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.

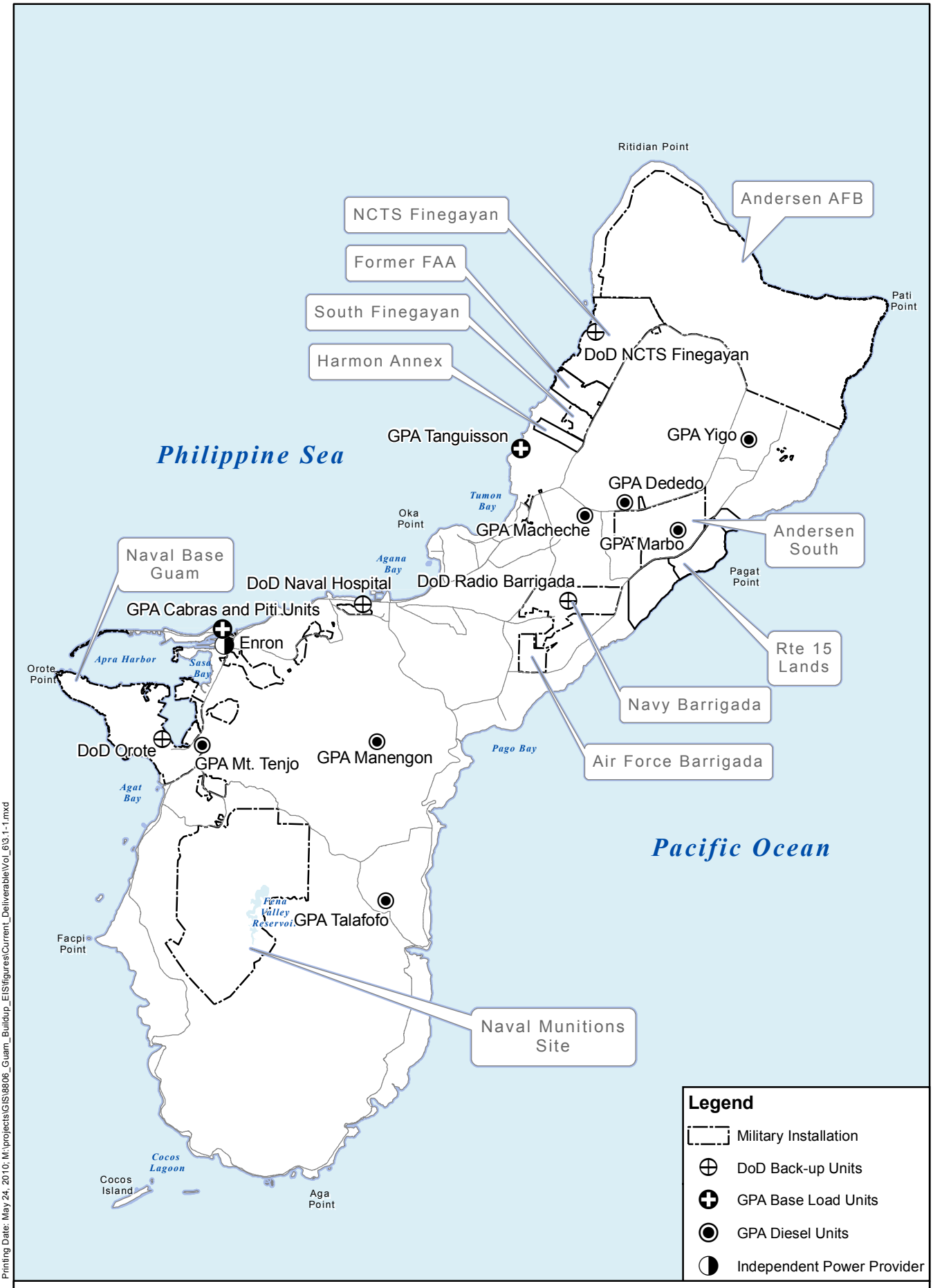

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Figure 3.1-1
Power Facility Locations, Guam

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.

