If you have questions or require additional information, please contact myself at (866)233-8177 extension 311 or richelle.takara@fhwa.dot.gov or Jason Bright at bright@pbworld.com, (801) 288-3248.

[1] Peter "Pete" Casarez. *U.S. Latino and Latina World War II Oral History Project.* University of Texas Libraries, Austin. TX. http://lib.utexas.edu/ww2latinos/template-stories-indiv.html?work_urn=urn%3Autlol%3Awwlatin.015&work_title=Casarez%2C+Peter%22Pete%22

Sincerely yours,

Richelle MTakara

Richelle M. Takara, P.E.
Transportation Engineer

Enclosures: Enclosure A, GRN projects with Section 106 findings.
GRN map book provided to Guam SHPO February 24, 2010.

cc: Andrew Leon Guerrero, DPW
Joaquin Blaz, DPW
Paul Wolf, PB

I, the undersigned, concur with the APE, determination of eligibility, and findings of effect stated above for the Guam Haul Roads Network projects.

Lynda Bordallo Aguon
State Historic Preservation Officer

Date

GUAM HRN PROJECT LIST

GRN #	Region	FHWA #	Route	Segment Limits	Requirements/Description	Project Type	Historic Properties in APE	Finding of Effect	Probability Area Recommendation
1	Central	GU-DAR-2001(006)	1	Route 1 / Route 8 Intersection	Intersection Improvements (.15 mi on Rte 1 & .09 mi on Rte 8) to provide two left-turn lanes and two right-turn lanes for northbound Route 8 approaching Route 1.	Intersection	US Naval Cemetery and Fortification, Cormoran Monument.	No Adverse Effect to cemetery. No Historic Properties Affected elsewhere	No/Low
2	Central	GU-DAR-2001(014)	1	Route 1 / Route 3 Intersection	Intersection Improvements (.24 mi on Rte 1 & .04 mi on Rte 3) to provide southbound left, combined left/right, and free right with accel lane; east to north double left-turn lane.	Intersection	None	No Historic Properties Affected	No/Low
3	Central	GU-DAR-2001(010)	1	East of Route 4	Agana Bridge Replacement	Bridge Replacement	Agana Bridge	mitigated No Adverse Effect	No/Low
4	Apra Harbor	GU-DAR-2011(001)	11	Port to Intersection with Route 1	Pavement strenghtening (two lanes)	Pavement Strengthening	None	No Adverse Effect	Medium
5	Apra Harbor	GU-DAR-2011(002)	11	Route 1 / Route 11 Intersection	Intersection Improvements (.12 mi on Rte 1) to provide additional eastbound left-turn lane.	Intersection	None	No Adverse Effect	Medium
6	Central	GU-DAR-2001(020)	1	Route 27 to Chalan Lujuna	Pavement strengthening (four lanes)	Pavement Strengthening	None	No Historic Properties Affected	No/Low
Inc	Inc	Inc	Inc	Route 1 / Route 28 Intersection	Intersection improvements to provide additional eastbound left-turn lane; southbound Route 28 approach to include two right-turn lanes and combined left/through lane.	Intersection	None	No Historic Properties Affected	No/Low
Inc	Inc	Inc	Inc	Route 1 / Route 26 Intersection	Intersection improvements to provide additional westbound left-turn lane, eastbound right-turn lane; northbound Route 26 approach to include left-turn, combined left-turn/right-turn, and right-turn lane.	Intersection	None	No Historic Properties Affected	No/Low
7	Central	GU-DAR-2001(016)	1	Route 3 to Route 27	Pavement strengthening (six lanes)	Pavement Strengthening	None	No Historic Properties Affected	No/Low
Inc	Inc	Inc	Inc	Route 1 / Route 27 Intersection	Intersection improvements to provide double eastbound left-turn lanes, eastbound right-turn lane, and triple westbound left-turn lanes. Northbound Route 27 approach to include left-turn, combined left-turn/through and two right-turn lanes.	Intersection	None	No Historic Properties Affected	No/Low
Inc	Inc	Inc	Inc	Route 1 / Route 27A Intersection	Intersection improvements to provide additional eastbound left-turn lane, additional northbound Route 27A right-turn lane.	Intersection	None	No Historic Properties Affected	No/Low
8	North	GU-DAR-2003(001)	3	Route 28 to Route 1	Pavement strengthening (four lanes), including re-establishment of 2nd SB through lane at Okkodo HS access	Pavement Strengthening	None	No Historic Properties Affected	No/Low
9	North	GU-DAR-2003(004)	3	NCTS Finegayan to Route 28	Pavement strengthening, widen from 2 lanes to 4 lanes, add median and shoulders	Widening	None	No Adverse Effect	Medium
Inc	Inc	Inc	Inc	Route 3 / Route 28 Intersection	Intersection improvements to provide additional southbound left-turn lane and add northbound right-turn lane.	Intersection	None	No Adverse Effect	Medium
10	North	GU-DAR-2003(008)	3	NCTS Finegayan to Route 9	Pavement strengthening, widen from 2 lanes to 4 lanes, add median and shoulders	Widening	None	No Adverse Effect	Medium
Inc	Inc	Inc	Inc	Route 3 / Route 3A Intersection	Eliminate Y-intersection, provide four-legged intersection with one left-turn and one right-turn lane on Route 3A, a northbound left-turn lane on Route 3.	Intersection	None	No Adverse Effect	Medium
11	Central	GU-DAR-2099(001)	Chalan Lujuna	Route 1 to Route 15	Pavement strengthening (two lanes), Turning lane & intersection improvements for trucks	Pavement Strengthening	None	No Historic Properties Affected	No/Low
12	Central	GU-DAR-2015(006)	15	Smith Quarry to Chalan Lujuna	Pavement strengthening (two lanes), Safety/ Operational Improvements	Pavement Strengthening	None	No Adverse Effect	Medium

