MEMORANDUM

Basis of Design Memorandum Biosolids Processing Facility

Miami-Dade Water and Sewer Department

MIAMI-DADE COUNTY

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October 2015

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M E M O R A N D U M

Basis of Design Memorandum - Biosolids Processing Facility

Prepared for

Miami-Dade Water and Sewer Department (WASD)

October 2015

Executive Summary

This Basis of Design Memorandum (BDM) for one Biosolids Processing Facility (BPF) or two BPFs presents the recommended technologies, sizing, and approach that will be considered for the implementation of the BPF(s) for the Miami-Dade Water and Sewer Department (WASD). The BDM will be used to support the qualification and selection process for a service provider who will enter into a design-build-finance-operate and maintain (DBFOM) with WASD to provide the facilities, operations, and financing for a BPF to handle the biosolids produced by the WASD South District Wastewater Treatment Plant (SDWWTP) and the Central District Wastewater Treatment Plant (CDWWTP).

The CDWWTP also receives, digests, and dewaters the solids produced by the North District Wastewater Treatment Plant (NDWWTP). A new wastewater treatment facility is planned for construction in approximately 2025 to 2030. This facility, called the West District Wastewater Treatment Plant (WDWWTP), will receive some flows that are presently treated at the NDWWTP and CDWWTP, in addition to serving currently unsewered areas in western Dade County.

Current operations at the CDWWTP and SDWWTP process sludge onsite through gravity thickeners and anaerobic digesters. At the CDWWTP, digested biosolids are dewatered and then sent to Class B land application when weather and site availability permit, or disposed in a landfill when there are no available land application sites. At the SDWWTP, digested sludge is dewatered by centrifuges prior to (1) Class B land application, (2) composting, or (3) landfill disposal (including a portion of the solids mixed with grit removed from the influent with subsequent landfill disposal of the mixture). Some residuals are composted onsite at the SDWWTP using the aerated static pile process, after which the compost product qualifies for Class AA marketing and distribution.

The BPF(s) will be designed to accept and process all dewatered solids produced at the SDWWTP and the CDWWTP. Currently, the CDWWTP also treats solids generated by the NDWWTP; therefore, the BPF(s) could initially process solids from the three WASD wastewater treatment plants (WWTPs) until the WDWWTP is constructed per the Compliance Plan to address the requirements of Chapter 2008-232 Laws of Florida Wastewater Disposal/Ocean Outfalls. WASD may continue to operate the existing solids processing systems at the CDWWTP and land apply or landfill the Class B dewatered cake, or construct a BPF at the CDWWTP meeting the basic requirements described herein, or construct one BPF at the SDWWTP to process solids both from the SDWWTP and trucked in from the CDWWTP. Regardless of this decision, the guaranteed minimum and maximum amount of solids to be processed by the BPFs will be established with the selected DBFOM Provider. It is assumed that once the new WDWWTP begins operation, the WDWWTP will process and manage the solids produced at that facility separately and not send material to the BPF.

The required location of the BPF(s) are on the SDWWTP site (in the case of one BPF), or on the CDWWTP and SDWWTP sites (in the case of two BPFs) including approximately 4.5 acres of the existing property on each WWTP site that can be made available as a potential site for the BPF if thermal drying is used. If a composting process is used, the operation will be performed only at the SDWWTP within the current composting system boundary, consisting of approximately 25 acres of land. No composting will be allowed at the CDWWTP. If composting is used by the DBFOM Provider at the SDWWTP, WASD and the DBFOM Provider will negotiate to determine the value and intended uses of the infrastructure and equipment being provided by WASD and used by the DBFOM Provider.

The BPF(s) will be designed for a 20-year service life, and the design year for the facility or facilities will be 2035. The required design year capacity of the BPF(s) was estimated using the 2013 Ocean Outfall Compliance Plan growth projections and historical solids production rates (WASD, 2013). Based on 6 years of operating data, the SDWWTP and CDWWTP produce dewatered cake at approximately 0.39 to 0.41 dry ton per million gallons(DT/MG) treated at each WWTP. The CDWWTP and SDWWTP have several projects planned to improve digester performance and other solids handling upgrades. With these improvements, the volatile solids reduction (VSR) achieved in the digesters at each WWTP is estimated to increase to at least 56 percent. Solids production and therefore sizing of the BPF(s) are based on these improvements being in place and performing as intended.