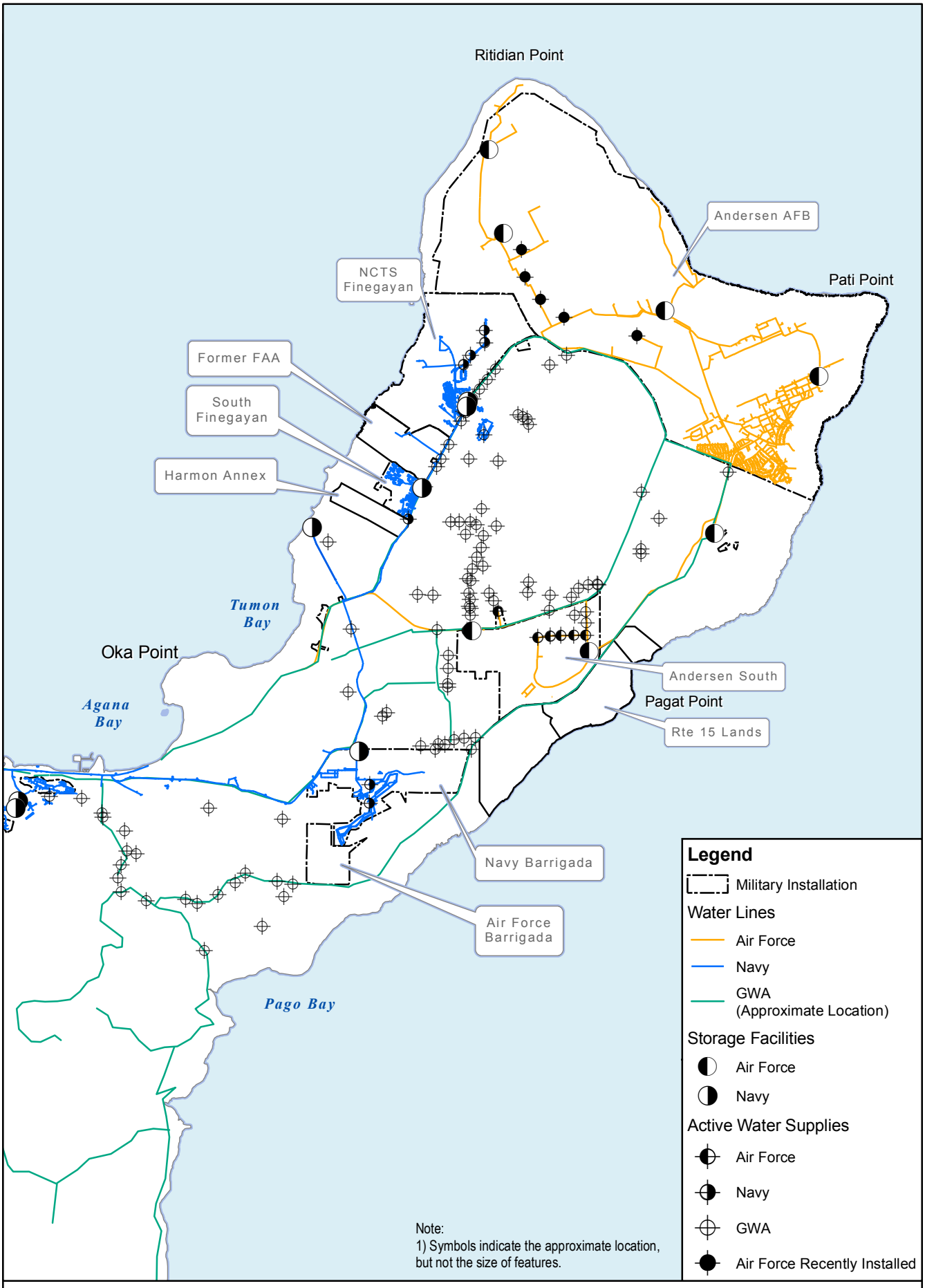

Figure 3.1-2
Potable Water Systems-North and Central Guam

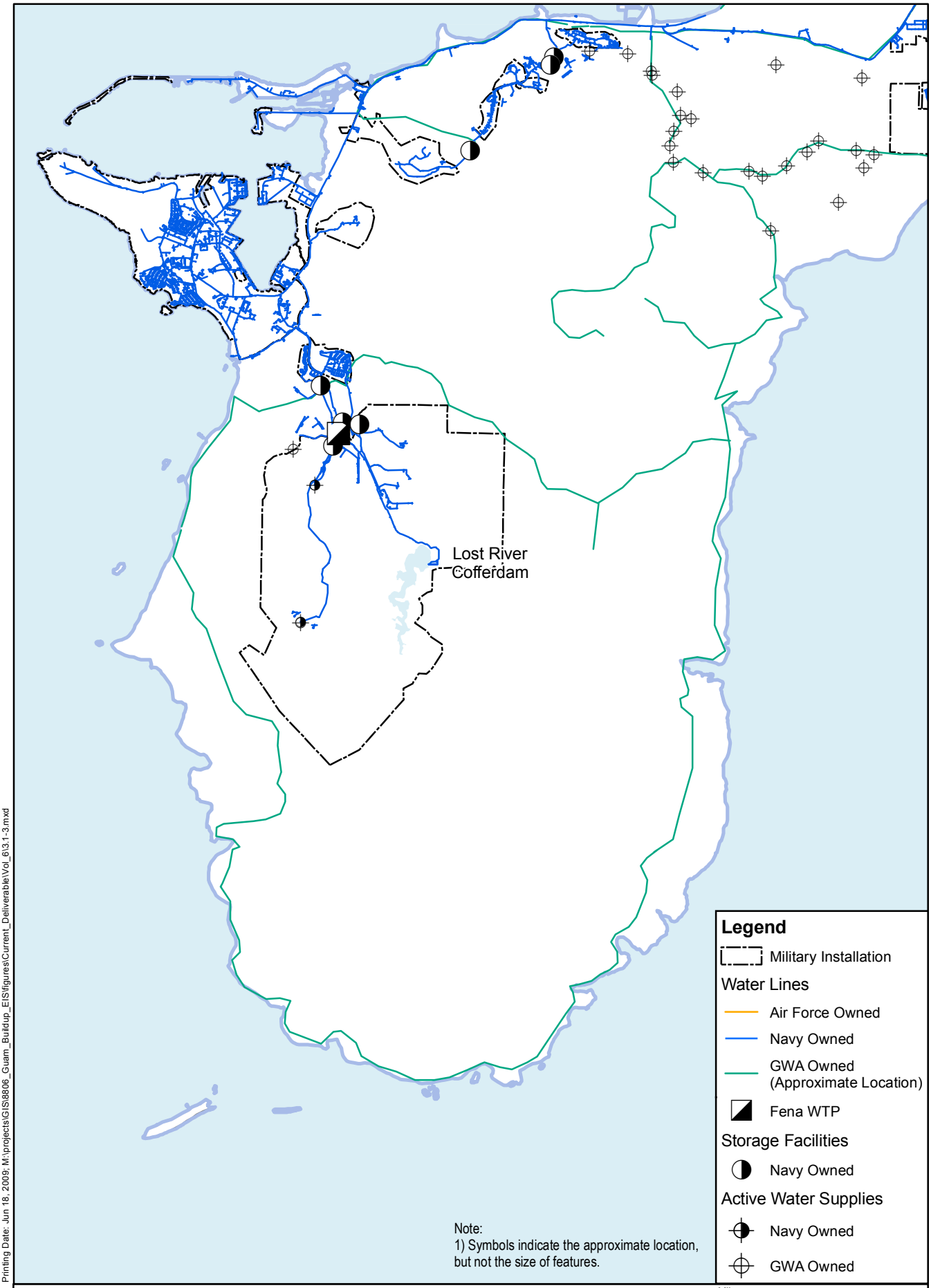

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Figure 3.1-3
Potable Water Systems - Central and South Guam

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.

