CHAPTER 1 - WASTEWATER SYSTEM DESCRIPTION

1.1 Introduction

The GWA provides wastewater services for Guam's general population and for Andersen Air Force Base. The wastewater system is made up of seven wastewater basins: Agat, Umatac-Merizo, Inarajan, Baza Gardens, Northern District, Hagatna and Pago Socio. Figure 1-1 delineates the respective wastewater basins and includes 270 miles of collection system, 77 wastewater pump stations and 7 wastewater treatment plants.

The collection systems serving the seven basins are described in Chapter 4 – Wastewater Collection System in this volume. Approximately 41 percent of island residents live in areas that are not served by collection systems.

The purpose of this chapter is to present an overview of the wastewater treatment systems; a detailed description of the individual treatment plants is presented in Chapter 5 – Wastewater Treatment Facilities later in this volume. Six of the seven wastewater treatment plants are profiled in detail below. Pago Socio has limited information available and does not require an NPDES permit.

1.2 Wastewater Treatment Plants (WWTPs)

The following discussion provides a brief description of the WWTPs (sometimes called Sewage Treatment Plants (STPs)), summary of their respective conditions, and class level designation as defined by the GEPA Water and Wastewater Regulations. For each plant, the major topics include plant description, staffing implications, and regulatory issues. A more detailed discussion of wastewater regulatory issues is presented in Chapter 2 of this volume.

1.2.1 Agat-Santa Rita STP

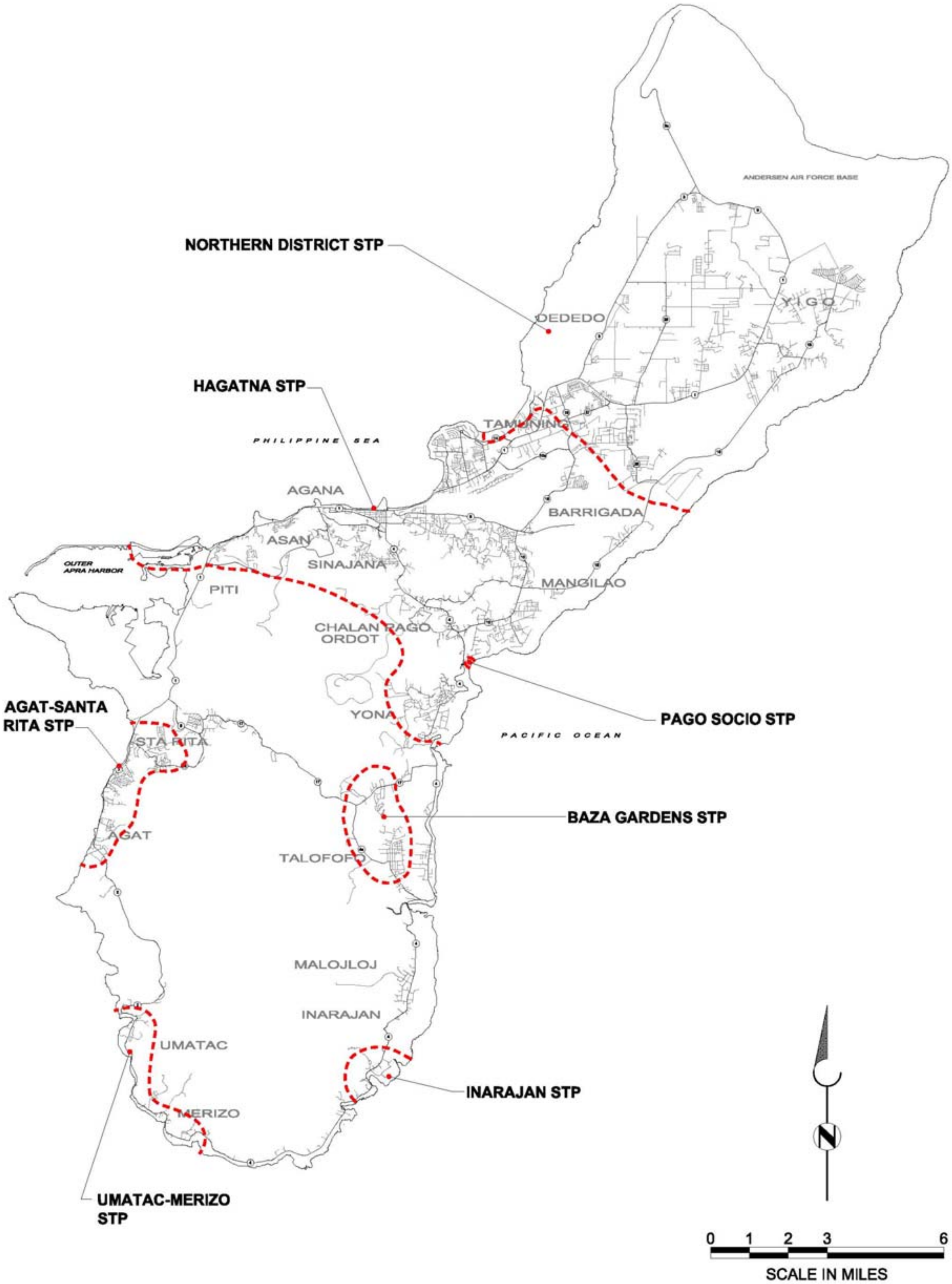
Plant Description – The Agat-Santa Rita STP was built in 1972 and is designated a Class II WWTP. The plant uses a single process train, contact stabilization process producing secondary treatment. The effluent from this treatment facility is sent through a combined outfall shared with the Navy's Apra Harbor WWTP, which discharges to Tipalao Bay. The facility's basin consists of approximately 1,500 sewer connections.