The historical performance of the CDWWTP centrifuges shows they produce approximately 23 percent dry solids, and the centrifuge dewatering process at the SDWWTP produces 16 to 17 percent solids. WASD plans to implement dewatering improvements to the SDWWTP by 2020, thus it is expected that both WWTPs will average 23 percent dry solids from dewatered cake at both WWTP's. The resultant required capacity in the design year in dry tons per day (DTPD) from the CDWWTP and SDWWTP for the BPF is summarized in Table ES-1 and shows the anticipated total wet ton per day (WTPD) production rates, assuming that the dewatering improvements at SDWWTP begin operating between 2020 and 2025. These projections also are based on the WDWWTP being in service in 2030, with the assumption that all solids generated at the WDWWTP will be treated and re-used or disposed separately from the BPF. The peak-capacity year for wet material to be delivered to the BPF is approximately 2020, just before the planned dewatering improvements at SDWWTP go online, at which time approximately 465 WTPD is projected to be processed in total. There is expected to be excess capacity at the SDWWTP BPF after the dewatering system at the SDWWTP is upgraded.

TABLE ES-1. Projected Solids Production – CDWWTP and SDWWTP[a]
WASD Biosolids Processing Facility

	CDWWTP Including NDWWTP Solids		SDWWTP		Combined CDWWTP and SDWWTP Production	Combined CDWWTP and SDWWTP Production
Date	**(DTPD)**	**(WTPD)**	**(DTPD)**	**(WTPD)**	**(DTPD)**	**(WTPD)**
2015	55.0	234	35.0	208	90.0	442
2020	57.8	246	36.8	157	94.6	465
2025	60.8	258	38.7	165	99.4	423
2029	63.2	269	40.2	171	103.5	440
2030	38.7	165	40.6	173	79.3	338
2035	38.7	165	42.7	182	81.4	346

Note:

[a]Projections assume that CDWWTP and SDWWTP digestion improvements and SDWWTP dewatering improvements are online by 2025, and WDWWTP is online by 2030.

Table ES-2 includes an estimate of the minimum amount of biosolids that must be processed in the initial stages of operation. The quantities in this table are based on the lowest monthly average production over the last 6 years from each WWTP.

TABLE ES-2. Minimum Estimated Solids Production – CDWWTP and SDWWTP
WASD Biosolids Processing Facility

Date	CDWWTP Including NDWWTP Solids (DTPD)	CDWWTP Including NDWWTP Solids (WTPD)	SDWWTP Solids (DTPD)	SDWWTP Solids (WTPD)
2015	35	150	27	160

If CDWWTP solids are handled separately during the early stages of operation, the BPF would have to process approximately 27 DTPD (approximately 160 WTPD) for the SDWWTP. If solids from both WWTPs are processed at a single BPF, then the minimum capacity would be approximately 62 DTPD (approximately 310 WTPD). WASD will need to establish a schedule for CDWWTP solids-handling operations or transport to SDWWTP in the RFP upon which DBFOM Providers will based their proposals.

Six general technologies for solids stabilization screened were for the BPF: (1) anaerobic digestion, (2) aerobic digestion, (3) composting, (4) thermal drying, (5) chemical stabilization, and (6) high-temperature combustion/oxidation. Digestion, anaerobic or aerobic, is not in the BPF scope and was eliminated as a possible alternative because CDWWTP and SDWWTP currently operate anaerobic digesters producing class B biosolids. Chemical stabilization and high-temperature processes are not applicable to WASD because of staff concerns with chemical handling and safety, lack of familiarity with these processes, and less operational experience; therefore, they were eliminated from the possible alternatives.

The two preferred and recommended technologies are composting and thermal drying. Several variations of composting or thermal drying may be considered for the BPF located at the SDWWTP. For a BPF located at the CDWWTP, only thermal drying technology will be considered. Because of the abundant rainfall in South Florida, a new cover over composting and curing areas will be required to maintain consistent compost quality.

The thermal drying process is based on one of the following principles:

The materials to be dried are directly exposed to the heat source (direct drying systems)

The heat is transferred from one form, such as heated oil or fluid, to the material through a conducting medium (indirect drying systems)

Both general types of thermal drying technologies will be considered as viable alternatives for the BPF(s). Heat sources that may be used for thermal drying include heat from combustion of natural gas and waste heat from the Cogeneration Facilities at the CDWWTP and SDWWTP. The WASD intends to identify and use the most cost-effective and sustainable of these technologies for the new BPF(s).

The contract vehicle for implementing this project is highly dependent on Miami-Dade County's (County's) preferences and procurement requirements. Currently, a full-service, DBFOM contract (planning steps, design engineering, permitting, construction services, operations, and financing) is envisioned as the approach. As the procurement process moves forward, the contract type and services to be included will be further defined.

Contents

SECTION 1

1 Introduction/Background

WASD is the County Department charged with providing drinking water and wastewater services to its citizens. As a department of Dade County (the County), WASD follows the County's purchasing and procurement rules.

WASD provides sewer service to most of the County. The sewer system consists of over 1,000 gravity sewer collection basins, four major gravity interceptors, over 1,000 pumping stations including five major booster stations, transmission mains, and three regional wastewater treatment plants (WWTPs) owned and operated by WASD. The three WWTPs include the North District WWTP (NDWWTP), Central District WWTP (CDWWTP), and South District WWTP (SDWWTP).