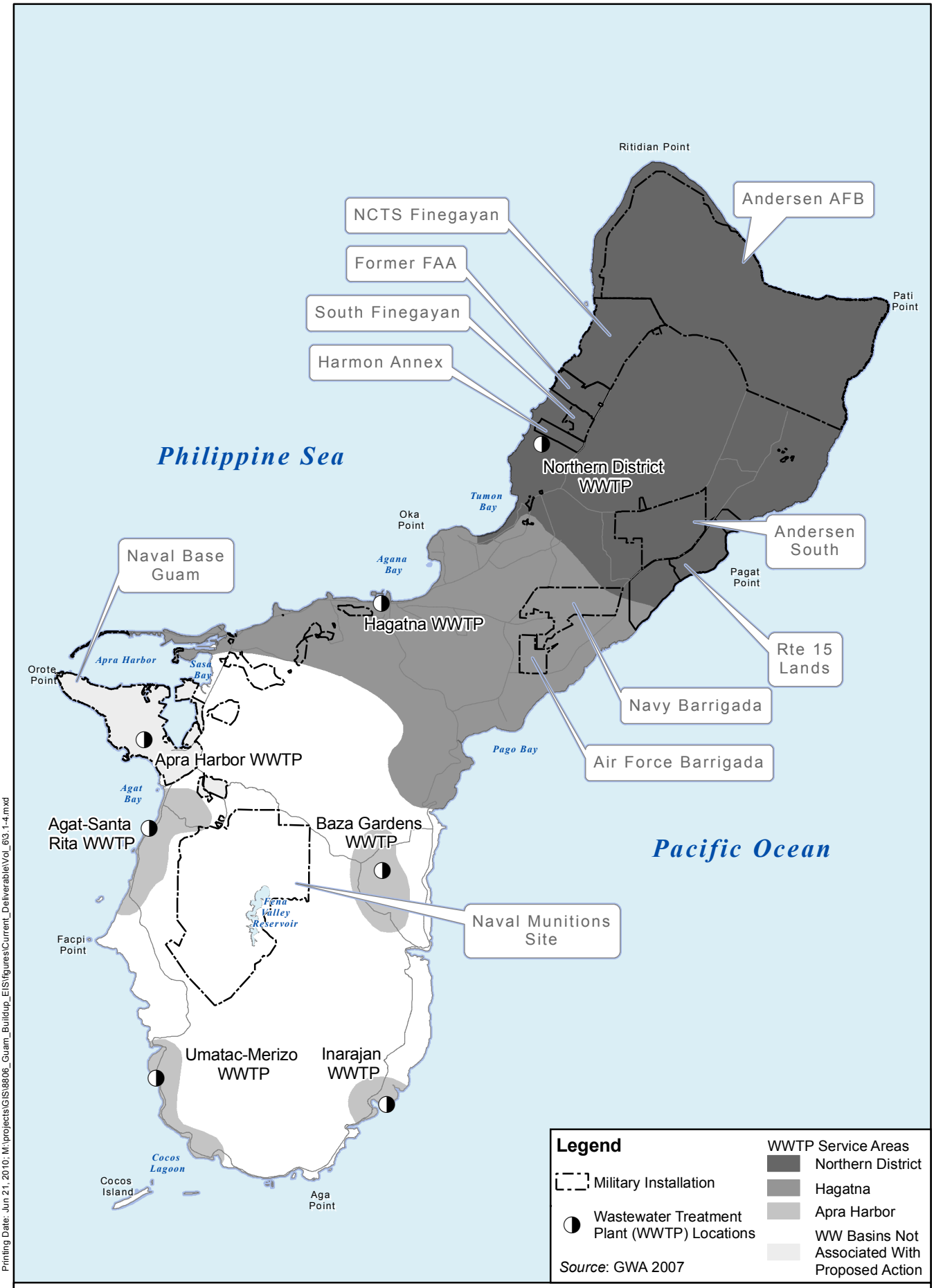

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Figure 3.1-4
Wastewater Treatment Plant Locations and Service Areas, Guam

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.