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13	Central	GU-DAR-2001(007)	1	Route 11 to Asan River	Pavement strengthening (four lanes)	Pavement Strengthening	Aspaalas #675, Memorial Beach Park, Asan Invasion Beach	No Adverse Effect	High
14	Central	GU-DAR-2001(008)	1	Asan River to Route 6 (Adelup)	Pavement strengthening (four lanes)	Pavement Strengthening	Adelup RT Burial #300, Asan WWII Memorial, Asan archaeological site #153	No Adverse Effect	High
15	Central	GU-DAR-2001(009)	1	Route 6 (Adelup) to Route 4	Pavement strengthening (six lanes)	Pavement Strengthening	Toves House, Agana Spanish Bridge, San Nicholas Bridge #150, Guam Heroes Memorial, Skinner Plaza, Taitano House #1137, Garrido House #1135, Agana-Hagatna Pillbox	No Historic Properties Affected	No/Low
16	Central	GU-DAR-2008(001)	8	Tiyan Pkwy/Route 33 (east) to Route 1	Pavement strengthening, widening from 4/6 lanes to 6 lanes, with median.	Widening	Agana Historic District	No Historic Properties Affected	No/Low
17	Central	GU-DAR-2008(002)	8	Route 10 to Tiyan Pkwy/Route 33(east)	Pavement strengthening (four lanes)	Pavement Strengthening	None	No Historic Properties Affected	No/Low
18	Central	GU-DAR-2016(005)	16	Route 27 to Route 10A	Pavement strengthening (six lanes)	Pavement Strengthening	Battle of Finegayan Battlefield	No Historic Properties Affected	No/Low
Inc	Inc	Inc	Inc	Route 16 / Route 27 Intersection	Intersection improvements to provide additional northbound, southbound left-turn lanes, change westbound right-turn to combined through/right-turn lane.	Intersection	None	No Historic Properties Affected	No/Low
19	Central	GU-DAR-2016(004A)	16	Route 10A to Navy Barrigada Residential Gate	Pavement strengthening (four lanes)	Pavement Strengthening	None	No Historic Properties Affected	No/Low
Inc	Inc	Inc	Inc	Route 16/ Route 10A Intersection	Intersection improvements to provide one additional lane on northbound and southbound off-ramps to provide one left-turn, combined left/through/right-turn and right-turn lane. Restripe to provide additional westbound left-turn lane.	Intersection	None	No Historic Properties Affected	No/Low
63	Central	GU-DAR-2016(004B)	16	Route 10A to Navy Barrigada Residential Gate	Pavement strengthening, widening from 4 to 6 lanes, with median.	Widening	None	No Historic Properties Affected	No/Low
20	Central	GU-DAR-2016(001)	16	Navy Barrigada Residential Gate to Route 8/10	Pavement strengthening (four lanes)	Pavement Strengthening	None	No Historic Properties Affected	No/Low
21	Central	GU-DAR-2027(001)	27	Route 1 to Route 16	Pavement strengthening (six lanes)	Pavement Strengthening	None	No Historic Properties Affected	No/Low
22	North	GU-DAR-2009(002)	9	Route 3 to AAFB (North Gate)	Pavement strengthening, widen from 2 lanes to 4 lanes, with median.	Widening	None	No Adverse Effect	Medium
22a	North	GU-DAR-2009(001)	9	AAFB North Gate to Route 1 (AAFB Main Gate)	Pavement strengthening (two lanes), widen to add median and shoulders	Widening	None	No Adverse Effect	Medium
23	North	GU-DAR-2001(021)	1	Chalan Lujuna to Route 9 (AAFB)	Pavement strengthening (four lanes)	Pavement Strengthening	None	No Historic Properties Affected	No/Low
24	Apra Harbor	GU-DAR-2001(004)	1	Route 11 to Route 2A	Pavement strengthening (four lanes)	Pavement Strengthening	Atantano Shrine	No Adverse Effect	Medium
25	South	GU-DAR-2005(002)	5	Route 2A to Route 17	Pavement strengthening (two lanes)	Pavement Strengthening	None	No Historic Properties Affected	No/Low
Inc	Inc	Inc	Inc	Route 5 / Route 17 Intersection	Intersection improvements to add right-turn lane on Route 17 approaching Route 5.	Intersection	None	No Adverse Effect	Medium
26	Apra Harbor	GU-DAR-202A(001)	2A	Route 1 to Route 5	Pavement strengthening (four lanes)	Pavement Strengthening	None	No Historic Properties Affected	No/Low
27	South	GU-DAR-2005(001)	5	Route 17 to Naval Ordnance	Pavement strengthening (two lanes)	Pavement Strengthening	None	No Adverse Effect	Medium
28	Central	GU-DAR-2026(001)	26	Route 1 to Route 15	Pavement strengthening, widen from 2 lanes to 4 lanes	Widening	None	No Adverse Effect	Medium

