Validation of Solids Process Selection and Supporting Analysis

PREPARED FOR:	City of St. Petersburg
COPY TO:	Alliance for Bayway Communities, Eckerd College
PREPARED BY:	CH2M
DATE:	November 30, 2015
CITY PROJECT NUMBER:	15074-121
TASK ORDER NUMBER:	12-07-CH2/W
REVISION NO.:	FINAL

CH2M has been tasked by the City of St. Petersburg to perform a peer review of the Biosolids to Energy Project that will centralize biosolids treatment at the Southwest Water Reclamation Facility (SWWRF). At the completion of these projects, all waste activated sludge from the Northeast Water Reclamation Facility (NEWRF) and the Northwest Water Reclamation Facility (NWWRF) will be transferred into the SWWRF collection system and conveyed by gravity to the head of the plant. Primary clarification will be added to treat the additional load prior to secondary treatment and to enhance the solids processes downstream. The upgraded solids treatment train at SWWRF will produce biosolids to Class A standards utilizing a process that includes thickening, temperature phased anaerobic digestion, dewatering and energy recovery.

Objective

The objective of this Technical Memorandum (TM) is to review and validate the selection of the solids treatment processes, the decision to centralize the facilities at the SWWRF and the parameters and analysis that supported these decisions.

Documents

The following documents produced by Brown and Caldwell (B&C) were reviewed as part of the evaluation:

- TM No. 2: Evaluation of Heat Drying System at SWWRF – Post Mechanical Sludge Dewatering/Pre Proposed Energy Recovery Process; January 20th, 2011. (B&C TM No. 2)
- TM No. 3: Evaluation of WRF Sludge Consolidation/Conveyance Options to SWWRF and NW/NEWRF Conversion to Class-A Biosolids/Beneficial Reuse to Land Disposal; January 20th, 2011. (B&C TM No. 3)
- TM No. 4: Recommended Plan for Biosolids and Yard Waste to Energy; July 18th, 2011. (B&C TM No. 4)
- TM No. 5: Evaluation of Centralization of Solids Projects; March 20th, 2013. (B&C TM No. 5)
- TM No. 6: FOG and Gas Treatment Evaluation; June 9th, 2014. (B&C TM No. 6)
- PDR: Biosolids to Energy Project; June 19th, 2015. (B&C PDR)

- Southwest Water Reclamation Facility Biosolids to Energy Project, Volume 2 – Technical Specifications. Guaranteed Maximum Price; September 2015. (B&C GMP Biosolids Specifications)
- Southwest Water Reclamation Facility Biosolids to Energy Project, Volume 4 – Drawings Biosolids Improvements. Guaranteed Maximum Price; September 2015. (B&C GMP Biosolids Drawings)

Findings

Regulatory Discussion

In B&C TM No. 3, the regulatory discussion begins by stating that 'Florida Statute 62-640 requires that biosolids processing be improved to Class-A treatment levels or for all practical purposes bans land application of those biosolids.' B&C continues by describing the level of treatment required to produce Class A and benefits of producing Class A biosolids including public relations, disposal options, and long term cost effectiveness. The City currently produces Class B biosolids at the NEWRF and NWWRF and distributes the solids for land application. In order to produce Class A biosolids a higher level of treatment is required, but the resulting product can be used as a fertilizer product with fewer restrictions for use as compared to Class B biosolids.

CH2M offers the following comments on the regulatory aspects of the Biosolids to Energy Project as part of this peer review:

1. The Florida Department of Environmental Protection (FDEP) has increased the requirements for land application sites that receive Class B solids. All land application sites must now be permitted by the FDEP through one responsible party (for example, site owner, biosolids hauler) according to the *Biosolids in Florida: 2013 Summary* (FDEP December 2014, http://www.dep.state.fl.us/water/wastewater/dom/docs/BiosolidsFlorida-2013-Summary.pdf). However, these changes have not banned Class B biosolids or significantly reduced the amount of land application to date. According to the FDEP summary, in 2013 32% of all biosolids produced in Florida were used in land application as compared to 33% used for Class AA marketing and 35% disposed in landfills.
2. The production of Class A biosolids does have advantages over land application of Class B some of which are described in B&C TM No. 3. The decision for the City to produce Class A solids does provide greater flexibility in the future and is reasonable for this project.