Other public and private entities, called Volume Sewer Customers (VSCs), are interconnected to WASD facilities and convey sewage to the regional plants. The wastewater transmission systems for the three WWTPs are interconnected. This provides WASD with some capability to direct sewage flows between service areas from one plant to another. WASD can exercise this option during storm events, emergencies, and planned shutdowns to balance flows between the three plants to optimize capacity. The three WWTPs are further described as follows:

NDWWTP: Located in the northeast section of the County at 2575 N.E. 151st Street, the NDWWTP serves the northern portion of the County. The plant is permitted to treat an annual average daily wastewater flow of 112.5 million gallons per day (mgd) to secondary treatment standards with basic disinfection. The pure oxygen activated treatment plant with primary and secondary clarification discharges effluent via ocean outfall and deep injection wells. Solids produced by the NDWWTP are pumped to the CDWWTP, where they are mixed with the influent wastewater to the CDWWTP for treatment.

CDWWTP: Located on Virginia Key, the CDWWTP serves the central portion of the County, including Miami Beach and Key Biscayne. The facility has a permitted capacity to treat an annual average daily wastewater flow of 143 mgd. The pure oxygen activated treatment plant has two independently operated process trains that discharge chlorinated effluent to the ocean. Similar to the NDWWTP, effluent is discharged by gravity during low flow periods and pumped the remainder of the time. The biosolids removed in the treatment process are pumped to gravity sludge thickeners. The concentrated sludge is then pumped to anaerobic sludge digesters. After the digestion process, the biosolids are dewatered prior to Class B land application when weather and site availability permit, or disposed in a landfill when there are no available land application sites.

SDWWTP: Located in the southeast section of the County at 8950 S.W. 232nd Street, the SDWWTP serves the southern and southwest portions of the County. It is permitted to treat an annual average daily wastewater flow of 112.5 mgd with secondary treatment processes, followed by high-level disinfection and filtration, prior to deep well injection. A total of 17 deep injection wells are installed for the disposal of treated effluent from the plant. The sludge removed in the treatment is processed onsite through gravity thickeners, anaerobic digesters, and dewatered by centrifuges prior to (1) Class B land application, (2) composting, or (3) landfill disposal. A portion of the residuals is composted onsite at the SDWWTP using the aerated static pile process, after which the compost product qualifies for Class AA marketing and distribution.

The general relationship and locations of these treatment facilities is shown on Figure 1.

In the future, as flows and loads increase in WASD's wastewater system, a fourth WWTP (West District WWTP [WDWWTP]) will be added. The WDWWTP is further described in Section 2.