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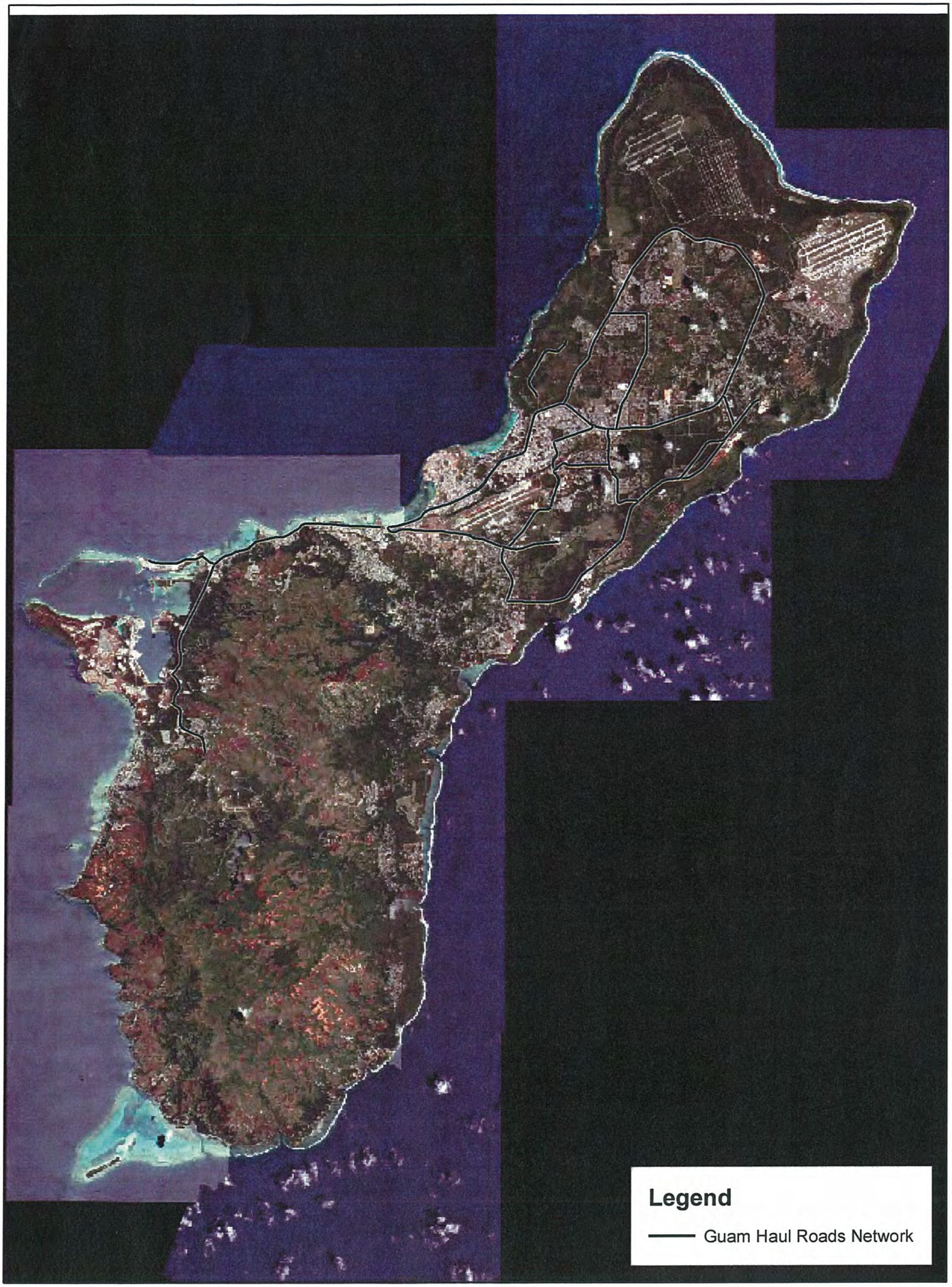
Inc	Inc	Inc	Inc	Route 26 / Route 25 Intersection	Intersection improvements to provide northbound left-turn, through, combined through/right, southbound left-turn, two throughs, and right-turn, eastbound left-turn, left-through, and right-turn lane. Southbound right-turn should have raised island and free right to westbound Route 25 curb lane.	Intersection	None	No Adverse Effect	Medium
29	Central	GU-DAR-2025(001)	25	Route 16 to Route 26	Pavement strengthening, widen from 2 lanes to 4 lanes	Widening	None	No Adverse Effect	Medium
30	Central	GU-DAR-2010(002)	10	Route 15 to Route 8 & 16	Pavement strengthening (four lanes)	Pavement Strengthening	None	No Historic Properties Affected	No/Low
31	Central	GU-DAR-208A(002A)	8A	Route 16 to NAVCAMS Barrigada	Pavement strengthening (two lanes)	Pavement Strengthening	None	No Historic Properties Affected	No/Low
74	Central	GU-DAR-208A(002B)	8A	Route 16 to NAVCAMS Barrigada	Pavement strengthening (two lanes), widen to provide median and shoulders	Widening	None	No Adverse Effect	Medium
32	Central	GU-DAR-2015(001)	15	Route 10 to Connector (Chalan Lujuna end)	Pavement strengthening (two lanes)	Pavement Strengthening	None	No Historic Properties Affected	No/Low
Inc	Inc	Inc	Inc	Route 15 / Route 26 Intersection	Signalize intersection.	Intersection	None	No Historic Properties Affected	No/Low
33	Central	GU-DAR-2001(012)	1	Route 8 to Route 3	Pavement strengthening (six lanes)	Pavement Strengthening	None	No Historic Properties Affected	No/Low
Inc	Inc	Inc	Inc	Route 1 / Route 14 (NSV) Intersectio	Intersection improvements to add southbound right-turn lane.	Intersection	None	No Historic Properties Affected	No/Low
Inc	Inc	Inc	Inc	Route 1 / Route 14A Intersection	Intersection improvements to add northbound and southbound left-turn lanes, southbound right-turn lane.	Intersection	None	No Historic Properties Affected	No/Low
Inc	Inc	Inc	Inc	Route 1 / Route 10A Intersection	Intersection improvements to add southbound left-turn lane, northbound right-turn lane.	Intersection	None	No Historic Properties Affected	No/Low
Inc	Inc	Inc	Inc	Route 1 / Route 14B Intersection	Intersection improvements to change eastbound right-turn lane to combined right-turn/left-turn lane.	Intersection	None	No Historic Properties Affected	No/Low
Inc	Inc	Inc	Inc	Route 1 / Route 14 (ITC) Intersectio	Intersection improvements to include southbound right-turn lane.	Intersection	None	No Historic Properties Affected	No/Low
Inc	Inc	Inc	Inc	Route 1 / Route 30 Intersection	Intersection improvements to provide additional northbound left-turn lane, change existing lanes on eastbound approach to combined left-turn/through, and two right-turn lanes.	Intersection	None	No Historic Properties Affected	No/Low
35	Central	GU-DAR-2001(003)	1	Various	Replace Bridges (Atantano, Laguas, Sasa, Fonte, Asan 1, Asan 2, Agueda)	Bridge Replacement	None	No Adverse Effect	High
36	Central	GU-DAR-2015(005)	15	Route 15 Realignment	Relocate Route 15 onto existing DoD Property to allow Firing Range in Vicinity	Route 15	Unnamed Prehistoric site	Adverse Effect	High
57	North	GU-DAR-2028(001)	28	Route 1 to Route 3	Pavement strengthening, widen from 2 to 3 lanes, with shoulders	Widening	None	No Adverse Effect	Medium
Inc	Inc	Inc	Inc	Route 28 / Route 27A Intersection	Intersection improvements to provide northbound left-turn, through, combined through/right-turn, southbound left-turn, through, and combined through/right-turn, eastbound left-turn, through, and right-turn lane.	Intersection	None	No Adverse Effect	Medium
110	South	GU-DAR-2002(001)	2	Route 2 / Route 12 Intersection	Intersection improvements to convert northbound right-turn lane to combined through/right-turn lane.	Intersection	None	No Historic Properties Affected	No/Low
113	Central	GU-DAR-2007(001)	7	Route 7 / Route 7A Intersection	Intersection improvements (signing, striping and minor construction) to establish two-lane circulation around Y-intersection.	Intersection	None	No Historic Properties Affected	No/Low
117	North	GU-DAR-2015(007)	15	Route 15 / Route 29 Intersection	Intersection improvements to signalize, provide additional northbound, southbound left-turn lanes, southbound right-turn lane	Intersection	None	No Historic Properties Affected	No/Low

124	North	GU-DAR-2099(002)	Finegayan Connection	Route 1/16 Intersection to S. Finegayan	New two-lane road, with left-turn lanes at existing access points, 4' paved shoulders.	New Road	None	No Historic Properties Affected	No/Low
Inc	Inc	Inc	Inc	Route 1 / Route 16 Intersection	Intersection improvements to provide northbound two left-turn lanes, three through lanes and right-turn lane (500'); southbound, two left-turn lanes, two through lanes, and one combined through/right lane; eastbound, two left-turn lanes (250'), two through lanes, and right-turn lane (500'); westbound, two left-turn lanes, two through lanes, and right-turn lane.	Intersection	None	No Historic Properties Affected	No/Low
Inc	Inc	Inc	Inc	Route 1 / Route 16 Intersection	Intersection improvements to provide northbound, right-turn lane (700'); southbound, additional left-turn lane.	Intersection	None	No Historic Properties Affected	No/Low
38	North	GU-DAR-2003(007)	3	NCTS Finegayan (Commercial Gate)	Military Access Point 2, located 125 feet north of Chalan Kareta. Would be signalized; eastbound, left-turn lane (300'), combined through/right; westbound, left-turn lane (150'), combined through/right; northbound, left-turn lane (480'), through, combined through/right; southbound, left-turn (150'), through, and combined through/right.	Intersection	None	No Adverse Effect	Medium
38A	North	GU-DAR-2003(007)A	3	NCTS Finegayan (Commercial Gate)	Military Access Point 2, proposed to be a T-intersection 1,215 feet south of Flores Para Eso Street. Would be signalized; eastbound, left-turn lane (300'), combined through/right; northbound, left-turn lane (480'), through, combined through/right; southbound, through, and combined through/right.	Intersection	None	No Adverse Effect	Medium
39	North	GU-DAR-2003(006)	3	NCTS Finegayan (Main Gate)	Military Access Point 3, signalized; eastbound, two left-turn lanes (300'), free right-turn with acceleration lane on Route 3; northbound, two left-turns (600'), through lanes, combined right/through lane, southbound left-turn lane (150'), two through lanes, right-turn lane (600'), westbound left-turn lane and combined through/right-turn lane from parking lot.	Intersection	None	No Adverse Effect	Medium
39A	North	GU-DAR-2003(006)A	3	NCTS Finegayan (Main Gate)	Military Access Point 3, located across from signalized intersection with Route 28. Eastbound, two left-turn lanes (300'), one through lane, free right-turn with acceleration lane on Route 3; northbound, two left-turns (600'), two through lanes, and right-turn lane, southbound, two left-turn lanes, two through lanes, right-turn lane (600'), westbound two left-turn lanes, through, and right-turn lane.	Intersection	None	No Adverse Effect	Medium
41	North	GU-DAR-2003(002)	3	South Finegayan (Residential Gate)	Military Access Point 5, aligned with Kamute Avenue. Would be signalized; eastbound, left-turn lane (200'), combined left-turn/through lane, free right-turn with acceleration lane on Route 3; northbound, two left-turns (700'), through, combined through/right, southbound, left-turn (150'), through and combined through/right-turn, westbound left-turn, combined through/right-turn.	Intersection	None	No Adverse Effect	Medium

