CHAPTER 3 – WASTEWATER FACILITIES CONDITION ASSESSMENT

3.1 Introduction

A condition assessment of equipment associated with the wastewater pump and ejector stations and the wastewater treatment plants was conducted in February and March 2005. The assessment was performed by visiting each of the sites and visually inspecting the equipment. When possible, the equipment was assessed during operation. This chapter summarizes the results of the condition assessment. Selected wastewater facilities were evaluated as part of the overall corrosion assessment described in Volume 1, Chapter 11. Electrical power assets were assessed separately and are discussed in Volume 1, Chapter 12 – Electrical Assessment.

3.2 Assessment Approach

A team consisting of a Brown and Caldwell senior operations specialist and an engineer together with GWA staff visited each of the sewage treatment plants and wastewater pump stations and conducted a qualitative assessment of equipment physical condition and functionality. The qualitative assessment consisted primarily of visual observation, but in case where equipment was operating, a visual and sound assessment was also conducted. GWA staff who accompanied the assessment team were questioned about the equipment and their input was used to assess "mean time between failure" because maintenance records were not available readily.

Table 3-1 – Assessment Elements lists the elements that were assessed. It includes the component, the information assessed for the component and the details of the assessment. The full assessment is provided in Appendix 3A.

Table 3-1 – Assessment Elements

Component	Assessment Information	Detail
Motors	• Physical Condition • Functionality • Runtime • Motor Base • Meantime Between Failure • Vibration • Temperature • High Efficiency Motor	• 0 to 4 Rating (see Table 3-2) • 0 to 4 Rating (See Table 3-3) • Hours if available • 0 to 4 Rating • Excessive, high but acceptable, normal • Normal, excessive (if equipment was operating) • Normal, excessive (if equipment was operating) • Yes, no
Driven Equipment	• Physical Condition • Functionality • Runtime • Motor Base • Meantime Between Failure • Vibration • Temperature • Cavitation • Seals Functional • Seal Water Functional	• 0 to 4 Rating (see Table 3-2) • 0 to 4 Rating (See Table 3-3) • Hours if available • 0 to 4 Rating • Excessive, high but acceptable, normal • Normal, excessive (if equipment was operating) • Normal, excessive (if equipment was operating) • Yes, no (if applicable) • Yes, no (if applicable) • Yes, no (if applicable)

Table 3-1 – Assessment Elements (continued)

Component	Assessment Information	Detail
Buildings	• Exterior Wall Condition	• 0 to 4 Rating (see Table 3-2)
	• Interior Wall Condition	• 0 to 4 Rating (see Table 3-2)
	• Exterior Finish Condition	• 0 to 4 Rating (see Table 3-2)
	• Interior Finish Condition	• 0 to 4 Rating (see Table 3-2)
	• Equipment Finish Condition	• 0 to 4 Rating (see Table 3-2)
	• Roof Condition	• 0 to 4 Rating (see Table 3-2)
	• Window Condition	• 0 to 4 Rating (see Table 3-2)
	• Pipe Support Condition	• 0 to 4 Rating (see Table 3-2)
	• Equipment Layout Access OK	• Yes, no
Wet Wells	• Top Slab Condition	• 0 to 4 Rating (see Table 3-2)
	• Interior Wall Condition	• 0 to 4 Rating (see Table 3-2)
	• Hatchway Condition	• 0 to 4 Rating (see Table 3-2)
	• Hatchway Accessible	• 0 to 4 Rating (see Table 3-2)
	• Ventilation	• Yes, no
	• Separate from Drywell	• Yes, no
Dry Wells	• Mechanical Ventilation	• Yes, no
	• Gas Detection Equipment	• Yes, no
	• Dehumidification Equipment	• Yes, no
Generators	• Back-up Power	• Yes, no
	• Emergency Generator	• On-site, potable, auto start, manual start
	• Physical Condition	• 0 to 4 Rating (see Table 3-2)
	• Functionality	• 0 to 4 Rating (see Table 3-3)
	• Size Adequate	• Yes, no
	• Fuel Tank	• Yes, no
	• Spill Containment	• Yes, no
	• Transfer Switch	• Yes, no
	• Outdoor Panel	• Yes, no
Miscellaneous	• Odor Control	• Yes, no
	• Hoist	• Yes, no

Both physical condition and functionality were given a numeric rating from 0 to 4. Descriptions of these ratings are provided in Table 3-2 and Table 3-3. Physical condition relates to the appearance, including apparent wear and corrosion, as well as operating characteristics such as noise, vibration, and temperature. Functionality relates to the ability of the piece of equipment to accomplish its purpose.