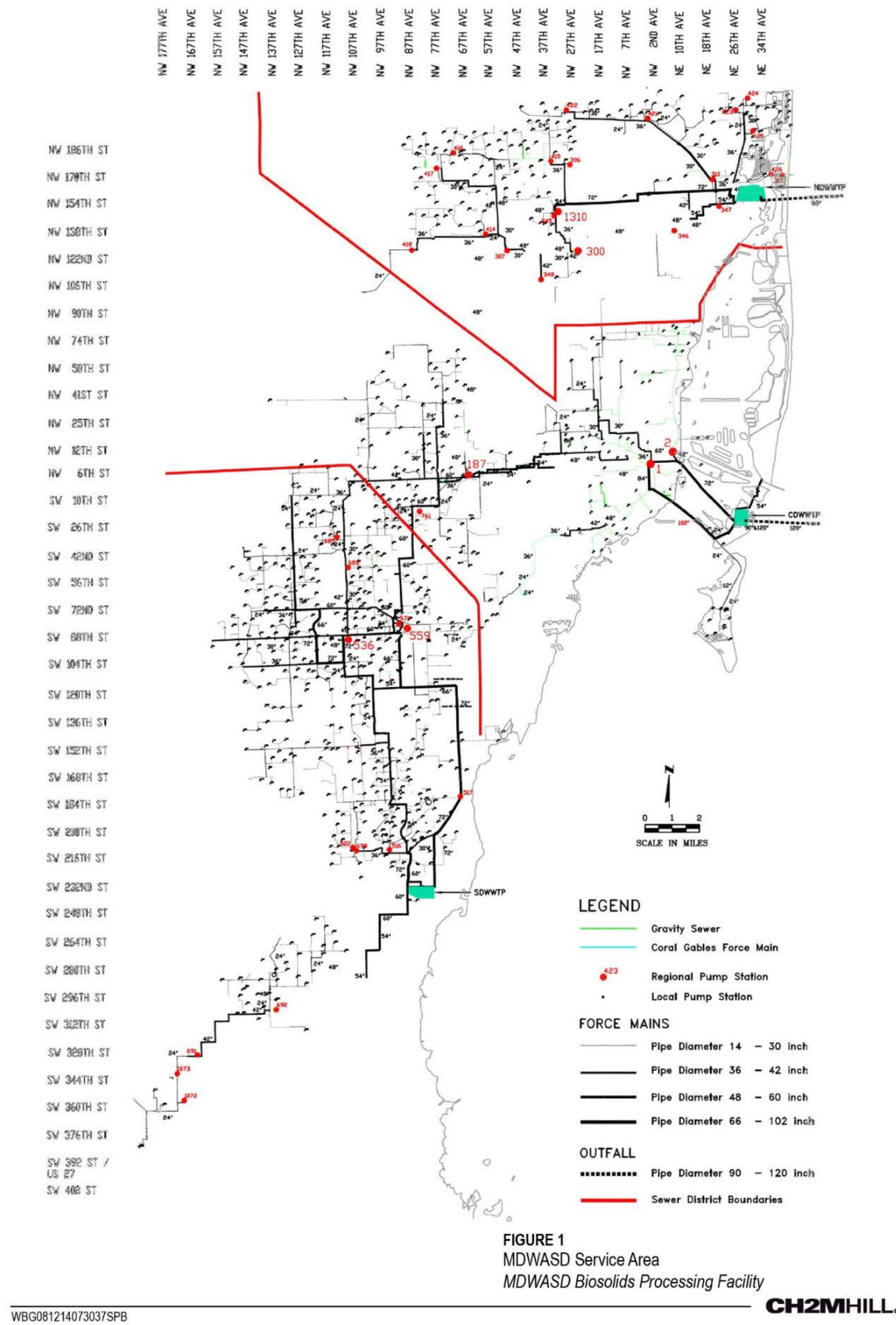


Figure 1 WASD Service Area
WASD Biosolids Processing Facility

SECTION 2

2 Program Overview

In June 2013, WASD developed a Compliance Plan to address the requirements of Chapter 2008-232 Laws of Florida Wastewater Disposal/Ocean Outfalls (Section 403.086 (9), Florida Statutes and Amendment CS/SB 444). The recommended alternative in that plan includes a new WDWWTP with an average daily flow capacity of 102 mgd, reduced daily flow capacities at the NDWWTP of 85 mgd and at the CDWWTP of 83 mgd, and a design flow capacity at the SDWWTP of 131 mgd. The total system average daily capacity is projected to be 401 mgd. Biosolids produced at the CDWWTP and SDWWTP are expected to be processed and then land applied, distributed as compost or dried biosolids, or disposed in a landfill, depending on the quality of the material produced. Processing alternatives for the biosolids include anaerobic digestion and dewatering, thermal drying, or composting, as described herein.

The current WASD biosolids program functions well most of the time; however, there are issues that present challenges to biosolids management for WASD. These challenges include poor equipment conditions in the solids processing trains at each WWTP, peak wet-weather flow concerns, the vulnerability of operations to inclement weather, changing regulations, workforce changes, and limited capital and operating budgets.

The digestion and dewatering facilities at the CDWWTP and SDWWTP can produce Class B biosolids when they are functioning as designed. WASD expects continuing social and regulatory pressure on Class B land application programs, and is evaluating the use of processes to generate higher-quality Class A or Class AA products for future biosolids management, or other beneficial use products if a market is available (such as biofuel). WASD previously investigated approaches to implementing a biosolids program based on biosolids processing technologies capable of producing and reusing a Class AA product. In this investigation, information was collected on potential emerging and sustainable technologies capable of processing biosolids to a Class AA product (CDM 2007 and 2009).

The biosolids programs rely heavily on the anaerobic digestion and centrifuge dewatering processes at both the CD and SD WWTPs. If there are equipment failures in either of these processes, removing the biosolids from the WWTPs is challenging and could affect effluent quality. The solids stream treated via composting at the SDWWTP can produce higher quality, Class AA material; however, it is a large, open-air process that is detrimentally affected by wet weather. During rainy months the composting operation cannot produce Class AA material.

The BPF(s) are under consideration by the WASD to improve the quality of the biosolids products produced, reduce the risk of operational challenges caused by weather or staffing changes, and to control the cost of operating the biosolids management program.

The WASD has assessed delivery alternatives for the BPF(s) such as design-build (DB), design-build-operate (DBO), and design-build-finance-operate and maintain (DBFOM) through a DBFOM, and decided on the latter alternative for implementation. As the first step in a two-step selection process, the County will issue an Request for Qualifications (RFQ) to obtain statements of qualifications from respondents interested in being considered for inclusion on a pre-qualified shortlist for providing planning, permitting, engineering, design, construction, operation, and financing to WASD for the SDWWTP and the CDWWTP BPF(s). Upon completing Step 1, Evaluation of Qualifications, three prequalified firms will be invited to Step 2, Evaluation of Proposals, and will submit proposals for this work. The BPF is required at the SDWWTP in order for the CDWWTP, NDWWTP, and SDWWTP to operate efficiently and cost effectively, and to remain in compliance with discharge permit requirements.