41A	North	GU-DAR-2003(002)A	3	South Finegayan (Residential Gate)	Military Access Point 5, located 680 feet south of Hahasu Dr. Would be signalized; eastbound, two left-turn lanes (200'), free right-turn with acceleration lane on Route 3; northbound, two left-turns (700'), two through lanes, southbound, through and combined through/right-turn.	Intersection	None	No Adverse Effect	Medium
42	North	GU-DAR-2009(003)	9	AAFB (North Gate)	Military Access Point 6, proposed between Routes 3 and 9. Would be STOP-controlled with STOP for access from base; eastbound, left turn lane (600'), two through lanes; westbound, one through lane and one right-turn lane (320'); southbound, left-turn lane, free right-turn lane with accel lane (becomes second westbound through lane).	Intersection	None	No Adverse Effect	Medium
44	Central	GU-DAR-2001(019)	1	Anderson South (Main Gate)	Military Access Point 8, at Turner Street. Would be signalized; westbound Route 1 left-turn lane (500', restripe existing 2WLTL); eastbound Route 1 right-turn lane (1,000'); and northbound two left-turn lanes (300') and right-turn lane.	Intersection	None	No Adverse Effect	Medium
46	Central	GU-DAR-2015(004)	15	Anderson South (Secondary Gate)	Military Access Point 10 at Unnamed road, 1.16 miles east of Route 26. Would be STOP controlled with STOP for access from base; eastbound Route 15 left-turn lane (250'); southbound, left-turn lane (150') and right-turn lane.	Intersection	None	No Adverse Effect	Medium
47	Central	GU-DAR-2016(002)	16	Barrigada (Navy)	Military Access Point 11, approximately 1,315 feet north of northerly post office driveway. New four-lane access road connected to Route 16 as T-intersection. Route 16. Route 16/Access Road would be signalized. Northbound Route 16, two through lanes and combined through/right lane; southbound Route 16, two left-turn lanes (one lane 425', the other lane drop from third southbound through lane), and two through lanes; westbound, two left-turn lanes and free right-turn lane.	Intersection	None	No Historic Properties Affected	No/Low
48	Central	GU-DAR-208A(001)	8A	Barrigada (Navy)	Military Access Point 12, Extension of north/south road from Route 16/Sabana Barrigada Drive to Route 8a, with one lane in each direction.	Intersection	None	No Adverse Effect	Medium
49	Central	GU-DAR-2015(003)	15	Barrigada (Air Force)	Military Access Point 13, across from Chada Street. Would be signalized; eastbound, left-turn lane (250'), combined through/right-turn lane; westbound, left-turn lane (150'), combined through/right-turn lane; southbound, left-turn lane (150'), combined through/right-turn lane; northbound, combined left/through/right-turn lane.	Intersection	None	No Historic Properties Affected	No/Low
49A	Central	GU-DAR-2015(003A)	15	Barrigada (Air Force)	Military Access Point 13A, across from Chada Street. Would be signalized; eastbound, two left-turn lanes (500'), combined through/right-turn lane; westbound, left-turn lane (150'), through lane, right-turn lane (1,000'); southbound, two left-turn lanes (500'), combined through/right-turn lane; northbound, combined left/through/right-turn lane.	Intersection	None	No Historic Properties Affected	No/Low
50	Apra Harbor	GU-DAR-2001(002)	1	Navy Main Base	Military Access Point 14, at existing signalized intersection of Routes 1 and 2a. Intersection improvements to provide additional westbound left-turn lane.	Intersection	None	No Adverse Effect	Medium
52	South	GU-DAR-2012(001)	12	Naval Munitions Site	Military Access Point 16, proposed relocation of existing access point to Harmon Road for safety/operational improvements.	Intersection	None	No Adverse Effect	Medium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Guam Haul Roads Network

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Attachment 2. FHWA Letters (April 11 and June 14, 2010) to Guam Department of Parks and Recreation Regarding Section 4(f) Impacts on Public Parks

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U.S. Department of Transportation
Federal Highway Administration

Hawaii Federal-Aid Division

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April 11, 2010

In Reply Refer To:
HDA-HI

Joseph Duenas, Director
Government of Guam
Department of Parks and Recreation
490 Chalan Palasyo
Agana Heights, Guam 96910

Dear Mr. Duenas:

The Federal Highway Administration (FHWA) requests your concurrence that the proposed projects would not adversely affect the activities, features, and attributes of Paseo de Susana Park, Buffer Park and Chinese Park, thus allowing the FHWA to issue a final *de minimus* impact finding for each of these three properties. The following information explains the scope of the project and the impacts they will have on the subject resources.

The U.S. Department of the Navy has prepared the Guam and Commonwealth of the Northern Marianas (CNMI) Military Relocation Draft Environmental Impact Statement/Overseas Environmental Impact Statement (Draft EIS/OEIS). The three major actions of this proposed project are as follows:

- Development and construction of facilities and infrastructure to support the relocation of approximately 8,600 Marines and their 9,000 dependents from Okinawa to Guam; development and construction of facilities and infrastructure to support training and operations on Guam and Tinian for the relocated Marines.
- Construction of a new deep-draft wharf with shoreside infrastructure improvements creating the capability in Apra Harbor, Guam, to support a transient nuclear-powered aircraft carrier.
- Development of facilities and infrastructure on Guam to support the relocation of approximately 600 military personnel and their 900 dependents, and the establishment and operation of an Army Missile Defense Task Force (AMDTF).

Several related actions were identified for the proposed military buildup. One related action is the proposed Guam Road Network (GRN) improvements. The purpose of the GRN construction is to improve the existing roadway network on Guam through the Defense Access Road (DAR) Program and provide

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mission-critical transportation infrastructure as part of the planned military buildup. The improvements proposed for the GRN would result in strengthened roadways, bridge replacement, increased roadway capacity, roadway realignment (Route 15), new access, and enhanced roadway safety on Guam as a response to construction for military buildup and growth. The GRN is comprised of 44 (off-base) projects, including 6 intersection improvements, 2 bridge replacements, 25 pavement strengthening projects, relocation of one road, 9 road widening projects and construction of one new road, along 20 federal-aid roadways and one local road. These projects total approximately 66 miles in length. The two bridge replacement projects would result in the replacement of five bridges, and replacement of three box culverts at three other bridges (total of 8 bridges).