Staffing Implications – When experienced wastewater operations personnel on the WRMP consulting team visited the plant, there did not appear to be a good understanding of the plant process. There was no on-site simple testing tool to determine the condition of the activated sludge. Also, the fact that the return sludge pump was nonfunctional for an extended time period indicated a lack of understanding of the importance of such equipment in the activated sludge process. These observations indicate the need for process orientation for all plant personnel.

Regulatory Issues – Several regulatory issues have been associated with this plant. Some of those issues may have been resolved before the publication of this final report. The following examples are taken from a Comprehensive Performance Evaluation (CPE) conducted in 2004 or from recent Discharge Monitoring Reports (DMR):

- During the period from January 2004 through March 2006, performance consistently failed to meet compliance with the NPDES permit.
- DMR flow and laboratory data are questionable.

Figure 1-1 – Wastewater Basins



1.2.2 Hagatna STP

Plant Description – The Hagatna STP was commissioned in 1979 and is designated a Class III WWTP. Hagatna STP is a primary treatment facility that discharges its effluent through an ocean outfall. Liquid treatment is handled by three primary clarifiers, and solids stabilization is handled by four aerobic digesters. Flow is measured by a Parshall flume before it enters the primary clarifiers. Pretreatment of the raw wastewater is designed to occur at the Hagatna main pump station just upstream of the plant.

Effluent may flow by gravity or be pumped to the ocean outfall when gravity flow is insufficient. A sludge dewatering centrifuge was originally installed to thicken sludge; however, it is currently inoperable and solids are hauled to the Northern District STP for dewatering.

Staffing Implications – Because much of the equipment is inoperable, staff time is minimized. Direct Responsible Charge (DRC) issues were resolved in April 2005 with the hiring of a supervisor having the required certification level.

Regulatory Issues – The plant has not met NPDES requirements 58 percent of the time for monthly average 5-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) effluent concentration in milligrams per liter (mg/L). Additionally, based on questionable flow data, 25 percent of all flow measurement results exceed the permit requirements of 12 million gallons per day (mgd); 75 percent of the monthly average results for settleable solids are not met.

1.2.3 Baza Gardens STP

Plant Description – The Baza Gardens STP began operation in 1975 and is designated a Class II WWTP. Liquid treatment is accomplished by a single process train extended aeration process and secondary clarifier. Solids stabilization is provided by an aerobic digester. The effluent is discharged to the Togcha River, which is a tributary to the Pacific Ocean.

An influent pump station delivers flow to the headworks, which consists of a manual barscreen, aerated grit chamber, and comminutor. Flow from the headworks enters the aeration tank and then passes to the contiguous secondary clarifier. Airlift pumps deliver return activated sludge back to the aeration tank and are also used to transfer waste activated sludge to the aerobic digester.

Effluent chlorination was designed for disinfection, but it is currently not used due to the lack of dechlorination facilities. Stabilized digested sludge is delivered to the Northern District treatment plant and dried on sludge drying beds.

If upgraded and maintained, the basic elements at the plant appear to meet the original design intent for wastewater treatment. A combination of mechanical attention and better understanding of applied activated sludge principles could make facility operations much more efficient.