Alternatives Analysis

Range of Treatment and Disposal Options

Based on review of the documents listed above, B&C TM No. 3 includes the primary evaluation of alternatives for the handling and treatment of biosolids with some updated information and a follow-up evaluation included in B&C TM No. 4. Seven alternatives were identified and evaluated in B&C TM No. 3:

Alternative 1 – Class A treatment at each WRF

Alternative 2 – Consolidated Treatment at SWWRF

Alternative 2a – No digestion with thermal energy recovery

Alternative 2b – Class B digestion with thermal energy recovery

Alternative 2c – Class A digestion without thermal energy recovery

Alternative 2d – Class A digestion thermal energy recovery

Alternative 3 – Dewatered Sludge Cake Hauling

Alternative 3a – Haul raw dewatered cake to SWWRF

Alternative 3b – Haul Class B digested, dewatered cake sludge to SWWRF

These alternatives did provide a reasonable range of conveyance and treatment options, however the following comments were developed during this peer review:

1. B&C TM No. 3 stated that municipal wastewater agencies have tended to implement lower-cost technologies for produced Class A as compared to higher-cost options such as composting or heat-drying. During CH2M's review of the Class A biosolids producers in Florida listed in the 2014 FDEP report two utilities were identified using digestion, while the majority used heat drying, composting, or lime stabilization. Based on the widespread use and success of these other technologies, including them in the high level economic evaluation and triple-bottom-line assessment (financial, social and environmental included in B&C TM No. 3) would have provided more support for B&C's ultimate recommendation of anaerobic digestion.
2. All alternatives included in B&C TM No.3 (and listed on page 2) that utilized Class A digestion included the temperature phased anaerobic digestion (TPAD) process. Additional digestion processes (thermal hydrolysis followed by mesophilic digestion, batch thermophilic digestion, and multi-stage thermophilic digestion) were evaluated in previous workshops, but not in the present worth analysis shown in B&C TM No. 3. The TPAD process is an established, reasonable process for this application.
3. Two options for biosolids distribution were included within the evaluated alternatives: land application and use as a feedstock along with yard waste to the proposed thermal energy facility. Additional options that could have been evaluated include utilizing a third party vendor or landfill disposal. Landfill disposal does not provide some of the benefits that Class A or land application does, but inclusion would provide a baseline cost for comparison. Utilizing a third party biosolids vendor to further treat and distribute the City's biosolids was mentioned in B&C TM No. 3 (H&H facility in Clewiston, FL), however there was not expected to be sufficient capacity for the City's solids. It was not indicated whether other third party vendors were evaluated, but the amount of solids produced by the City would provide a significant baseload for a vendor attempting to develop a regional facility in the Bay area.

Evaluation of Selected Alternative

In the conclusions of B&C TM No. 3, Alternative 2d (Consolidated Class A Digestion at SWWRF with Thermal Energy Recovery) was recommended, but with a phased approach to implement the biosolids improvements first and the energy recovery facility sometime in the future. The first phase of this approach is essentially Alternative 2c (Consolidated Class A Digestion at SWWRF without Thermal Energy Recovery). Neither alternative included using the Class A product as a feedstock to the energy recovery facility and assumed the biosolids would be land applied. In the follow-up evaluation included in B&C TM No. 4 the recommended alternatives were updated and referred to as Phase 1 (Alternative 2c) and Phase 2 (Alternative 2d). The recommended approach consisted of:

- Conveyance of WAS from the NEWRF and the NWWRF via force mains into the SWWRF sanitary sewer collection system
- Addition of primary clarification and the ability to step feed into secondary treatment with auxiliary facilities and equipment
- Upgrading thickening facilities
- Fats, oils and grease (FOG) receiving
- New TPAD process including a thermophilic digester, batch tanks and a thermo/mesophilic digester
- Combined heat and power recovery systems

- New dewatering and truck loading facilities

The selection of WAS conveyance via the sanitary sewer, the addition of primary clarification, and the new FOG receiving facility are discussed more in the following section.

The upgraded thickening facilities will expanded the existing thickening building at SWWRF, relocate existing equipment from NEWRF and install new auxiliary equipment (for example, polymer storage and feed systems). The new facility will also include odor control.