The Federal Highway Administration (FHWA) jointly with the U.S. Department of the Navy and the Guam Department of Public Works (DPW) has prepared the portion of Volume 6 of the Draft EIS/OEIS that addresses the impacts of the GRN Project to various environmental resources. Since the implementation of the proposed GRN would involve the potential use of Section 4(f) land, consisting of public parks and recreation areas, as determined pursuant to the U.S. Department of Transportation Act of 1966 (49 U.S. Code § 303), a Section 4(f) Evaluation was prepared in accordance with 23 *Code of Federal Regulation* (CFR) §774 (see Chapter 21 of Volume 6).

Based on the Section 4(f) Evaluation, three public parks under the jurisdiction of the Guam Department of Parks and Recreation (DPR), would be subject to minor right-of-way (ROW) acquisition or temporary use, as described below.

- **Paseo de Susana Park** would be affected by GRN Project #3 (Agana Bridge Replacement). The bridge replacement limits are very conceptual at this stage, and the affected land cannot be accurately estimated; however, based on the preliminary design, approximately 4,800 square feet of land in the park may be required. There likely would be work in the Agana River and possibly slope protection at the abutment. At the very least, it would be a temporary impact during construction, limiting access to this area of the park. See Enclosure 1A to this letter.
- **Buffer Strip Park** would be affected by GRN Project #7 and GRN Project #6 intersection widening at Routes 1 and 27, and Routes 1 and 26, respectively. While the widening currently depicted can likely be adjusted to avoid most of the linear impact, at the intersection with Route 27, the existing roadway appears to encroach on the park ROW by approximately 500 square feet. See Enclosure 1B to this letter.
- **Chinese Park** would be affected by GRN Project #33 intersection widening at Routes 1 and 14. The existing ROW parcel line appears to indicate that the existing roadway is built partially inside the park ROW. Approximately 15,900 square feet of land would need to be acquired to correct this situation and to allow the intersection improvements. Based on field observations, the potentially affected area is rocky land that slopes approximately 45 degrees. It appears to be unusable for park purposes. See Enclosure 1C to this letter.

Note that the above information is subject to change during the detailed engineering design phase. Some design adjustment could also minimize impacts to the existing parklands to ensure the project does not adversely affect important park features, attributes or activities. Because construction of the proposed improvement projects would be centered on the existing roadway corridor and intersections, no park closure is anticipated during construction.

The Section 4(f) Evaluation also identified measures to minimize harm on these potentially affected parks. To minimize the park taking at Chinese Park, the DPW will evaluate the feasibility of constructing a retaining wall approximately 20 feet high; aesthetic treatment could be used to minimize the visual effect of the wall. Measures to minimize park use at Paseo de Susana Park and Buffer Strip Park would also be considered during the detailed engineering design phase. To ensure maintenance of access to public parks, the DPW will develop a Traffic Management Plan (TMP) for implementation during construction activities. The TMP will identify and provide alternate traffic detour routes, construction materials hauling routes, bus stops, transit routes and operation hours, pedestrian routes, and residential and commercial access routes to be used during the construction period. The DPW will also develop an outreach program to keep residents, tourists, businesses, and any service providers within the area informed, and to inform surrounding communities about the project construction schedule, traffic-impacted areas, the TMP, and other relevant project information.

In light of the above, the FHWA has determined that the transportation use of Paseo de Susana Park, Buffer Strip Park and Chinese Park, including the measures to minimize harm, does not adversely affect the protected activities, features or attributes that qualify these properties for Section 4(f) protection. Therefore, it is FHWA's determination that a Section 4(f) *de minimus* (of minimum importance) impact finding may be made for each of these three Section 4(f) resources.

However, prior to making final *de minimus* impact findings for these three properties, coordination, as specified in 23 CFR §774.5(2), is required by the FHWA. This coordination is required in two parts:

- Per 23 CFR §774.5(2)(i), public notice and an opportunity for public review and comment concerning the effects on the protected activities, features, or attributes of the property must be provided. FHWA has satisfied this coordination requirement, as the Draft EIS/OEIS was released to the public on November 20, 2009, for a 90 day period. During the 90 day period, the public was encouraged to review and submit comments on the Draft EIS/OEIS. Four public hearings were held on Guam to provide an opportunity for the community to submit both oral and written comments regarding the Draft EIS/OEIS. A total of two written comments pertaining to parkland impacts were received. The first comment stated that the affected parkland should be replaced prior to the roadway construction. FHWA made a clarification that the required acquisition of the parkland would be minimal and no parkland replacement would be needed. The second comment stated that the federal government should pay for the retaining wall construction near the Chinese Park since the proposed roadway improvement is a part of the military action. FHWA responded that funding for the design and construction of the retaining wall would be requested through the DAR program. Maintenance costs would be the responsibility of the DPW since they would own the facility.

- The second part of the coordination, as put forth in 23 CFR §774.5(2)(ii), requires that the FHWA inform the official(s) with jurisdiction over the public parks of its intent to make a *de minimis* impact finding. The FHWA believes that this requirement has also been satisfied, as a meeting between FHWA, DPW and DPR, was held on Tuesday, January 12, 2010 at 10:00 AM, at the Division of Highways Building, Room 201. Four DPR representatives attended the meeting, including Joseph Duenas (Director), Jose Quinata, Jose Garrido, and William Hernandez. The meeting included discussions of each of the potentially affected parks and FHWA's intent to issue a *de minimus* impact finding for each of the properties. DPR representatives did not express any issues with the projects or their potential effects on the parks at the time of the meeting.

As FHWA has satisfied the coordination requirements of 23 CFR §774.5(2), it hereby requests DPR's written concurrence that the proposed GRN Projects would not adversely affect the activities, features, and attributes of Paseo de Susana Park, Buffer Park and Chinese Park, thus allowing the FHWA to issue a final *de minimus* impact finding for each of these three properties.

The FHWA is thankful for your assistance in making this transportation project possible. Should you have any questions or concerns, please contact me at (808)541-2700 extension 2311 or richelle.takara@dot.gov.

Sincerely yours,

Richelle M Takara

Richelle M. Takara, P.E.
Transportation Engineer

Enclosures

cc: Andrew Leon Guerrero, DPW (via email)
Joaquin Blaz, DPW (via email)
Robin Shishido, PTG (via email)
Elvira Gaddi, PTG (via email)

ENCLOSURE 1A

Potential Use of Paseo de Susana Park

Legend

1	Route Number
■	Project Locations and GRN#
P	Park Locations
▨	Park Takes
◐	Bridge Replacement
◆	Intersection Improvement
⊡	Military Access Point
🟧	Pavement Strengthening
🟩	Widening/ Pavement Strengthening
🟥	Realignment/ New Construction