Table 3-2 – Equipment Physical Condition Rating

Rating Scale	Description
0	Not Applicable
1	Equipment integrity severely compromised by corrosion and/wear.
2	Moderate to high risk of failure
3	Visible degradation of equipment, but acceptable
4	Well-maintained, like new condition of equipment

Table 3-3 – Equipment Functionality Rating

Rating Scale	Description
0	Not Applicable (Not operational or abandoned)
1	Equipment is not currently functioning for its intended use.
2	Equipment is in service but function is highly impaired.
3	Equipment functions as intended, maintenance frequencies and tasks as expected for this asset class.
4	Equipment functions as intended, by maintenance frequencies and tasks exceed (i.e. are less than) those expected for this asset class.

3.3 Factors Affecting Condition

There are several factors that affect the condition of GWA Wastewater System equipment. Some of these factors are controllable and some are not. Several of these factors are described in this section.

- **Use** – All equipment has a useful or expected life. As the run-time hours increase, the condition of the equipment naturally degrades.
- **Maintenance** – Predictive and preventive maintenance activities are necessary for any equipment to achieve its useful life. These activities can also prolong and even extend the useful life of equipment. Equipment has been historically poorly maintained.
- **Power Quality** – The quality of electrical power supplied by GPA affects the life of electrical motors. The effect of power quality on motors is being addressed in Volume 1, Chapter 12 – Electrical Assessment.
- **Corrosive Environment** – There are two types of corrosion that affect equipment corrosion: (1) GWA equipment and facilities are affected by rust and subsequent corrosion due to the island's marine air, (2) Warm wastewater contributes to the production of hydrogen sulfide which is oxidized by bacteria to form corrosive sulfuric acid.
- **Vandalism /Theft** – Most of GWA's wastewater facilities are not secure and show indications of vandalism. Though most stationary equipment are not targets of theft, some appurtenant equipment such as emergency generator batteries are. Many of the batteries associated with GWA generators have been removed to prevent their theft. This reduces their functionality because they cannot start automatically.

- **Weather and Natural Disasters** – Guam experiences typhoons and earthquakes. Within the last 10 years two super typhoons with winds exceeding 200 miles per hour hit the island.

There is a lot of synergy among these factors that affect condition. For example, when a piece of equipment fails or is taken out of service, the use of back-up equipment increases. Poor maintenance practices and the corrosive environment place added wear on the back-up equipment, further reducing its useful life.

3.4 Condition Assessment

The discussion of the condition assessment for GWA's wastewater system is organized by treatment facility and pump stations. This chapter is intended to summarize the results of the condition assessment. A compact disc (CD) is provided in Appendix 3A with all the information collected.

3.4.1 Hagatna STP

Most of the equipment has either failed or is near the end of its useful life. Only one of three primary clarifiers was functional, though the chains and flights in a third clarifier were being replaced. Though the aerobic digesters were in use, it is doubtful that any stabilization was occurring. The solids dewatering equipment is completely non-functional, requiring that sludge be hauled to the Northern District STP.

The condition of equipment at the Hagatna STP is the result of many factors, the most notably being lack of maintenance. It appears that equipment failures resulted in its abandonment rather than in repair. The corrosive marine environment further contributes to equipment deterioration.

Condition Summary – Major deficiencies are summarized below:

- Preliminary treatment equipment was not functional.
- From January 2004 to March 2006, only one of the three clarifiers was in service due to mechanical failures.
- Sludge dewatering centrifuge equipment was inoperable, so decanted sludge has to be trucked to the Northern District STP for further processing.
- Odor control system was not functional.
- Concrete corrosion from hydrogen sulfide was critical in the concrete channels.
- Influent flow meter was not functional.