Delivery alternatives will be addressed in the RFQ and Request for Proposals (RFPs). There are numerous technical alternatives for biosolids processing, as well as many vendors and suppliers in the biosolids management field; therefore, the County has developed technical criteria by which to request alternatives, and establish a common basis by which to evaluate the technologies and costs of each proposed alternative.

Through this procurement, WASD will evaluate and select preferred technologies, identify qualified providers of these technologies, and identify project delivery methods that include financing and operations to find a cost-effective approach that can be implemented to manage costs and resources. The service provider selected will be capable of permitting, designing, constructing, operating, and financing the BPF(s). An option for BPF operation to return to WASD's control will be included as part of this procurement. This option would potentially be exercised if the Agreement term expires and is not renegotiated, if the DBFOM Provider does not meet the contractual obligations identified in the Agreement, or for WASD's convenience. The performance requirement details will be established during the RFP and contract negotiation stages.

Performance will be monitored by WASD, and the DBFOM Provider will be required to submit monthly operations and maintenance (O&M) reports summarizing O&M activities that occurred during the month including, but not limited to, the following:

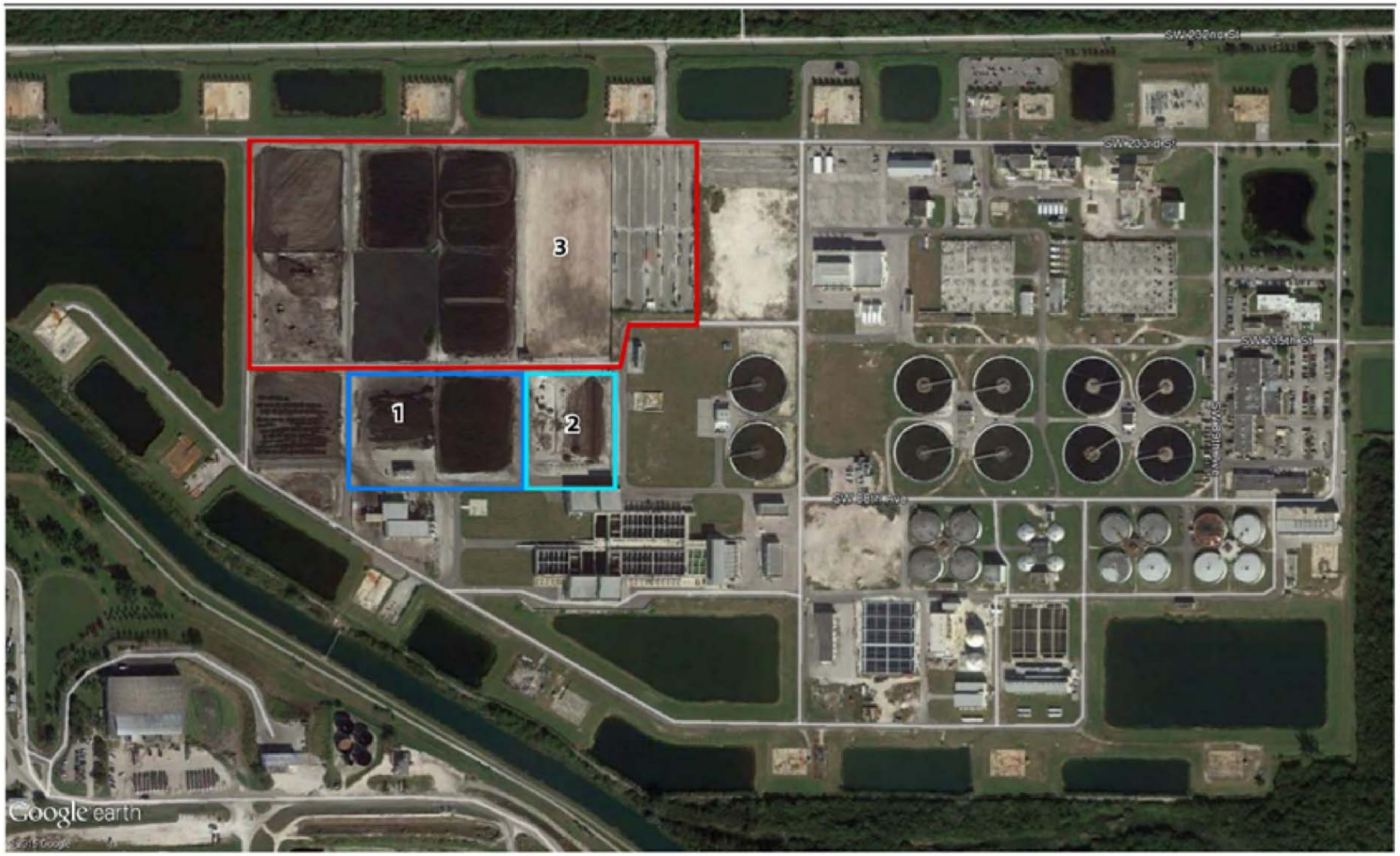
- Daily production statistics including wet tons, percent solids, and dry tons of biosolids received; wet tons, percent solids, and dry tons of Class AA product; and the amount of Class B or unclassified material production and its destination(s)
- Summary of regular maintenance, unplanned maintenance, and equipment repairs made during the month
- Remarks on any other issues or activities affecting operations or maintenance that occurred during the month

WASD reserves the right to observe and inspect the BPF(s), or portions thereof, following adequate notice of intent to the DBFOM Provider.