As indicted TPAD was selected as the preferred technology for producing Class A biosolids during workshops and was included in the selected alternative for the Biosolids to Energy Project. The TPAD process includes two new digesters, batch tanks and equipment for sludge transfer, mixing, gas collection and energy recovery. The key parameters for sizing the TPAD process presented in the B&C PDR include:

- Peak week organic loading rate of less than 0.35 lb-VS/ft3-day in thermophilic digester
- Hydraulic retention time of greater than 7 days at average loading condition in thermophilic digester
- Hydraulic retention time of greater than 10 days at average loading condition in mesophilic digester
- 24 hours retention time at least 131 deg F in batch tanks

Centrifuge dewatering was initially selected as the dewatering technology for this project. However, during the design process it was determined that the potential for pathogen regrowth in high solids centrifuges following the TPAD process would potentially be too great a risk and may not allow the City to consistently produce a Class A product. Other dewatering technologies, such as belt filter presses (BFP) and screw presses have shown less likelihood for pathogen regrowth and thus may be more appropriate for use at SWWRF following the TPAD process. Ultimately, screw presses were selected as preferred dewatering equipment.

The following comments are provided as part this peer review by CH2M in relation to the biosolids handling and treatment processes included in the selected alternative:

1. The continued use of gravity belt thickeners (GBTs) is reasonable and valid based on the historic use of this technology at each of the City's WRFs and the condition of the existing equipment.
2. The hydraulic retention times were presented in the PDR for the design conditions and meet the above criteria. However, the maximum week loading criteria was not included in the mass balance. Maximum week conditions were determined based on the following:
    1) Primary sludge (80,900 lb-TS/day) and WAS (21,600 lb-TS/day) rates from Table 2-11 in PDR assuming 80% TSS removal in primary treatment
    2) Primary scum value of 2,500 lb/day (assumed value between maximum month and maximum day values from mass balance in GMP Design Drawings)
    3) Design FOG loading rate of 4,050 lb-VS/day
    4) 95% GBT solids retention
    5) 83% VSS/TSS in Primary Sludge and 75% VSS/TSS in WAS (TM No. 4)

   This results in a maximum week loading of 0.36 lb-VS/ft3-day which is higher than the 0.35 lb-VS/ft3-day criteria listed in the B&C PDR. The maximum week loading rate corresponds to the hydraulic retention time of the thermophilic digester at peak conditions and is an appropriate period for a design criteria. The fact that the current design results in a loading rate that exceeds the stated criteria in the B&C PDR is a concern. Thermophilic digesters can accept loading rates significantly higher than mesophilic digesters. The designer should consider enlarging the capacity of the thermophilic digester or justifying the loading rate greater than the criteria stated in the B&C PDR.

3. The use of screw presses for dewatering in this project is reasonable due to the lower potential for pathogen regrowth and the low maintenance requirements and consistent operation.

The current Biosolids to Energy Project also includes a Biogas Upgrading System (BUS) that will provide pipeline quality gas for use in onsite combined heat and power uses or a new fueling facility. The creation of fuel for vehicles can offset operating costs and potentially qualify the project for alternate funding sources. In B&C TM No. 6 a number of technologies and systems for biogas upgrading were identified, evaluated and scored based on nine criteria. From this scoring three options were evaluated in further detail:

- Option 1 - the use of a Guild pressure swing adsorption (PSA) system to treat the entire stream for use as biomethane for vehicle fuel, cogeneration or boilers
- Option 2 - the use of a Guild PSA to treat ~60% of the gas to biomethane for fueling and another system to 40% of the gas for cogeneration or boilers (Cogeneration system do not require the same level of treatment as vehicle fuel)
- Option 3 - the use of a water solvent system to the entire stream for use as biomethane for vehicle fuel, cogeneration or boilers

A present worth analysis indicated that a single Guild PSA system, would be most cost effective for the City assuming additional hydrogen sulfide removal was not required. Further analysis was conducted including site visits to PSA and water solvent type systems. Additionally B&C contacted the manufacturer Guild which indicated that the expected hydrogen sulfide levels would be acceptable for their system. Ultimately, the Guild PSA was selected as the BUS technology and was included in the Biosolids to Energy Project design (GMP Biosolids Specifications).