3.4.2 Agat-Santa Rita STP

The equipment condition at the STP varies. This secondary treatment facility depends on influent and effluent pumping and the blowers for the STP to function properly. Enough of the necessary equipment, except the effluent pumps, is in sufficient condition and functioning properly to provide the level of treatment necessary. Despite the condition, poor performance of the treatment process has been observed during numerous site visits. A key reason for this result is failure to adequately return activated sludge (RAS) from the secondary clarifier to the aeration basin. This failure is the result of either a RAS line subject to continuous plugging, or a poor air lift return. This problem should be a high priority for repair to ensure the plant operates effectively.

Condition Summary – Major deficiencies are summarized below:

- All preliminary treatment equipment has been removed.
- The ultrasonic (polysonic) influent flow meter was not functioning properly.
- Aeration in the all basins appeared to be limited, possibly due to frozen valves and clogged or malfunctioning diffusers.
- Clarifier weir was not level.
- Sludge scraper was not functional (separated from drive unit).
- Existing bar screen allowed a significant amount of solid material to pass to the treatment process.
- The effluent flow meter was not functional.

3.4.3 Baza Gardens STP

The equipment condition at the STP varies. The aeration blowers are the critical equipment for this facility and two new blowers are now operational. However, in the event of a power outage, the blowers depend upon emergency power. The emergency generator is not functional.

Condition Summary – Overall, the plant condition is quite good. Major deficiencies are summarized below:

- Aeration diffusers need to be cleaned or redesigned as air distribution was inadequate.
- A transfer switch for the generator needs to be installed to make the generator functional.

3.4.4 Inarajan STP

There is very little equipment associated with this facility, as wastewater enters by gravity and effluent exits through an irrigation piping system.

Condition Summary – Because there is minimal equipment, there are no severe mechanical problems. Major deficiencies are summarized below:

- The surface aerators need rehabilitation.
- The effluent flow meter needs rehabilitation.
- The effluent irrigation piping system is severely corroded.

3.4.5 Northern District STP

This primary treatment STP is the largest plant operated by GWA. It also processes all the sludge produced at the plant and the sludge produced by the other STPs.

The headworks are being upgraded currently with new blowers to aid in raw sewage grit removal. There is no effective screening of the raw sewage.

The sludge pumping system associated with the primary clarifiers is also being upgraded. New sludge pumps are being installed, but only one is operational currently.

The anaerobic digesters are nothing more than pass-through vessels. Though some digestion might be occurring, virtually all of the equipment is not functioning. In addition, the solids dewatering system is in total disrepair. The sludge drying beds are functional, but not being used as intended and are labor intensive. The beds are intended to aid in dewatering and drying digested sludge, but are being used for raw sludge drying and dewatering.

Condition Summary – This plant is in severe critical need of upgrading and equipment replacement to make it a functioning facility. Major deficiencies are summarized below:

- The comminutor and grit removal equipment at the headworks are non-functional. The system is being upgraded to include a new aeration blower, diffusers, and classification for grit removal.
- The primary clarifiers are operational, but the pumps associated with the primary clarifiers were out-of-service or in poor condition. Some of the pumps and associated piping are being upgraded or replaced.
- The sludge stabilization and dewatering complex is not functioning as designed. The anaerobic digesters are on-line, but are not heated and only mixed by means of the primary sludge feed and sludge withdrawal. The heating system (e.g., boiler, heat exchangers, and recirculation pumps) were not functional. The dewatering centrifuges, as well as the building they are housed in, are in a serious state of disrepair. Primary sludge is simply pumped into the anaerobic digesters and then pumped to the drying beds.

3.4.6 Umatac-Merizo STP

This facility has very little equipment associated with it and most is in good condition. The booster pumps that lift the pond effluent to the irrigation field are the weak link in the treatment system. Pump 2 needs repair maintenance to ensure it can back-up Pump 1. If both pumps fail, full treatment will not be achieved and overflow of the ponds might occur.

Condition Summary – Because the plant has so few moving parts, the overall condition is fairly good and plant operation is not hampered by maintenance problems. Major deficiencies are summarized below:

- The influent flow meter is not functional.
- Booster Pump 2 needs repair to ensure it can back-up Pump 1.