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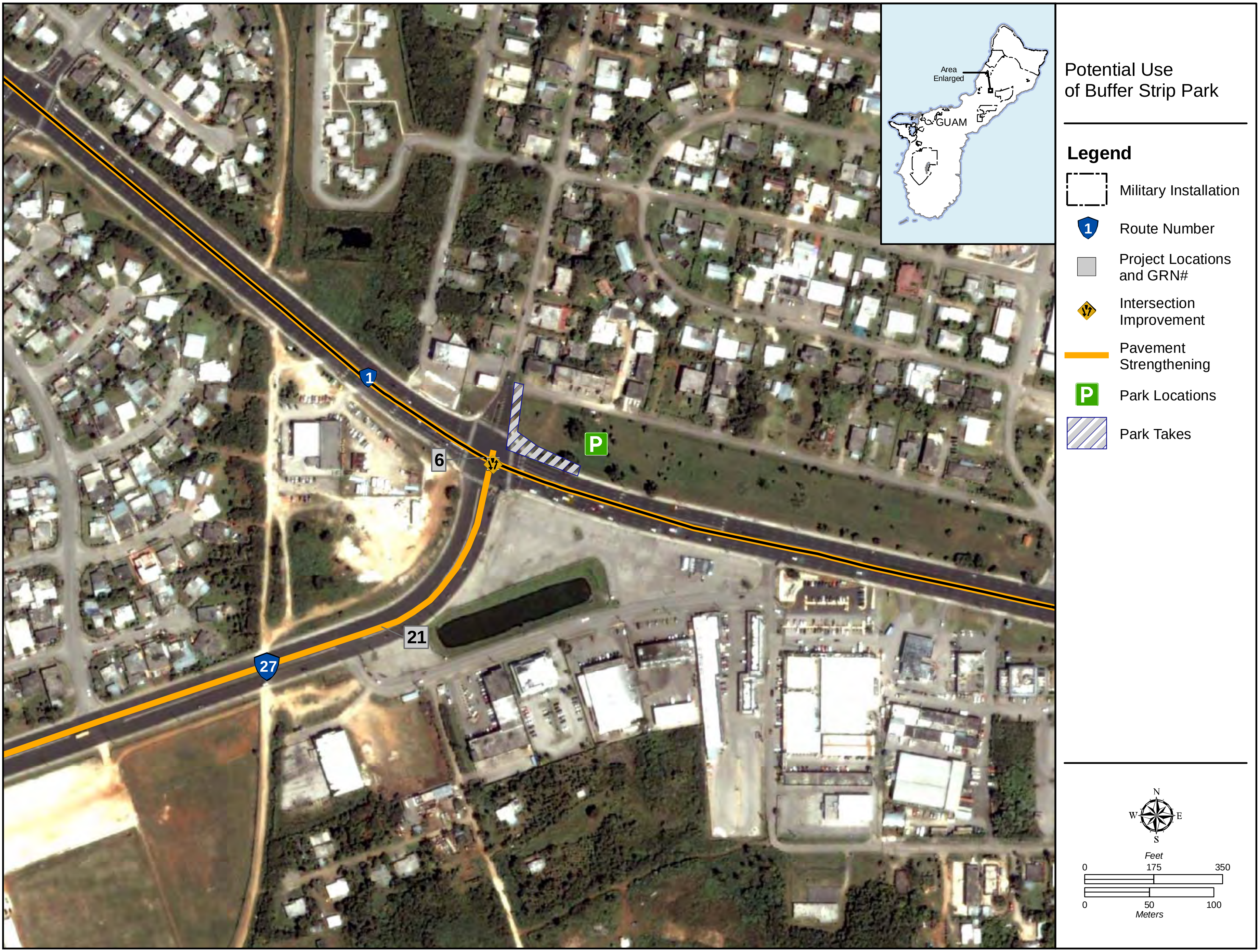
ENCLOSURE 1B



Potential Use of Buffer Strip Park

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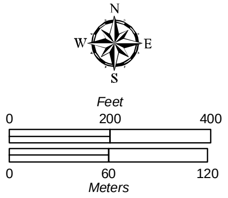
ENCLOSURE 1C

Potential Use of Chinese Park

Legend

▭	Military Installation
1	Route Number
▢	Project Locations and GRN#
◆	Intersection Improvement
━	Pavement Strengthening
P	Park Locations
▨	Park Takes



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of Transportation
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June 14, 2010

In Reply Refer To:
HDA-HI

Joseph Duenas, Director
Government of Guam
Department of Parks and Recreation
490 Chalan Palasyo
Agana Heights, Guam 96910

Dear Mr. Duenas:

Thank you for your continued assistance and coordination on this project. As a follow up to the letter received by your department dated May 26, 2010 regarding non-concurrence of final *de minimus* impact finding to Paseo de Susana Park, the Federal Highway Administration (FHWA) would like to further clarify the project and impacts. The impact identified to the park on the northwest corner of Agana Bridge No. 1 was incorrectly labeled as Paseo de Susana Park and will be revised to Guam Seal Park in the Guam and Commonwealth of the Northern Marianas (CNMI) Military Relocation Final Environmental Impact Statement (Final EIS).

Furthermore, to allow continued access along the Hagåtña Heritage Walking Trail, the construction of the bridge will generally be phased in two major components. First, traffic will be shifted to the south and the north side of Route 1 and Agana Bridge will be reconstructed and widened. Pedestrian movements along Route 1 will be accommodated on the existing sidewalk on south side of the street. Secondly, traffic will be shifted to the north and the work will be completed on the south side of the road and Agana Bridge. Pedestrian movements in the second phase will be accommodated on the north side of the roadway. Other minor phases of construction are anticipated and pedestrian movements along Route 1 will be maintained on one side of the road, or the other, at all times.

As FHWA has satisfied the coordination requirements of 23 CFR §774.5(2), it hereby requests DPR's written concurrence that the proposed GRN Project would not adversely affect the activities, features, and attributes of Guam Seal Park, thus allowing the FHWA to issue a final de minimus impact finding for this property.

The FHWA is thankful for your assistance in making this transportation project possible. Should you have any questions or concerns, please contact me at (866)233-8177 extension 2311 or Richelle.takara@dot.gov.

Sincerely yours,

Richelle M Takara

Richelle M. Takara, P.E.
Transportation Engineer

cc: Andrew Leon Guerrero, DPW (via email)
Joaquin Blaz, DPW (via email)
Robin Shishido, PTG (via email)
Elvira Gaddi, PTG (via email)

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Attachment 3. Guam Department of Parks and Recreation De Minimus Impact Concurrence Letter on Dededo Buffer Strip Park and Chinese Park

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Department of Parks and Recreation
Government of Guam
490 Chalan Palasyo
Agana Heights, Guam 96910
Director's Office: (671) 475-6296/7
Facsimile: (671) 477-0997
Parks Division: (671) 475-6288/9
Guam Historic Resources Division: (671) 475-6288/9
Facsimile: (671) 477-2822

Felix P. Camacho
Governor

Michael W. Cruz, MD
Lt. Governor

Joseph W. Dueñas
Director

Jose M. Quinata, Jr.
Deputy Director

In reply refer to:
RC2010-6912/07-0782

May 26, 2010

Richelle Takara, P.E.
Transportation Engineer
FHWA-Hawaii Division
300 Ala Moana Blvd. 3-306, Box 50206
Honolulu, HI 96850

Subject: FHWA Request for Concurrence (49 U.S. Code § 303) 23CFR§774.5 (2)(i) and (2)(ii) with the Proposed Guam Road Network associated with the proposed military buildup that the following public and historic sites: Paseo de Susana Park, Hagatna; Buffer Strip Park, Dededo; Chinese Park, Upper Tumon;

Dear Ms. Takara:

The Department of Parks and Recreation has (DPR) reviewed your request for concurrence for a final *de minimus* impact finding for the above public parks. DPR concurs with your findings on two parks, Buffer Strip Park, Dededo; and Chinese Park, Upper Tumon. However, we do not concur with the final *de minimus* concerning the Paseo de Susana Park, as area of potential effects (APE) impacts the Guam Seal Park, which is part of the Hagåtña Heritage Walking Trail. However, this may be corrected with an adjustment of the APE southward to allow access and a buffer for the Guam Seal Park in concurrence with DPR.