During the initial project scoping, WASD determined that the new BPF(s) would be designed to accept digested and dewatered solids produced at the CDWWTP (which includes solids from the NDWWTP) and the SDWWTP. The DBFOM Provider will decide whether to design, construct and operate a BPF based on thermal drying at the CDWWTP separate from a BPF at the SDWWTP, or to design/construct/operate one BPF at the SDWWTP and truck biosolids from the CDWWTP to the BPF at the SDWWTP. WASD staff will continue to operate the solids handling, digestion, and dewatering facilities at these WWTPs. The entity selected to provide the BPF will be responsible for collecting solids as they discharge from the dewatering equipment, providing appropriate short-term storage at the WWTPs to account for variations in production, transporting them from the CDWWTP or SDWWTP to the new BPF(s), and processing the solids at the new BPF(s) to produce reusable, Class AA material for distribution and marketing.

The BPF(s) will be located at the SDWWTP and potentially the CDWWTP within the site limits established on Figure 2 (SDWWTP site) and Figure 3 (CDWWTP site). When implemented, the WDWWTP will process its biosolids onsite and will not send material to other BPF(s) for processing.

Implementation of the BPF(s) will be coordinated with other projects planned for both the CDWWTP and SDWWTP. These projects are part of the Consent Decree between the County, the United States of America, the State of Florida, and the Florida Department of Environmental Protection (FDEP) for improvements to the County's wastewater collection and treatment system (United States of America, 2013). The Consent Decree projects include work on thickening, digestion, and dewatering facilities at the CDWWTP and SDWWTP (refer to the Miami-Dade County website for more information on the Consent Decree projects). Specifically, the dewatering improvements at these facilities include new solids dewatering facilities at the SDWWTP (Project 1.8, construction planned from 2016-2019) and the CDWWTP (Project 2.16, construction planned from 2018-2012)



1. Proposed Thermal Drying P3 Site: 4.5 acres
2. Proposed Sludge Thickening/Dewatering Site: 2.3 acres
3. Proposed Composting P3 Site: 25.1 acres

FIGURE 2
Composting and Thermal Drying at SDWWTP
MDWASD Biosolids Processing Facility

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Figure 2 Composting and Thermal Drying at SDWWTP
WASD Biosolids Processing Facility

