Solids Facilities Observations Memorandum

PREPARED FOR:	City of St. Petersburg
COPY TO:	Alliance for Bayway Communities, Eckerd College
PREPARED BY:	CH2M
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CH2M has been tasked by the City of St. Petersburg to perform a peer review of the ongoing projects that will centralize biosolids treatment at the Southwest Water Reclamation Facility (SWWRF). At the completion of these projects all waste sludge from the Northeast Water Reclamation Facility (NEWRF) and the Northwest Water Reclamation Facility (NWWRF) will be pumped to the SWWRF where it will be treated along with SWWRF sludge to Class A standards in a new treatment process that includes thickening, anaerobic digestion, dewatering and energy recovery.

Each of the existing WRFs were designed to thicken, stabilize to Class B standards with a mesophilic anaerobic digestion process followed by dewatering and truck loading for land application. These facilities are still in place however due to expansion, upgrades and out of service equipment each WRF operates differently to make use of the facilities and equipment available to them. The NWWRF and NWWRF both still utilize the original design process of thickening, anaerobic digestion and dewatering but with different technologies and operational techniques. The SWWRF no longer thickens or digests, but utilizes a proprietary lime stabilization process to produce a Class A biosolid following dewatering.

Objective

The objective of this TM is to summarize findings from site visits to the SWWRF, NWWRF and NEWRF. The site visits and the findings described here focus on current biosolids production and the capacity and condition of existing treatment facilities at each WRF. Pictures taken during these site visits are included in Appendix A.

Site Visit Observations

The site visits occurred over two days with the NEWRF site visit on September 29th and the remaining two on September 30th. Each visit began with a review of the current biosolids process and facilities with the respective chief operator as well as other operators as needed. The facilities were then observed and photographed. Key questions to document from the discussions and observations were:

- How does the current hydraulic and mass loading compare to the design capacity?
- Are there process or capacity limitations?
- How the current processes are operated?
- Is the current operation different from the original design?
- What facilities and/or equipment is out of service?
- What is the expected useful life for the current facilities and equipment?
- Equipment condition was based on:

- Corrosion of the metal surfaces
  - Condition of paint or coatings
  - Signs of leaking
  - Concrete surfaces intact with no cracks and no exposed rebar
  - No signs of concrete weeping
  - No major settlement of the tanks and equipment
  - Piping supports and valves not rusted and no sign of leakage. Paint in good condition
  - Equipment not rusted, no abnormal vibration, no leakage, and no abnormal noise.
  - Control panels not rusted, all lights functional, HMIs working, panels function as intended
  - Field instruments working, no loose wiring, well supported

Definition of Condition Assessment

- Very good condition means that the equipment shows no sign of rust, minimal wear and no leaks. It works as intended with normal maintenance required, equipment was installed recently and will operate for many years without replacement of parts for several years
- Good condition means that the equipment shows minimal signs of rust, normal wear, minor leaks and works as intended but with more maintenance than expected but still acceptable, very serviceable and can continue operation for many years but expect some parts replacement.
- Moderate condition means excessive rust but still operational, more wear than would expect and require upgrading if to be in continued use, more noise and vibration than expected, close to its useful life
- Poor condition means the equipment needs to be replaced or total upgraded to make acceptably operational, expect that rust can cause leaks, excessive maintenance, past its useful life

Southwest WRF

As indicated above the SWWRF previously utilized thickening, anaerobic digestion and dewatering for solids treatment. Due to the poor condition of some of these treatment facilities, a proprietary lime stabilization process (Bioset) was added in 2012 to provide treatment and allow SWWRF to produce a Class A product. Therefore, several solids treatment facilities are not in service, some due to failing equipment and others because they are not required as part of the current process.

Thickening

Waste solids are pumped from the secondary treatment process to the Sludge Storage Tank which is in good condition (Figure SWWRF-1). The Sludge Storage Tank is sized to provide operational flexibility, but it not large enough to store solids if a downstream process were out of service for an extended [eriod. The thickening facility is located in the Gravity Belt Thickener (GBT) Building in the northwest portion of the plant site adjacent to the anaerobic digesters (Figure SWWRF-2). The GBT Building is open on the sides and includes one Ashbrook GBT and auxiliary equipment. The building and equipment is in moderate condition. The current biosolids treatment process does not require thickening, but operations continues to maintain this facility for future use. The City has indicated that a second GBT will need to be installed to meet demand and serve as a backup.

Anaerobic Digestion

The three existing digesters at SWWRF have been out of service for at least three years. The floating cover on each digester is in poor condition and some cracking in the tanks have been observed by operations (Figure SWWRF-3 and SWWRF-4). Auxiliary pumping, piping and mixing associated with these digesters appears in moderate condition and has been well maintained (Figure SWWRF-5 and SWWRF-

6). However the original digester facility was constructed in 1955 and therefore much of the equipment, including the gas heaters and components are past the expected useful life.