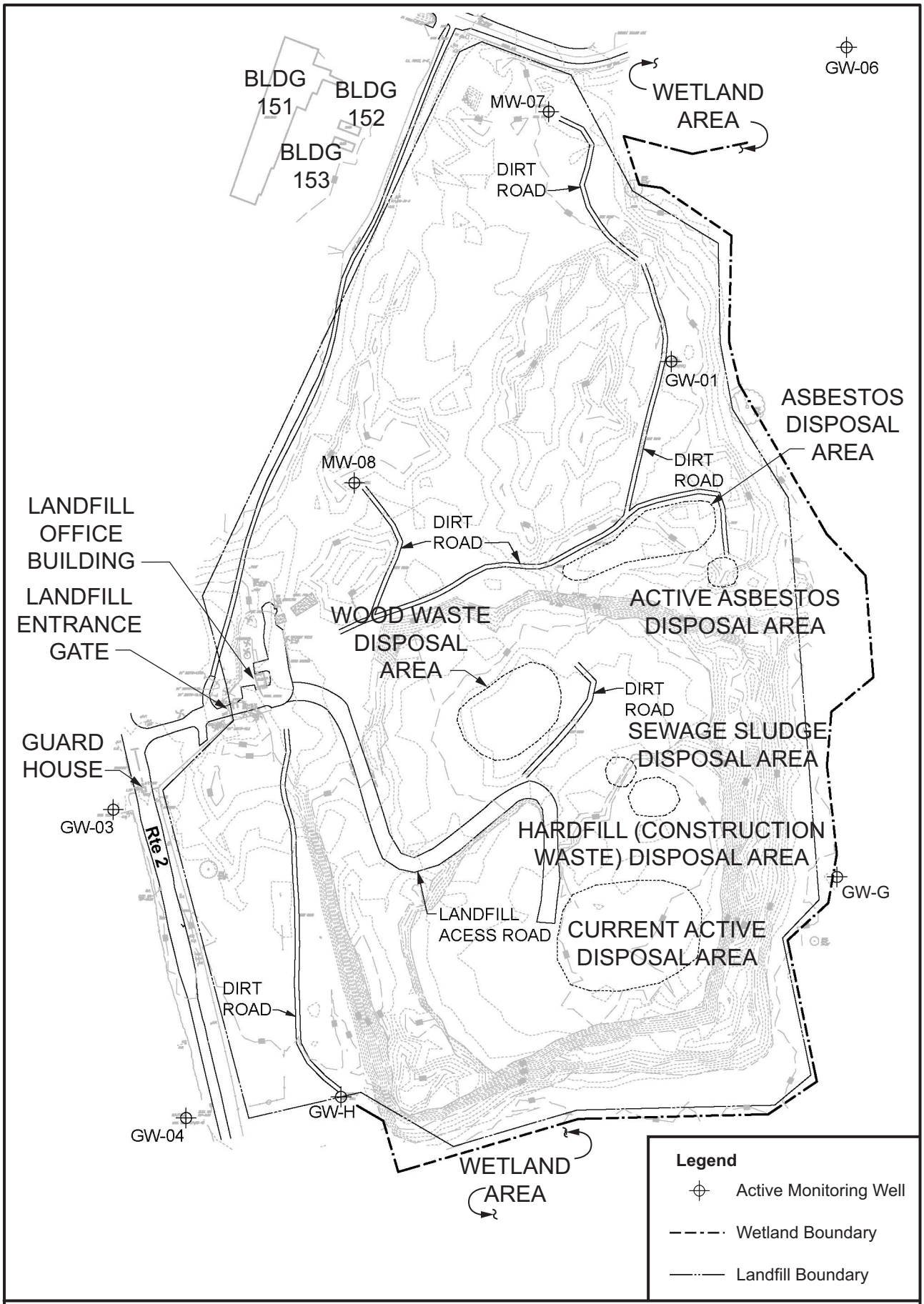

Figure 3.1-5
Existing Navy Sanitary Landfill, Guam

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

	Year									
GWA Water System	*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

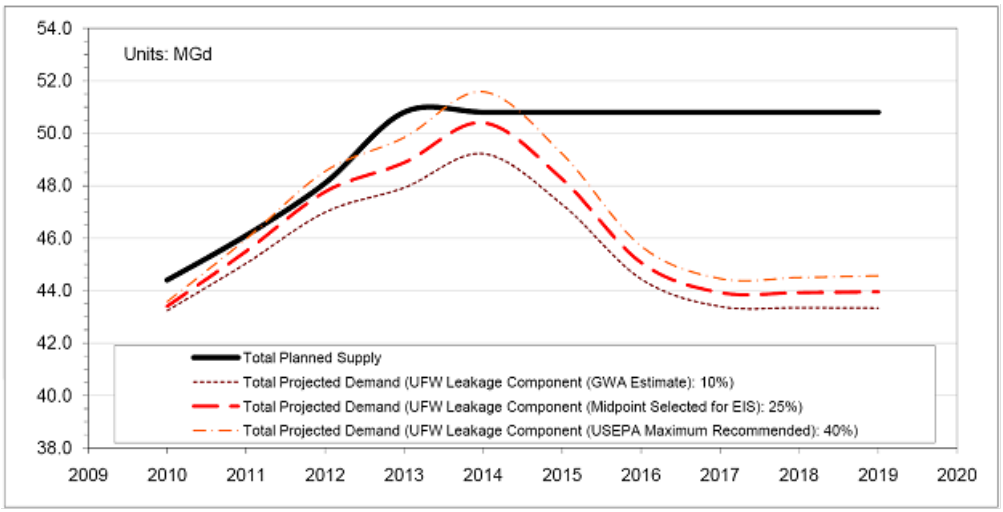

Figure 3.2-1. GWA Supply and Demand

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.