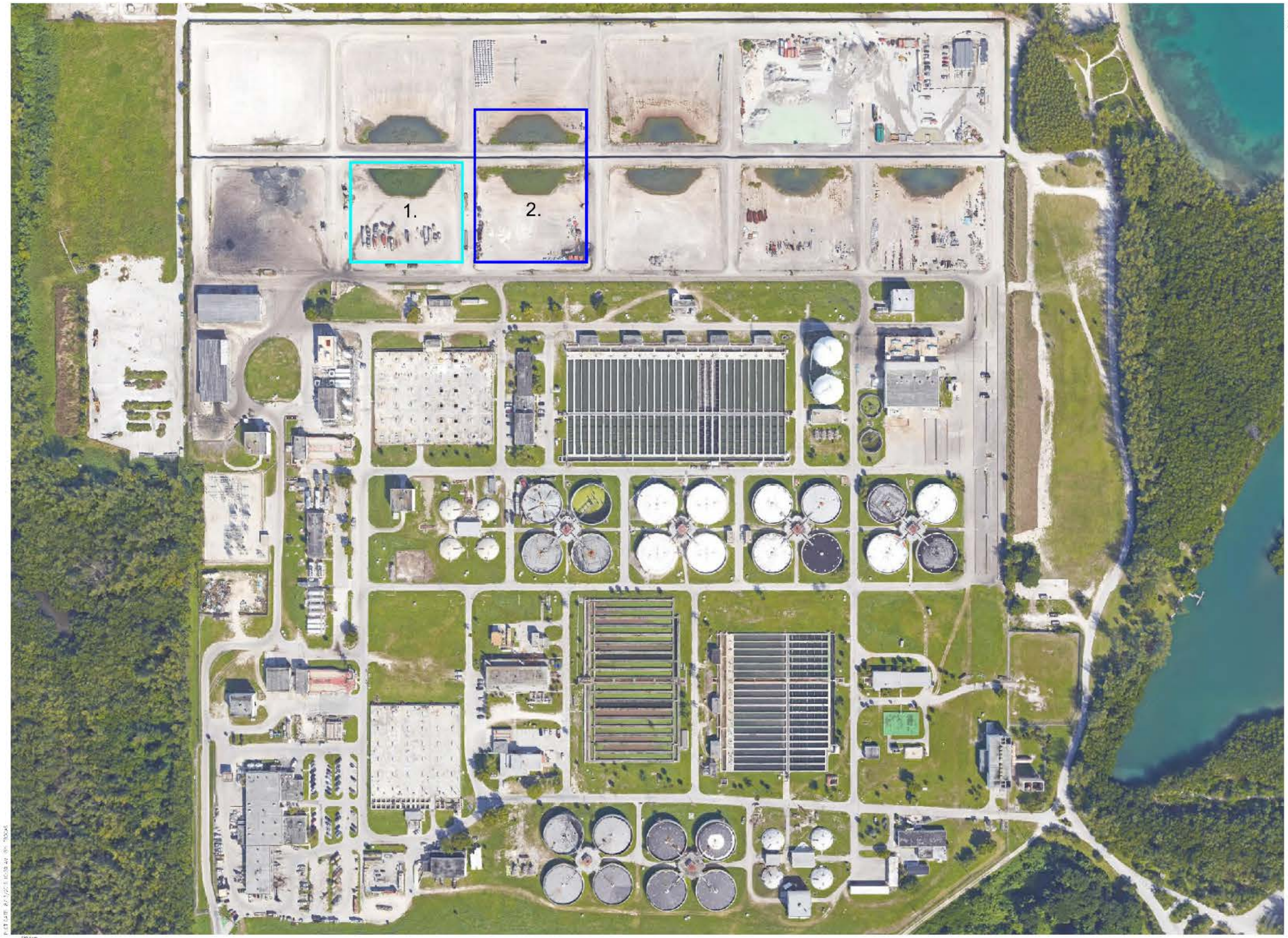

Figure 3 Thermal Drying at CDWWTP
WASD Biosolids Processing Facility

SECTION 3

Design Criteria

3.1 System Capacity

The BPF(s) will accept and process all dewatered solids produced at the SDWWTP and the CDWWTP. Currently, the CDWWTP also treats the solids generated by the NDWWTP; therefore, the BPF may initially process all solids from the WASD until the WDWWTP is constructed. Table 1 includes a summary of the current and anticipated hydraulic capacity of these facilities and data from the last 6 years of operations.

Table 1. Wastewater Flows – Total WASD Service Area
WASD Biosolids Processing Facility

Treatment Facility	Average Daily Flow 2009 – 2014 (mgd)	Present Design Flow (mgd)	Future Design Capacity 2035 (mgd)
NDWWTP	--[a]	112.5	85
CDWWTP	118.4	143	83
SDWWTP	95.8	112.5	131
WDWWTP	N/A	N/A	102

Note:

[a] Since solids from this facility are treated at the CDWWTP, influent flow data were not analyzed for the NDWWTP.

The required design year capacity of the BPF(s) was estimated using the 2013 Ocean Outfall Compliance Plan projections and historical solids production rates (WASD, 2013). Based on 6 years of recent operating data, the SDWWTP and CDWWTP produce dewatered cake at approximately 0.39 to 0.41 (DT/MG) treated. However, WASD is planning several projects at both the CDWWTP and SDWWTP that will improve digester operations, increase volatile solids reduction, and improve dewatering. These projects are included in the Consent Order Capital Projects Plan and will all be implemented by 2020. Solids production is based on a population growth of approximately 1 percent and with the assumption that the WDWWTP will be in service and treating all of the solids produced at that new facility onsite after its startup. The resultant required capacities in various years in DTPD for the BPF is summarized in Table 2. The maximum total solids-processing capacity needed at the BPF(s), in terms of dry solids, occurs in approximately 2029, at 101.5 DTPD, just before the WDWWTP goes into service. If the BPF(s) are constructed at this capacity, there will be excess capacity, on the whole, in the years 2030 and beyond. The capacity variations in BPF's as noted in Table 2 could be addressed in any number of ways, which will be left up to the DBFOM Project Respondents to propose in response to the RFP.