Dewatering

The SWWRF utilizes belt filter presses (BFPs) for dewatering prior to the Bioset process (Figure SWWRF-7). The BFPs, installed in the 1980s, are in moderate condition and are at or near the end of their useful life. The polymer includes two dry polymer make-up units installed in 1985, and they appear to be in moderate condition. An upgrade to a new emulsion polymer system is in progress. Some auxiliary equipment in the Sludge Dewatering Building has been upgraded. The dewatered sludge feeds into a screw conveyor system which is in moderate condition.

Lime Stabilization

A Bioset system was installed at SWWRF in 2012 as an interim replacement of the treatment capacity of the failing digesters before the new digesters as part of the Biosolids to Energy Project. The Bioset process operates between 10-12 hours per day, seven days a week by adding lime to the dewatered sludge which maintains elevated temperature and pH levels in order to stabilize the biosolids (Figure SWWRF-8 and SWWRF-9). The Bioset process has been approved to produce Class A biosolids. Operations indicated that this process and the low metals present in the raw wastewater allow SWRF to produce a Class AA biosolid. The addition of the Bioset reactor as part of the conveyance upgraded a portion of the truck loading area which overall appeared in moderate to good condition.

Northeast WRF

The NEWRF continues to utilize thickening, mesophilic anaerobic digestion and dewatering to treat its waste sludge and produce a Class B biosolid. However, due to the poor condition of some facilities and some facility upgrades the operation has been adjusted to meet the current conditions. The solids treatment processes at NEWRF are operated continuously in order to get consistent stabilization in the digester and maximize dewatering capacity.

Thickening

Waste activated sludge from the secondary process is thickened by two Ashbrook GBTs. Both GBTs appear in good condition with one in service approximately 6 years and another in service 15 years. Operations indicated good performance from the GBTs as NEWRF thickens to an average of 8.2% solids with a maximum of 9.2% and a minimum of 7.1% in order to maximize detention time in the one in-service digester. The GBT Building and auxiliary facilities also appeared in good condition (Figure NEWRF-1). Thickened sludge is pumped to the anaerobic digester with one of three progressing cavity pumps. These pumps appear in good condition and operations did not indicate any significant operational or maintenance related issues (Figure NEWRF-2).

Anaerobic Digestion

The NEWRF has three anaerobic digesters. Digesters No. 1 and No. 2 were constructed in 1955 and share a building with auxiliary piping and pumping. Digester No. 3 was added in the 1980s. In 2012 Digester No. 1 was relined and its floating cover rehabilitated (Figure NEWRF-3 and NEWRF-4). Digester No. 1 appears in moderate to good condition. Volatile gas produced in the digester is burned through an adjacent flare which appears in moderate condition (Figure NEWRF-5).

Currently Digester No. 1 is the only digester in service as the poor condition of the floating covers require Digesters No. 2 and No. 3 be out of service (Figure NEWRF-6). Digester No. 2 had a membrane failure causing seepage through the walls; however, Digester No. 3 can be used for storage as needed. The original digester facility was constructed in 1955 and much of the equipment is past its useful life including the gas heater system.

The digested sludge is transferred to dewatering via another progressing cavity pump station. These pumps appeared in good condition and operations did not indicate any operational or maintenance related issues (Figure NEWRF-7).

Dewatering

The dewatering process includes one BFP (in service approximately 30 years) and two screw presses added in 2013 (Figure NEWRF-8). The BFP is maintained as a backup to the two screw presses which operate continuously. The dewatering process includes three Siemens Polyblend polymer blending units. These appear in excellent condition (Figure NEWRF-9). The screw presses are in good condition and operations indicated they can produce a dewatered product with up to 18% solids (Figure NEWRF-10). The City indicated that the hauled sludge from NEWRF had an average solids content of 16.1% with a maximum of 17.8% and a minimum of 14.1% so far during 2015.

The dewatered sludge is fed into a screw conveyor which shows some wear on the trough and screw but no significant corrosion. The conveyor system includes a flat section which receives the dewatered biosolids, an inclined shaftless screw that transfers the product to the truck loading area, and a final section which can rotate and has a reversing motor to fill either of the two truck bays. Operations indicated there were no major operational or maintenance related issues with the conveyors (Figure NEWRF-11 and NEWRF-12).

Northwest WRF

The NWWRF also utilizes thickening, mesophilic anaerobic digestion and dewatering to treat its waste sludge to a Class B biosolid.

Thickening

Waste activated sludge from the secondary process is thickened by two Ashbrook GBTs. Both GBTs appear in moderate to good condition and no major operational or maintenance issues were discussed. The PLC that controls both GBTs contains controls that are in poor condition. The City has indicated that there are constant problems with sequencing control and ancillary equipment. The GBTs have recently yielded an average solids content of 6.4% with a minimum of 5.4% and a maximum of 7.2%.