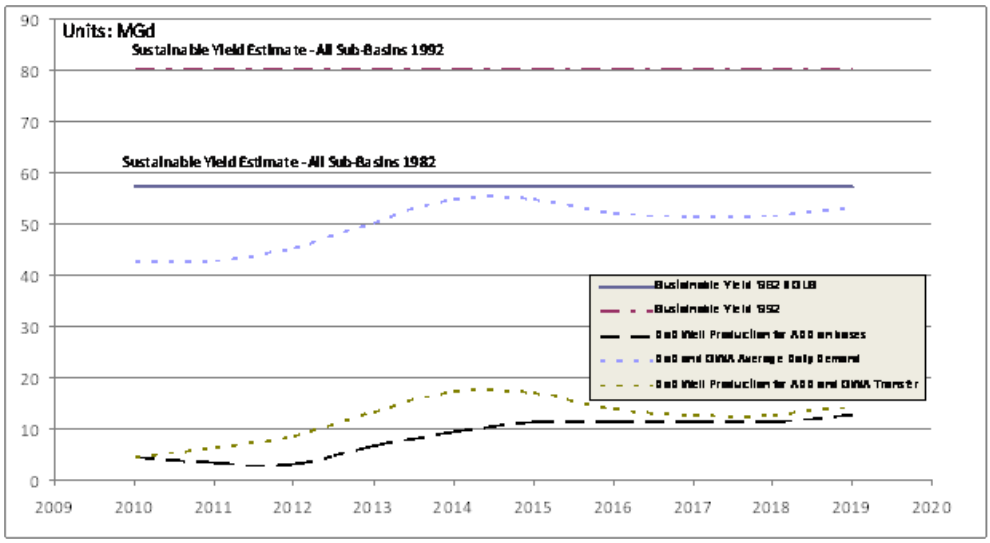

Figure 3.2-2. Well Withdrawal to Meet DoD Average Daily Demand and GWA Average Daily Demand in 2014

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.

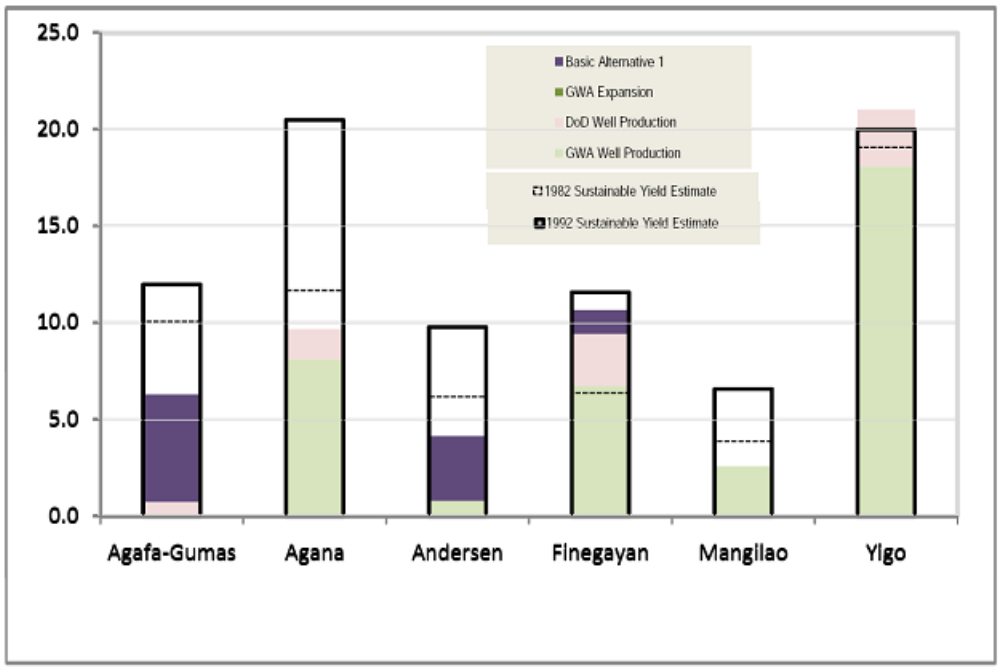

Figure 3.2-3. Well Withdrawal to Meet DoD Average Daily Demand and GWA Average Daily Demand By Subbasin in 2015

Proposed Mitigation Measures

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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