The Department of Parks and Recreation has (DPR) is only reviewing 23CFR§774.5 (2)(i) and (2)(ii) with the Proposed Guam Road Network associated with the proposed military buildup that the following public and historic sites: Paseo de Susana Park, Hagatna; Buffer Strip Park, Dededo; Chinese Park, Upper Tumon. As per request of your letter received April 22, 2010.

Any concurrence of (49 U.S. Code § 303) 23CFR§774.5 (1) For Historic Properties will have to be address to the Guam Historic Resources Division, State Historic Preservation Office of the Department of Parks and Recreation. If you have any questions, please call us at (671) 475-6295.

Sincerely,

Joseph W. Duenas
Director

Attachment 4. Guam Department of Parks and Recreation De Minimus Impact Concurrence Letter on Guam Seal Park

Department of Parks and Recreation
Dipattamenton Plaset Yan Dibuetsion
Government of Guam
490 Chalan Palasyo
Agana Heights, Guam 96910
Director's Office: (671) 475-6296/97
Facsimile: (671) 477-0997
Parks Division: (671) 475-6288/89
Guam Historic Resources Division: (671) 475-6295
Facsimile: (671) 477-2822

Felix P. Camacho
Governor

Michael W. Cruz, MD
Lt. Governor

Joseph W. Duenas
Director

Jose M. Quinata Jr.
Deputy Director

In reply refer to:
RC2010-6912/07-0782

June 23, 2010

Richelle Takara, P.E.
Transportation Engineer
FHWA-Hawaii Division
300 Ala Moana Blvd. 3-306
Box 50206
Honolulu, HI 96850

Subject: FHWA Request for Concurrence (49 U.S. Code § 303) 23CFR§774.5 (2)(i) and (2)(ii) with the Proposed Guam Road Network associated with the proposed military buildup that the following public and historic sites: Paseo de Susana Park, Hagatna; Buffer Strip Park, Dededo; Chinese Park, Upper Tumon.

Dear Ms. Takara:

The Department of Parks and Recreation has (DPR) reviewed your request for concurrence for a final de minimus impact finding for the above public parks. DPR concurs with FHWA mistake of labeling the Guam Seal Park as the Paseo de Susana Park in the Guam and Commonwealth of the Northern Marianas Military Relocation Final Environmental Impact Statement and looks forward to the correction. DPR further concurs that FHWA proposed undertaking would not adversely affect activities, features and attributes of the Guam Seal Park.

Any concurrence of (49 U.S. Code § 303) 23CFR§774.5 (1) For Historic Properties will have to be address to the Guam Historic Resources Division, State Historic Preservation Office of the Department of Parks and Recreation.

If you have any questions, please call us at (671) 475-6296/6297.

Sincerely,

Joseph W. Duenas
Director

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Attachment 5. Programmatic Section 4(f) Evaluation for Historic Bridges

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HAWAII DIVISION

FEDERAL HIGHWAY ADMINISTRATION
PROGRAMMATIC SECTION 4(f) DETERMINATION AND APPROVAL
UNDER THE
NATIONWIDE PROGRAMMATIC SECTION 4(f) EVALUATION
AND APPROVAL FOR FHWA PROJECTS THAT NECESSITATE
THE USE OF HISTORIC BRIDGES

(JULY 5, 1983)

BRIDGE NAME: Agana Bridge #1 BRIDGE ID: 2801-0005P

ROUTE: Route 1 (Marine Corps Drive) LOCATION: Guam

Instructions: Consult the Nationwide § 4(f) Evaluation as it relates to the following items. Complete all items. Any response in a shaded box requires additional information prior to approval. This § 4(f) determination will be attached to the applicable National Environmental Policy Act (NEPA) documentation.

Eligibility Criteria	YES	NO
1. Will the bridge be replaced or rehabilitated with federal funds?	X	
2. Will the project require the "use"[1] of a historic structure which is on, or eligible for listing on, the National Register of Historic Places (NRHP)?	X	
3. Has the bridge been determined to be a National Historic Landmark?		X
4. Is the environmental documentation an Environmental Impact Statement (EIS)?[2]	X	

Alternatives Considered	**YES**	**NO**
5. Have all of the following alternatives to avoid any use of the historic bridge been evaluated?[3]	X	
A. Has the “Do Nothing” alternative been studied and been determined, for reasons of maintenance and safety, not to be feasible and prudent?	X	
B. Has the “Build on New Location Without Using the Old Bridge Alternate” been studied and been determined, for reasons of terrain, and/or adverse social, economic or environmental effects, and/or engineering and economy, and/or preservation of the old bridge, not to be feasible and prudent?	X	
C. Has rehabilitation of the existing bridge without affecting the historic integrity of the bridge been studied and has it been determined, for reasons of structural deficiency and/or geometrics, that rehabilitation is not feasible and prudent?	X	

Measures to Minimize Harm ***When an item does not apply indicate with NA***	**YES**	**NO**
6. Has the project included all possible planning to minimize harm, including the following:	X	
A. For bridges that are **adversely affected**, have the Federal Highway Administration (FHWA), Guam State Historic Preservation Office (SHPO), and Advisory Council for Historic Preservation (ACHP) reached agreement [Memorandum of Agreement (MOA)] through the Section 106 process, and does this MOA include Stipulations which amount to Measures to Minimize Harm, and will those measures be incorporated in the project?	X	
B. For bridges that are to be **rehabilitated** to the point that the historic integrity is affected, or that are to be moved or demolished, have fully adequate records been made of the bridge in accordance with the Historic American Engineering Record (HAER) or other suitable means developed through the Section 106 consultation?	NA	
C. For bridges that are to be **replaced**, has the existing bridge been made available for an alternate use, provided a responsible party agrees to maintain and preserve the bridge?[4]	NA	
D. For bridges that are to be **rehabilitated** and there is an **“Adverse Effect”**[5] on the historic integrity of the bridge, is the historic integrity preserved to the greatest extent possible, and consistent with unavoidable transportation needs, safety, and load requirements? *(If the project is a* ***replacement*** *project, write NA. for this question.)*	NA	

NOTES
1. Definition of Use: The action will impair the historic integrity of the bridge either by rehabilitation or demolition. Where the definition of impair is to diminish the qualities that made it eligible for the NRHP (Federal Register, Vol. 48. No. 163, dated Monday, August 22, 1983). 2. The Programmatic § 4(f) for Historic Bridges (1983) does not speak to class of NEPA Action in contrast to the § 4(f) programmatics for projects with Minor Involvements with Historic Sites (1986) and Minor Involvements with Parks, Recreation Areas, and Wildlife and Waterfowl Refuges (1986); both state they do not apply to projects when an EIS is prepared. A sampling of FHWA Divisions' use of the Historic Bridges Programmatic 4(f) indicates several delete this question altogether. American Association of State Highway and Transportation Officials' (AASHTO's) Center for Environmental Excellence states the Historic Bridges Programmatic "can be used with all NEPA processing options." 3. Consult the Nationwide Programmatic § 4(f) Evaluation for the generic (not prudent and feasible) reasons that might be addressed (Federal Register, Vol. 48. No. 163, dated Monday, August 22, 1983). The evaluation of alternatives for the subject project; however, must quantify those reasons as applicable and be supported by the circumstances of the project. 4. The advertisement and marketing of this bridge is not technically feasible given it is a type of structure (reinforced concrete) that is not transportable; nor does the Guam SHPO necessitate it. Appropriate mitigation is addressed in the provisions in the MOA among the Government of Guam, FHWA, the SHPO, and the ACHP. 5. When it has been determined by FHWA in consultation with the SHPO and ACHP that the rehabilitation work will result in "No Effect" or "No Adverse Effect" on the historic integrity of the structure, the provisions of § 4(f) Evaluation do not apply.