The following comments relate to the BUS system as part of the CH2M peer review:

1. In B&C TM No. 6 it was indicated that the BUS Option 2 with separate systems for fuel and cogeneration would have the lowest operating costs, but the operating costs for this option were higher than BUS Option 1 Guild PSA in the comparison of net present values (B&C TM No. 6, Table 5-2).

2. Elevated hydrogen sulfide levels can be a concern for the Guild PSA, however B&C's follow up with Guild and the site visits validated the selection.

3. The inclusion of a BUS as part of this project allows the City to produce a higher quality fuel which gives them greater flexibility and qualifies them for additional funding. The analysis provided as part of the design processes included a present worth between various BUS options and Option 1 Guild PSA is a reasonable technology for this application.

Impact of Parameters in Selection

A key parameter to review during the evaluation of the alternatives and in the design of the Biosolids to Energy Project is the amount of gas produced and the value of that gas for energy recovery. The amount of energy used and produced was part of the alternatives analysis. The modeling results were included as Appendix A in B&C TM No. 3. A comment related to gas production is included below:

1. A heating value range of 530 – 580 BTU/scf was included in the PDR for the biogas upgrading system. This is a valid range for gas production in the TPAD process.

Centralization of Solids Processing and Handling

Centralization of biosolids treatment facilities was included in six of the seven alternatives in B&C TM3 with only Alternative 1 maintaining separate handling and treatment capacities. The recommended approach by B&C included centralization and conveyance of WAS via forcemains and the existing collection system. The location for centralizing biosolids treatment was further evaluated in B&C TM5. The infrastructure required for conveyance and biosolids treatment was determined assuming centralization at each of the three WRFs. Cost estimates were prepared and the present worth was compared for each location. The cost for the onsite biosolids treatment facilities was similar between the three WRFs, but the SWWRF had the lowest costs for the conveyance of WAS due to the location of each facility in relation to the service areas.

Therefore, the recommended approach by B&C was to centralize biosolids treatment at the SWWRF and discontinue all solids treatment and handling at the NEWRF and the NWWRF. Waste activated sludge (WAS) will be transferred into the SWWRF sanitary sewer collection system and enter at the headworks of the plant.

The following comments are provided by CH2M as part of this peer review:

1. Centralization of biosolids treatment is a common approach for utilities with multiple treatment plants, and provides greater efficiency for process and equipment sizing, allows operations to focus on key processes at their plant, and provides a single location for biosolids distribution.
2. Centralization showed economic advantages and additional benefits including less truck hauling traffic at all WRFs with the SWWRF having the lowest present worth costs.

Additional Treatment Facilities

WAS Pumping and Storage at NEWRF and NWWRF

The NEWRF and NWWRF will no longer treat or handle biosolids in the proposed biosolids improvements as WAS will be directly pumped to SWWRF (as part of the sanitary sewer collection system).

This approach is reasonable and provides economic and non-economic benefits. Two comments about these facilities are included below as part of CH2M's peer review:

1. The force main sizing included in B&C TM No. 3 indicated it would be sized for twice the maximum month WAS flow (resulted in an 8-in diameter). Providing additional capacity can be beneficial, but the expected velocities will be less than 2 feet per second (fps). Flushing system to be included in force main design to reduce settling concerns.
2. To avoid impacting the overall treatment capacity at the SWWRF, pumping of WAS will not occur during peak flow or other events that could jeopardize performance. Therefore the existing digesters at the NEWRF and NWWRF will be available for storage during these periods. The days of storage available was quantified in the B&C PDR based on just the smallest digester at each WRF and the corresponding maximum month WAS flow (assuming 1.5% solids) and was less than 3 days. Recent flow data has indicated that peak flow events at SWWRF can last considerably longer than 3 days (a concurrent CH2M project with the City, Liquids Processing and Emergency Operation Peer Review, is evaluating these peak flow events, projected flows and the overall hydraulic capacity). However, this storage only includes one digester at each facility and NEWRF currently has three digesters, and NWWRF has four digesters. Therefore, additional digesters should remain available for storage as needed during peak flow events. A backup option is available as the City has contracts in place that allow for local hauling companies to dispose of liquid sludge, Class B biosolids, and Class A biosolids. Liquid hauling was not needed during the July/August 2015 peak flow event.