The auxiliary equipment (for example, polymer storage feed system and wash water system) in the thickening process has not been upgraded and did show some wear (Figure NWWRF-1 and NWWRF-2). The polymer feed system currently uses a dry polymer, which requires excess dosing. The City has indicated that a new liquid polymer mixing and feed system is purchased and ready to be installed.

Anaerobic Digestion

The NWWRF has four anaerobic digesters onsite, however only two are in service. Digester No. 1 and No. 2, originally constructed in the 1950s, continue to produce Class B biosolids through a reduction in volatile solids (Figure NWWRF-3 and NWWRF-4) although Digester No. 1 has a hole in the gas collector skirt. Digesters No. 1 and No. 2 have gas collector style covers.Volatile gas produced in the digesters is burned through an adjacent flare which appears in moderate condition.

Digesters No. 3 and No. 4 have been out of service for several years. Digesters No. 3 and No. 4 had floating covers. These floating covers were in poor condition, collapsed, and have been removed. Digester No. 3 is used for sludge storage as needed (Figures NWWRF-5, NWWRF-6 and NWWRF-7).

The auxiliary equipment that supports Digester No. 3 and No. 4 includes a gas heater with the capability to generate heat using natural gas or digester gas. The equipment appeared in poor condition. Operations had no working knowledge of that equipment as they have not been operated in several years (Figure NWWRF-8, NWWRF-9 and NWWRF-10).

Dewatering

The dewatering process at NWWRF consists of two Ashbrook BFPs, a polymer storage and feed system, conveyors and truck loading. The BFPs are in moderate to poor condition and near the end of their useful life (Figure NWWRF-11, NWWRF-12 and NWWRF-13). Operations indicated the BFPs require frequent maintenance to remain in service. The BFPs have recently yielded an average solids content of 13.5% with a minimum of 11.2% and a maximum of 14.9%. This dewatering performance is lower than the other facilities and on the low end of expected BFP performance, which is likely due to the poor condition of the equipment.

The electrical equipment at dewatering is in poor condition and at the end of the useful life. Operations indicated that many parts are obsolete and difficult to find. The polymer storage and feed system is also in moderate to poor condition and near the end of its useful life. An ongoing project will upgrade the existing system to liquid polymer blending system similar to that at SWWRF and NEWRF (Figure NWWRF-14 and NWWRF-15).

The conveyor system is similar to the NEWRF, but shows more signs of wear and corrosion (Figure NWWRF-16 and NWWRF-17).

Summary

All three WRFs were designed with similar processes to handle, treat and dispose of waste sludge. Various upgrades and expansions over the years have changed the processes and facilities at each of the WRFs. In addition, aging facilities and failing equipment has forced changes to the operation and the process. At each WRF there exists facilities and equipment that continues to appear in good condition and operates reliability due to recent upgrades and good maintenance practices. However, each WRF also has facilities and equipment that is currently out of service, in poor condition or past its expected useful life.

The most notable process change occurred at the SWWRF where a lime stabilization process (Bioset) was added. This change was necessary because the floating covers on the anaerobic digesters failed and another method of stabilization was required. The Bioset process is in good condition, fits within the existing dewatering footprint and produces a Class AA biosolid. The process does have drawbacks however, the overall amount of solids for disposal is significantly higher with the Bioset process due to the lack of volatile solids reduction and the addition of lime for treatment. This creates an increase in operational and disposal costs as well as additional truck trips at the WRF.

The NEWRF and NWWRF still utilize the design solids treatment processes including thickening, mesophilic anaerobic digestion and dewatering. Both WRFs use GBTs for thickening with moderate to good conditions. The NEWRF is only operating with one anaerobic digester due to failing floating covers on Digester No. 2 and Digester No. 3. Therefore, the NEWRF has no onsite redundancy for sludge stabilization. The NWWRF has four total anaerobic digester, but Digesters No. 3 and No. 4 have been out of service for several years. Both WRFs continue to produce Class B biosolids but have reduced capacity due to these out of service facilities.

Dewatering at the NEWRF has sufficient capacity and redundancy with a BFP available to back the two in-service screw presses. This dewatering facility is in good condition and is operating well. In contrast the dewatering facility at NWWRF is in poor condition. The existing polymer storage and feed system and the two BFPs require significant maintenance.