Staffing Implications – The plant is in compliance with GEPA requirements for a DRC operator. During the consultant team's 2004 visit, there was a noticeable lack of understanding of the basic activated sludge process and its application to this plant. Subsequent training sessions should have corrected this situation.

Regulatory Issues – The plant did not meet the NPDES permit requirements for any regulated parameter during the period of plant visits for the CPE review. Note the plant permit includes stringent nutrient standards because treated effluent is discharged to a stream.

1.2.4 Umatac-Merizo STP

Plant Description – The Umatac-Merizo STP was built in 1981 and is designated a Class II WWTP. The plant is an aerated facultative lagoon with overland percolation systems designed to meet secondary treatment requirements and final disposal. The facility is operated on a zero discharge scheme with disposal accomplished by the overland flow system. Although the plant has an NPDES permit, the nutrient requirements are almost impossible to achieve with the existing facilities, thus making the zero discharge a continuing challenge for plant operations. GWA is required to report any discharges to the Pigua River or Toguan River to GEPA.

Influent is pumped to the aerobic facultative lagoon, which is aerated by two aspirator-type surface aerators. Lagoon effluent is pumped to an overland flow disposal system, located in the hills about a mile away. The overland flow system consists of two parallel, terraced grass fields. The fields are alternated receiving effluent from the effluent pump station. Effluent that is not removed by the overland flow disposal system is collected by a concrete interceptor ditch at the bottom of the overland flow areas, and then flows to a recirculation pond, where the recirculation pump station returns it back to the top of the overland flow disposal system. If the level of the recirculation pond reaches a high level, the overflow discharges to the Toguan River and then to the ocean.

Staffing Implications – The plant is in compliance with GEPA requirements for a DRC operator. Plant operators seem to have a grasp of general wastewater principles.

Regulatory Issues – Plant performance data reported to the GEPA were reviewed for the period from April 2001 through March 2004; however, it should be noted that plant performance is generally not reported. For approximately the last two years, the plant has had no reportable discharge. The following comments are noted:

- NPDES permit violations typically occur only when pump stations go offline and raw wastewater spills into the Pigua River or Toguan River, or when secondary effluent discharges over the recirculation pond overflow weir.
- The treatment plant does not have chlorination facilities and does not chlorinate its effluent because it operates as a zero discharge facility.
- The plant needs to install a monitoring device to indicate when the overland system is overflowing to the Toguan River.

1.2.5 Northern District STP

Plant Description – The Northern District STP was commissioned in 1979 and is designated a Class III WWTP. The plant is a primary treatment plant located on the northwestern coast of Guam. The Northern District STP provides wastewater treatment for the Andersen Air Force Base under an agreement with the U.S. Air Force. The Air Force base contributes 8 percent of the total flow or 0.73 mgd. The plant is designed to treat 12.0 mgd, with a peak design flow capacity of 27.0 mgd. The plant effluent is discharged through an ocean outfall into the Philippine Sea.

Wastewater flows through a comminutor, a Parshall flume, two rectangular preaeration tanks, and two rectangular aerated grit tanks prior to entering a flow divider box. Air is supplied to the two preaeration tanks and grit tanks by two centrifugal blowers. Settled grit is removed from the grit chambers by airlift pumps to an inclined screw-type grit classifier to separate the water from the grit.

Downstream of the headworks, flow passes to two circular primary clarifiers. Primary clarifier effluent flows through a Parshall flume and then to the chlorine contact tanks. Final effluent from the chlorine contact tank then flows into the ocean outfall.

Anaerobic digestion is used to stabilize the biosolids prior to dewatering on sand drying beds. Although the original solids handling system used centrifuges for dewatering, they are no longer in service, along with much of the rest of the digester-related equipment. More specifics on biosolids management are found in Chapter 8, Sections 8.1 and 8.4 of this volume.

Staffing Implications – The DRC requirement for plant supervision was met on April 29, 2005.

Regulatory Issues – Based on a review of available data for 2004, all regulated limits for all parameters were in violation of the NPDES permit, ranging from 8 to 100 percent of the time. Although the permit expired on June 30, 1991, it has been administratively extended while the reapplication is under review.

1.2.6 Inarajan STP

Plant Description – The Inarajan STP is designated a Class II WWTP. It is a secondary wastewater treatment facility employing an aerobic lagoon treatment system. Its major unit processes include four aerated lagoons, three percolation basins, and six sludge drying beds.