Primary Clarification

Primary clarification at the SWWRF will be added as part of the Biosolids to Energy Project, in order to provide benefits including: 1) primary clarification potentially negates any deleterious impacts to secondary treatment due to the additional load from the NEWRF and NWWRF WAS, and 2) primary sludge provides a greater level of volatile solids destruction in the digestion process and thus provides more for energy recovery.

CH2M believes the inclusion of primary clarification will provide for a more stable secondary treatment process and enhance the proposed TPAD process. Additional comments regarding the evaluation of primary clarification at SWWRF are listed below as part of CH2M's peer review:

1. In B&C TM No. 3 it was proposed to repurpose two (2) existing 75-ft diameter aeration basins as primary clarifiers. This concept provided cost advantages, but resulted in hydraulic loading rates significantly higher than is typically found in the industry. As the project progressed, this concept was not used. The B&C PDR proposes two (2) new primary clarifiers sized to achieve more typical loading rates, which resulted in additional construction costs.
2. The expected primary clarifier performance for total suspended solids (TSS) removal used in sizing the biosolids improvements processes was aggressive at 80%, particularly for an influent stream that includes WAS from the other WRFs which typically does not settle as efficiently. Ferric addition will enhance settling, but maintaining 80% removal at all hydraulic and loading conditions could be challenging. In addition:
    a. Using this high rate of performance for design criteria results in conservative sizing for primary sludge handling and digestion facilities.
    b. This high performance, however, could over predict gas production and energy recovery in the digester.
    c. In addition, the primary clarifier performance impacts the liquid processes as well. If primary clarification does not perform as predicted, secondary treatment facilities will experience higher solids loadings and increased aeration demand. A review of the calibrated BioWin model used in the B&C design indicated that the existing secondary treatment facilities can handle increased loading based on a minimum primary clarifier performance of 65% (the minimum evaluated in the B&C PDR). The SWWRF routinely operates with short solid retention times (SRTs) (~4 days) to avoid nitrification, and the SWWRF could operate at these lower SRTs as needed if primary clarifier performance was lower than predicted.

FOG Receiving Facility

The feasibility of a FOG receiving facility was evaluated in B&C TM No. 6. Brown and Caldwell began by assessing the market for collecting and utilizing FOG in the City of St Petersburg. It was estimated that up to 4 MG of FOG was produced within the City's service area annually. Currently this FOG is utilized by private companies or a regional solid waste incinerator. They indicated that there would be competition for FOG, but there could be market or municipal mechanisms for securing FOG generated in the City. It was recommended by B&C that a small FOG receiving facility be included at SWWRF as part of the Biosolids to Energy Project, which was described in the B&C PDR and shown in the GMP Design Drawings. The FOG will be added to the thermophilic digester along with the combined thickened sludge.

CH2M offers the following comments related to inclusion of a FOG facility:

1. A FOG receiving facility can provide benefits to the community as well as plant operations by removing these materials from the liquids processes.
2. A FOG stream can also provide significant energy recovery as it has more than twice the energy value as the combined sludge. B&C's TM No. 6 indicated that approximately 10% of the total energy production could be from FOG.

3. Although the market for receiving FOG is somewhat unknown, the benefit of the potential energy value that could come from a FOG stream makes the inclusion of this facility reasonable.

Cost Model

A 20-year present worth analysis was performed to make an economic evaluation between the seven alternatives and was presented in B&C TM No. 3. An updated present worth analysis was also included in B&C TM No. 4. The present worth analysis included:

- Construction costs
    - Near-term
    - 10-year CIP
    - Engineering – 16% (B&C TM No. 3), 15% (B&C TM No. 4)
    - Contingency – 25%
- Operation and maintenance costs
    - Material handling
    - Power – $0.10/kW-hr
    - Natural gas
    - Chemicals
    - Operations
- Discount rate – 4.4% (B&C TM No. 3), 5% (B&C TM No. 4)
- Escalation – 1.7% (B&C TM No. 3), 3% (B&C TM No. 4)

The following comments related to the cost model as part of CH2M's peer review are provided below:

1. The overall cost model concept is reasonable and includes all of the key parameters that would be expected as part of present worth analysis.
2. The specific parameters related to the present worth analysis (for example, time frame, discount rate) are reasonable and relevant to this analysis. The contingency should be considered a minimum for this level of cost estimate and a higher value (30%) could provide a more appropriate level of conservatism for planning level analyses.
3. The construction costs included in B&C TM No. 3 were described as probable cost opinions. Despite these cost estimates being used for comparison between alternatives, a more thorough approach would provide greater clarity in the planning level and the ability to compare estimates more accurately in later stages of the project. For example, defining the estimate in a 'class' of estimate according to Department of Energy or the AACEI would identify a range of accuracy to better define the estimates.
4. The cost estimate for Alternative 2a in B&C TM No. 3 included upgrades to thickening, but it was not clear why thickening would be required if no digestion was occurring.
5. The 10% increase for operations costs included for the new TPAD process is lower than expected for a complex operation.
6. The land application disposal rates of $16/wet ton (WT) of biosolids appears significantly lower compared to other rates seen in Florida (typically $40/WT). However, the City currently pays $17.5/WT to dispose of the lime stabilized Class A product from SWWRF, so this value may be relevant for this analysis.
7. Six of the alternatives evaluated in B&C TM No. 3 included a thermal energy recovery facility that could distribute biosolids as a feedstock for energy along with yard waste. The inclusion of the thermal energy facility in the evaluation and cost analysis was reasonable since it impacted the ability to distribute biosolids for several of the alternatives. However, the thermal energy

facility had a high construction cost which impacted the sensitivity of the overall cost model. Additional present worth analysis included in B&C TM No. 4 included additional three alternatives without a thermal energy recovery option.

8. A BUS is included in the project as described in the B&C PDR and shown in the GMP Design Drawings will provide pipeline quality gas for fueling fleet vehicles and cogeneration or boilers. The present worth analyses included in B&C TM No. 3 and B&C TM No.4 did not include the costs for the BUS as it was not part of the project at that time.
9. The gas production estimates included in the B&C TM No. 6 was approximately 10% higher than the later estimates included in the design (B&C PDR). This change would lower the expected power generated and energy costs offset or revenue generated.

Reliability and Redundancy of Selected Alternative

A key component of this peer review was to evaluate the reliability and redundancy included in the proposed facilities. Biosolids treatment facilities are not required to have the same reliability and redundancy as liquid treatment processes. Solids treatment often has additional flexibility as alternative disposal options exist (for example, the backup sludge hauling contract previously described). However, due to the significant investment of these new processes and the commitment to producing a Class A product, the City wants to ensure a reasonable amount of reliability and redundancy exists in the proposed biosolids improvements. To assess the current amount of redundancy, it was assumed that the current flows and loads are 85% of the design (2035) conditions based on the flow projections included in the B&C PDR.

Primary Clarification

There are two new primary clarifiers in the proposed biosolids improvements each sized to treat up to 20-mgd for a combined capacity of 40-mgd. Therefore, with one primary clarifier out of service, the remaining primary clarifier can still reliability treat the permitted annual average daily flow (AADF) of 20-mgd providing a degree of redundancy.

The following comment related to the reliability and redundancy of primary clarification was noted during the CH2M peer review:

1. Primary treatment is required for the successful operation of the SWWRF following the Biosolids to Energy Project. If flows above 20-mgd are experienced with one unit out of service, it is expected that clarifier performance will decrease which impacts liquid and solids treatment facilities downstream. These impacts were discussed above. In addition, the ability to hydraulically pass peak flows with one primary clarifier out of service will be confirmed in the concurrent peer review project.
2. A concurrent CH2M project with the City, Liquids Processing and Emergency Operation Peer Review, is evaluating recent peak flow events, projected flows and the overall hydraulic capacity.

Thickening

Thickening will continue to utilize gravity belt thickeners (GBTs) prior to digestion as is currently done at NEWRF and NWWRF and was previously done at SWWRF before the conversion to the Bioset process. The B&C PDR presents the expected flows and sludge loading rates based on a seven day/week, 23 hours/day operation. Two units were required to meet the manufacturer's recommendation for a 'safe maximum' loading based on the combined sludge solids content of 1.7% (as defined by manufacturer in B&C PDR) at the design peak hour conditions. Therefore, a third GBT would be required for complete redundancy. The GMP Design Drawings indicate that two GBTs are included in the proposed Biosolids to Energy Project.