Appendix A
Site Visit Pictures

SWWRF

Figure SWWRF-1. Sludge Storage Tank
Southwest WRF

Figure SWWRF-2. Gravity Belt Thickener
Southwest WRF

Figure SWWRF-3. Anaerobic Digester No. 1 Floating Cover
Southwest WRF

Figure SWWRF-4. Anaerobic Digester No. 2 Floating Cover
Southwest WRF

Figure SWWRF-5. Anaerobic Digester No. 1 and No. 2 Piping
Southwest WRF

Figure SWWRF-6. Anaerobic Digester Decant No. 3 Piping and Draft Tube Mixer
Southwest WRF

Figure SWWRF-7. Belt Filter Press
Southwest WRF

Figure SWWRF-8. Bioset System
Southwest WRF

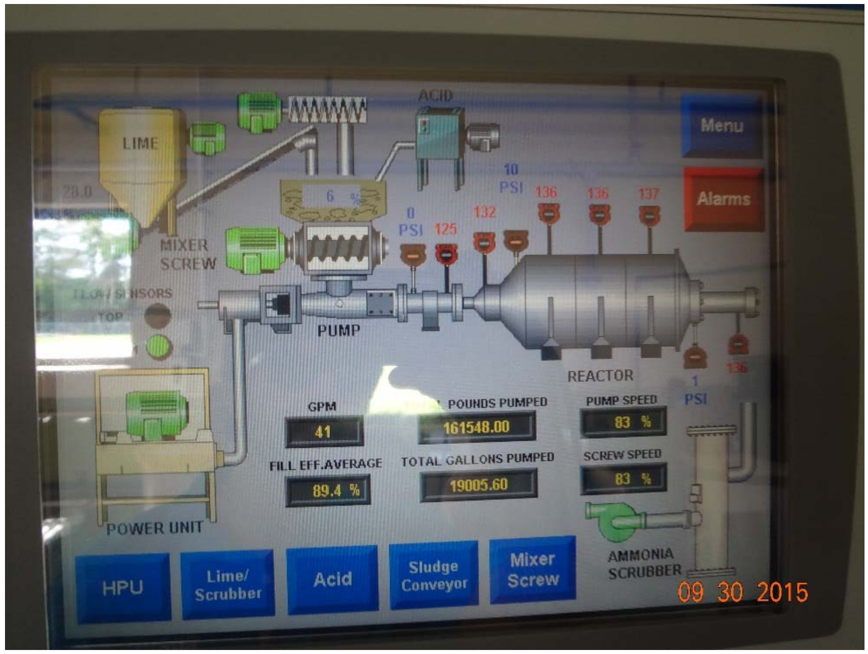

Figure SWWRF-9. Bioset Control Panel
Southwest WRF

NEWRF

Figure NEWRF-1. Gravity Belt Thickener
Northeast WRF

Figure NEWRF-2. Sludge Transfer Pump Station
Northeast WRF

Figure NEWRF-3. Anaerobic Digester No. 1
Northeast WRF

Figure NEWRF-4. Anaerobic Digesters No. 1 and No. 2 Pumping
Northeast WRF

Figure NEWRF-5. Anaerobic Digester Gas Flare
Northeast WRF

Figure NEWRF-6. Anaerobic Digester No. 2 Floating Cover
Northeast WRF

Figure NEWRF-7. Sludge Feed Pump Station
Northeast WRF

Figure NEWRF-8. Dewatering Building
Northeast WRF

Figure NEWRF-9. Dewatering Polymer Blending Units
Northeast WRF

Figure NEWRF-10. Screw Presses
Northeast WRF

Figure NEWRF-11. Screw Conveyor
Northeast WRF

Figure NEWRF-12. Truck Loading
Northeast WRF

NWWRF

Figure NWWRF-1. Gravity Belt Thickener
Northwest WRF

Figure NWWRF-2. Gravity Belt Thickener Piping
Northwest WRF

Figure NWWRF-3. Anaerobic Digester No. 1
Northwest WRF

Figure NWWRF-4. Anaerobic Digester No. 1 and No. 2 Pumping
Northwest WRF

Figure NWWRF-5. Anaerobic Digester No. 3
Northwest WRF

Figure NWWRF-6. Anaerobic Digester No. 4
Northwest WRF

Figure NWWRF-7. Anaerobic Digester No. 4 Draft Tube Mixer
Northwest WRF

Figure NWWRF-8. Anaerobic Digesters No. 3 and No. 4 Building Second Floor
Northwest WRF

Figure NWWRF-9. Anaerobic Digesters No. 3 and No. 4 Gas-fired Heater
Northwest WRF

Figure NWWRF-10. Anaerobic Digester Building Third Floor
Northwest WRF

Figure NWWRF-11. Belt Filter Press
Northwest WRF

Figure NWWRF-12. Belt Filter Press
Northwest WRF

Figure NWWRF-13. Belt Filter Press Electrical Room
Northwest WRF

Figure NWWRF-14. Dewatering Polymer Pumping
Northwest WRF

Figure NWWRF-15. Dewatering Polymer Storage and Feed
Northwest WRF

Figure NWWRF-16. Dewatered Sludge Conveyer
Northwest WRF

Figure NWWRF-17. Truck Loading
Northwest WRF