Raw wastewater from system pump stations is delivered to four aerated lagoons, laid out in series from cell 1 to cell 4. Each cell is aerated by mechanical surface aerators. The treated wastewater flows through the weir box and on to dosing chambers through a 60-degree V-notch weir equipped with an ultrasonic level sensor. Dosing chambers deliver flow to the percolation ponds. Solids that settle in each lagoon and the stabilized solids are transferred to sludge drying beds, and dried sludge cake is transported by trucks to a landfill.

Staffing Implications – The DRC requirement for plant supervision was met on April 29, 2005. Operators from other plants make surveillance checks at the site, and manpower needs are minimal.

Regulatory Issues – This plant is a zero discharge facility and has no NPDES permit; however, it does need to comply with GEPA regulations.

1.2.7 Pago Socio STP

Plant Description – Detailed information for the Pago Socio STP has limited coverage in this report for several reasons, namely:

- effluent disposal is through percolation basins which do not require NPDES permit limitations
- effluent volume is unknown
- there are no current monitoring records to evaluate treatment performance

1.3 Wastewater Collection System

There are two major components to the collection system – wastewater collection pipelines and wastewater pump stations, which are summarized below. A full description of the collection system evaluation process is presented later in this volume in Chapter 4 – Wastewater Collection System. There are areas of the island that are not sewered; this topic is covered in detail in Volume 3, Chapter 6 - Septic Systems and Unsewered Areas.

1.3.1 Wastewater Collection Pipelines

The total wastewater system comprises approximately 270 miles of pipeline, of which about 100 miles are equal to or greater than 10 inches in diameter and 170 miles are less than 10 inches in diameter. During the course of the study the WRMP study, 303 manholes in the system were inspected and given a condition rating. This was a representative sampling of the estimated 1,770 total number of manholes on lines 10 inches or greater in size. An estimated 4000 manholes are on lines smaller than 10 inches in diameter.

1.3.2 Wastewater Pump Stations

A complete inventory of pump stations was performed during the study, and a condition assessment was completed. The assessment defined the relative condition of a number of components associated with the station, including:

- Physical station condition
- Pump condition and functionality
- Pump motor condition and functionality
- Ancillary equipment condition and functionality
- Condition of 18 emergency generators owned by GWA, (an additional 23 generators are owned by the GPA)

There are 77 stations of varying types in the system. Twenty are the submersible type and eight are ejector stations where the motive force is supplied by compressed air. Completion of SCADA system upgrades will enhance reliability of these stations. More details on the condition assessment are included in Chapter 3 of this volume.

1.4 Conclusions

The following conclusions can be drawn from the assessment of the current design of GWA's wastewater system:

- GWA operates seven STPs, one of which is scheduled to be converted to a pump station site.
- Most of the STP's were constructed between 1971 and 1982, and most are in need of upgrades to meet NPDES and operability requirements as outlined in Chapter 3, Section 3.4 of this volume.
- GWA also operates and maintains 270 miles of collection system comprised of both gravity and force main lines as well as 77 pumping stations.

- Pump station conditions are detailed in Volume 1, Chapter 3 – Condition Assessment and for the most part, identify numerous upgrades needing to be done.
- Suggested collection system upgrades are outlined in Chapter 4 – Wastewater Collection System of this volume.
- Operation and maintenance personnel skills are on an improving trend by way of upgrading certification levels and hiring of skilled personnel.

1.5 Recommendations

The following recommendations are presented based on WRMP findings:

- Complete STP upgrades included in the CIP in order to meet regulatory and expansion requirements.
- Complete collection system inspection and pump station upgrades based on the CIP in the WRMP.
- Elevate personnel skill levels to assure an understanding of wastewater principles and the necessity of meeting regulatory requirements for liquids and solids treatment and disposal.
- Resolve administrative and political positions relative to unsewered areas, particularly in the Northern District to assure protection of potable water sources.
- Expedite completion of facilities to bring biosolids treatment and disposal into compliance with EPA regulations.
- Expedite completion of SCADA system upgrades to improve efficiency and reliability of STPs and pump stations.

1.6 CIP Impacts

Forty-five specific projects are detailed in Volume 3, Chapter 9 – Recommended Wastewater CIP and summarized in Volume 1, Chapter 15 – Capital Improvement Program as CIP items for the wastewater system. The following are key issues to be addressed:

- Upgrades to collection system and pump stations
- Upgrades to bring STPs into regulatory compliance and meet growth needs
- Install Supervisory Control & Data Acquisition (SCADA) system improvements
- Improve biosolids treatment and disposal by consolidating operations at a central location
- Complete electrical system upgrades at pump stations and STPs
- Complete projects that eliminate groundwater contamination of potable water sources