3.4.7 Pago Socio STP

The condition of the Pago Socio STP was not assessed because it will be converted to a wastewater pump station. (See discussion of this plant in Chapter 1, Section 1.2.7 and a description of the conversion in Chapter 5, Section 5.9 of this volume).

3.4.8 Wastewater Pump Stations

The pumping equipment associated with the wastewater pump stations is overall in better physical and functional condition than the equipment at the larger sewage treatment plants. When a pump station pump fails to operate, the impact is immediate and the potential for a spill increases. In the treatment plants, failure of a piece of equipment might result in reduced performance, but the flow still comes in and flows out.

The better condition at the pump stations is also partly due to a practice of installing submersible pumps and replacement of dry pit centrifugals with submersible pumps. GWA has a large inventory of submersible pumps and they can be replaced quickly when one fails.

The ejector stations in the Umatac-Merizo area are in good condition and function well.

The emergency generators for the pump stations are overall in poor functional condition. More than half have the lowest functional rating. Eighteen of the wastewater pump stations do not have generators.

The wastewater pump station buildings are either concrete or masonry construction in addition to having many years of useful life. Vandalism, poor maintenance, and typhoons have taken their toll on finishes, windows, doors, and other appurtenances.

3.5 Conclusions

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

- GWA operates seven STP's one of which is scheduled to be converted from treatment to a pump station site.
- Visits were made by consultant team members and GWA staff to conduct a qualitative assessment of equipment physical condition and functionality.
- Findings at the Hagatna STP showed that most of the equipment has either failed or is near the end of its useful life.
- The Agat-Santa Rita STP exhibited a mixture of equipment conditions. Enough of the necessary equipment, except the effluent pumps, is in sufficient condition and functioning properly to provide the level of treatment necessary.
- As with Agat-Santa Rita STP, the ratings at the Baza Garden STP show a mixture of conditions. The aeration blowers depend upon emergency power and the emergency generator was not functional.
- The Inarajan STP has very little equipment associated with this facility; the major finding was that the effluent piping system and its associated valves show significant corrosion.
- Ratings for the Northern District STP were performed, but it needs to be noted that the condition of the plant is dynamic in that significant upgrades were being performed at the time of the observations.
- The physical condition and functionality ratings for the Umatac-Merizo STP show equipment basically in good condition with the exception that pond effluent Pump 2 needs repair to ensure it can back-up Pump 1.
- The pumping equipment associated with the wastewater pump stations is in better physical and functional condition than the equipment at the larger sewage treatment plants.

3.6 Recommendations

- It is recommended that a high priority be placed on addressing equipment needs identified in the condition assessment. Some action on this recommendation is under progress at the time of the WRMP publication.

- A number of specific areas will be addressed in the 20-year CIP detailed in Volume 3, Chapter 9 – Recommended Wastewater CIP and Volume 1, Chapter 15 – Capital Improvement Program The highest priority should be placed on Life and Safety issues and those allowing facilities to consistently meet their NPDES requirements.

3.7 CIP Impacts

Some of the recommendations in the previous section have been developed into specific projects, which are included in the 20-year CIP presented in Volume 3, Chapter 9 – Recommended Wastewater CIP and in Volume 1, Chapter 15 – Capital Improvement Program. These projects are summarized below:

- Complete a facilities plan and complete the recommended upgrades to unit processes and equipment to bring the Hagatna STP into regulatory compliance.
- Replacement of the Agat-Santa Rita STP is identified as a CIP recommendation.
- Replacement of the Baza Garden STP is identified as a CIP recommendation.
- Complete a facilities plan for the Inarajan STP and complete the recommended upgrades to unit processes for expansion.
- Complete upgrades to the Northern District STP in progress during preparation of the WRMP and carry out recommended CIP projects including expansion of the plant and preparation of facilities making it the site for regional biosolids processing.
- Relatively minor upgrades are scheduled for the Umatac-Merizo STP in the year 2013 in the 20 year CIP.
- Major CIP activities for collection system pump stations include upgrading both the electrical and SCADA systems.