The following comments related to the reliability and redundancy of thickening were noted during the peer review:

1. One GBT is sufficient to operate up to design AADF conditions allowing for maintenance and service of the non-operating unit during much of the year. Two units will be needed for all flow and load conditions at the MMADF level and higher.
2. From the loading rates listed in the PDR, the anticipated loading rates to a single GBT with one unit out of service will be higher than the 'safe maximum' at MMADF, MDF and PHF conditions. While GBTs can accept higher loading rates performance will likely suffer which could then also impact the detention times in the TPAD process. Operations will have to closely monitor the condition and performance of the GBTs and schedule maintenance periods as efficiently as possible.

TPAD Process

The TPAD process will typically operate by sending thickened sludge first to the thermophilic digester, then to one of three batch tanks and a finally to a mesophilic digester. If one digester is out of service, the process will operate using a single thermophilic digester followed by the batch tanks. In order to accomplish this with only two digesters, the second digester was designed to also operate in the thermophilic range if needed. This provides some operational flexibility in order to take digesters out of service when required or as needed. Both digesters include four draft tube mixers with three required for adequate mixing which is a reasonable amount of redundancy.

The following comments related to the reliability and redundancy of the TPAD process were noted by CH2M during the peer review:

1. High temperature digestion processes require operational attention and experience to consistently achieve the desired performance. One advantage of the TPAD process is the mesophilic stage which provides a more consistent operation following the thermophilic stage. This is particularly appropriate for the SWWRF as operations has utilized mesophilic digestion for several decades. Operating solely as a single-stage thermophilic digester (along with the batch tanks) the process can achieve the required time and temperature needed for Class A, but will require significant operator attention during these periods.
2. In addition, the lack a mesophilic stage increases odor concerns downstream. Odor control is included downstream in the dewatering facility which should limit any additional odors when operating in this mode. In addition, this would not be a common occurrence, as it is expected that planned maintenance would require taking a digester down for up to 6 weeks once every 5 years.
3. Despite the challenges listed above, additional digesters to enhance reliability would significantly increase construction costs and space requirements. As stated above, the concept for operation with one digester out of service is reasonable and can produce Class A biosolids with proper operation.

Dewatering

The digested sludge from the TPAD process will be dewatered prior to disposal. Historically the City's WRFs utilized belt filter presses (BFPs) for dewatering, but the NEWRF has recently converted to screw presses. The original concept for dewatering as part of the Biosolids to Energy project was to replace the existing BFPs with centrifuges for maximum performance. However, this concept was changed due to the potential for pathogen regrowth in high solids centrifuge dewatering units that follow the TPAD process. Therefore, the dewatering technology selected for this project was screw presses. Due to the timing of this design change, the B&C PDR did not contain significant detail on the dewatering equipment. A review of the GMP Design Drawings indicates that three screw presses will be installed with all units operating for continuous operation.

The following comment related to the reliability and redundancy of the dewatering process was noted during CH2M's peer review:

1. Based on the information in the GMP Design Drawings it appears that the dewatering process will be operated continuously in the same manner as thickening with no installed backup. Screw press dewatering has not been used at the SWWRF, but it has been used successfully at the NEWRF in recent years. In addition, one key advantage of screw press dewatering is less maintenance requirements as compared to BFPs and more reliable operation.
2. It was assumed that the screw presses are sized such that three installed units are required for MDF conditions based on the specification section included in the GMP Design. At this sizing, a redundant unit would be available at the AADF conditions with all three units required for higher loading conditions.

Summary

The Biosolids to Energy Project was developed by the City over several years and involved the evaluation of a matrix of options including multiple treatment processes, biosolids distribution methods, and conveyance methods. The key aspects of the selected Biosolids to Energy project included production of a Class A biosolids, use of Temperature Phased Anaerobic Digestion (TPAD), and centralization at SWWRF. CH2M has reviewed and provided comments on each of the aspects including regulatory impacts, gas production, cost analysis and reliability and redundancy. Based on the peer review, the Biosolids to Energy Project includes the criteria requested by the City including sustainability, energy recovery, ability to use alternate funding and increased flexibility in biosolids disposal. The project includes a reasonable, proven process for centralizing biosolids treatment at the SWWRF in order to produce Class A biosolids.