Agana Bridge #1

Bridge ID Number: 2801-0005P

Owner: Government of Guam – Department of Public Works

Physical Description of Resource

The Agana Bridge #1 is of a single-span reinforced concrete box construction with a rectangular open abutment. The bridge carries a roadway (Route 1) and a tributary of the Agana River flows beneath. The bridge span length is 41.7 feet (12.7 meters) with a deck width of 87.0 feet (26.5 meters). This bridge is highlighted on each end by sloping flared-end parapet walls reflecting a Spanish-style influence. Open metal rail balustrades are inset into concrete sidewalks. The bridge has been expanded from its original dimensions to accommodate six lanes.

History

No original bridge design or as-built plans were located that specifically address this bridge, and it is believed that such records were destroyed in a typhoon. However, some of the origins of the bridge can be culled from a plaque that originally resided on the outside of a parapet on the west elevation. The bridge dates to 1945 and was built by the men of the 25th Naval Construction Battalion, under the direction of the Island Engineer, Navy Captain William O. Hiltabidle, Jr. The Construction Battalions of the U.S. Navy had been formed in January 1942, and with its acronym C.B., the name "Seabee" was quickly coined.

Guam, a U.S. territory since 1898, was captured by the Japanese in December 1941, shortly after the bombing of Pearl Harbor. U.S. Marine, Navy, and Army forces regained control of Guam following bloody combat in the summer of 1944. The Seabees participated by unloading ships and performing vital construction jobs, including building airstrips, hospitals, oil tank farms, power plants, barracks and buildings, roads, and bridges. Island Commander, Marine Corps Major General Henry L. Larsen placed top priority on constructing a permanent, multi-lane highway (later called Marine Drive) between Sumay and Agana to provide access to the airfields and naval facilities. The 12-mile (19-kilometer) long, four-lane highway included nine bridges, according to an article written at the time.

The reinforced concrete box bridge type came into common use throughout the U.S. and was ubiquitous in local and state road building programs beginning in the early decades of the 20th century. The Agana Bridge #1 was constructed by American military led by civil engineers; therefore, it is not surprising that a bridge design was chosen that both met the design and engineering standards promulgated by the American Association of State Highway Officials (now AASHTO) and could be built quickly and economically. However, over time, the bridge was required to be widened twice for roadway expansion purposes.

National Register Eligibility

In addition to possessing significance, properties eligible for the NRHP must retain sufficient integrity of location, design, setting, materials, workmanship, feeling, and association to convey important values. Despite its subsequent widening, the Guam SHPO has recently expressed their opinion that Agana Bridge #1 retains sufficient character-defining features in the distinctive form of its four parapet walls reflecting a Spanish stylistic vocabulary. The SHPO believes those particular bridge features, as contributors, are eligible for listing in the NRHP under Criterion A at the local level as they are associated with the broad pattern of events associated with Hagatna’s history and its place in the history of World War II in the Pacific. The SHPO does not believe any other physical aspects of the bridge warrant designation as being eligible for listing in the NRHP.

Contemporary View of Agana Bridge #1 showing parapet walls and railings

Contemporary View of Agana Bridge #1 and Route 1

ALTERNATIVES CONSIDERED

No Action

The no-action alternative was eliminated for reasons of safety. The most recent bridge inspection reports (2009) indicated an overall condition rating of 4, signifying an overall "poor" condition. Even with routine maintenance, the concrete bridge's structural integrity would continue to deteriorate. The bridge abutments indicate severe cracking and there are numerous locations in which the concrete has broken apart. The deck slab indicates cracking with severe spalling underneath. Reinforced steel rebar has been exposed in several places and exhibits an advanced stage of rusting.

Recent analysis of the hydraulic capacity of the existing bridge structure concluded that it is not sufficient to meet the future stream forces and provide for the necessary freeboard after proposed channel improvements are made by the U.S. Army Corps of Engineers.

From a pedestrian safety perspective, the bridge is deficient because the sidewalk approaches have settled up to 3 feet (1 meter) at each of the four bridge ends, but especially on the northwest and southwest corners. This condition will continue to deteriorate.

The bridge engineer's inspection report expressed that, "The deterioration of the superstructure appears to be due to the flexure stressed associated with overloading" and concluded that the bridge "is not capable of supporting any of the proposed military vehicles."

Build on New Location without Using the Old Bridge

Because Agana Bridge #1 ties into the six-lane main highway route, an option to shift the highway away to the north or south so as to construct a new bridge, leaving the older bridge in place, was not viewed as a practicable solution. The Guam SHPO agreed with that assessment. Not only would the re-routing be of major expense because of the necessity of roadway redesign and construction, but the new bridge location would involve the use of other 4(f) (park) resources and residential and/or business displacement and disruption of extraordinary magnitude.

DETERMINATION AND APPROVAL

Based on the environmental documentation and analysis and the results of public and agency consultation and coordination, FHWA has determined that:

- Use of Agana Bridge #1 meets the applicability criteria as set forth in the Nationwide Programmatic § 4(f) Evaluation and Approval for FHWA Projects that Necessitate the Use of Historic Bridges dated July 5, 1983;
- All of the alternatives set forth in the Findings section of the above Nationwide § 4(f) Evaluation have been fully evaluated. Based on the Findings, it is determined there is no feasible and prudent alternative to the use of the Historic Bridge; and
- The project complies with the Measures to Minimize Harm Section of the Nationwide § 4(f) Evaluation; and agreement between FHWA, SHPO, and ACHP has been reached.

Accordingly, the FHWA approves the proposed use of the historic bridge for construction under the above Nationwide § 4(f) Evaluation issued on July 5, 1983.

HAWAII DIVISION
FEDERAL HIGHWAY ADMINISTRATION
PROGRAMMATIC SECTION 4(f) DETERMINATION AND APPROVAL
UNDER THE
NATIONWIDE PROGRAMMATIC SECTION 4(f) EVALUATION AND APPROVAL FOR FHWA PROJECTS THAT NECESSITATE THE USE OF HISTORIC BRIDGES
(JULY 5, 1983)

SECTION 4(f) USE OF AGANA BRIDGE #1

Additional Information for "No" Response in Item 6B

In accordance with the MOA regarding replacement of the Agana River Bridge #1, the GDPW and the FHWA will commit to photographic and written documentation of the bridge using the Historic American Building Survey/Historic American Engineering Record standards. This work will be conducted prior to the proposed demolition and construction of the new structure.

CHAPTER 22. REFERENCES

22.1 PURPOSE OF AND NEED FOR ACTIONS

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22.21 SECTION 4(F) AND SECTION 6(F) EVALUATION

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