Table 2. Projected Dry Solids Production
WASD Biosolids Processing Facility

Date	CDWWTP Including NDWWTP Solids (DTPD)	SDWWTP (DTPD)	Combined CDWWTP and SDWWTP Production (DTPD)
2015	55.0	35.0	90.0
2020	57.8	36.8	94.6

Table 2. Projected Dry Solids Production
WASD Biosolids Processing Facility

Date	CDWWTP Including NDWWTP Solids (DTPD)	SDWWTP (DTPD)	Combined CDWWTP and SDWWTP Production (DTPD)
2025	60.8	38.7	99.4
2029	63.2	40.2	103.5
2030	38.7	40.6	79.3
2035	38.7	42.7	81.4

The wet quantity of material produced depends on the efficiency of the dewatering processes at both the CDWWTP and SDWWTP. Based on historical performance, the CDWWTP centrifuges produce approximately 23 to 24 percent dry solids and the centrifuge dewatering process at the SDWWTP produces 16 to 17 percent solids. WASD plans to upgrade the dewatering equipment at the SDWWTP, improving the future efficiency of dewatering around 2020. Table 3 shows the projected total mass of material in WTPD, assuming that dewatering improvements are implemented by 2020. Table 3 summarizes the estimated quantity of wet material that will be sent to the BPF(s). Based on these predictions, the peak year for wet material to be delivered to the BPF(s) is predicted to occur in 2019, just before the planned dewatering improvements go on-line, at which time approximately 465 WTPD is projected to be processed. So, there is expected to be excess capacity at the BPF(s) at after the dewatering system at the SDWWTP is upgraded.

Table 3. Projected Wet Solids Production[a]
WASD Biosolids Processing Facility

Date	CDWWTP Including NDWWTP Solids (WTPD)	CDWWTP Percent TS (%)[b]	SDWWTP (WTPD)	SDWWTP Percent TS (%)[c]	Combined CDWWTP and SDWWTP Solids (WTPD)
2015	234	23.5	208	16.8	442
2020	246	23.5	157	23.5	403
2025	258	23.5	165	23.5	423
2030	165	23.5	173	23.5	338
2035	165	23.5	181	23.5	346

Notes:

[a] Based on dry solids as shown in Table 2.

[b] Average percent Total Solids (TS) for the CDWWTP has historically been 23% TS and is not expected to exceed 23% TS regardless of process improvements to sludge thickening and dewatering at CDWWTP, unless thermal hydrolysis is implemented at the CDWWTP, in which case percent Total Solids is expected to increase to 30percent TS.

[c] Historical average percent Total Solids for the SDWWTP has been approximately 16% TS and is expected to increase to 23% TS when the new dewatering facility is operational by 2025.

Figure 4 presents the estimated future annual average solids production from the CDWWTP, SDWWTP, and combined using the parameters included in Table 2.

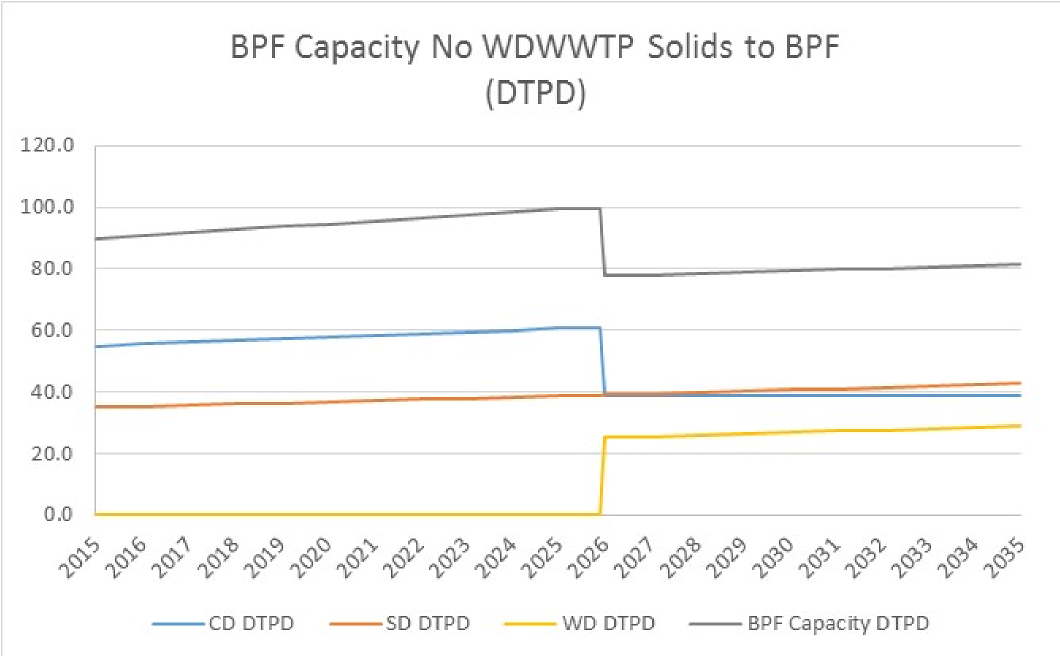

Figure 4. Projected Annual Average Dry Solids Production for the CDWWTP, SDWWTP, and Combined
WASD Biosolids Processing Facility

Figure 5 presents the projected wet solids production, assuming that dewatering improvements at the SDWWTP increase cake solids to the same level as that produced by the CDWWTP and that they are in place by 2022. Data for this graph are included in Table 3.

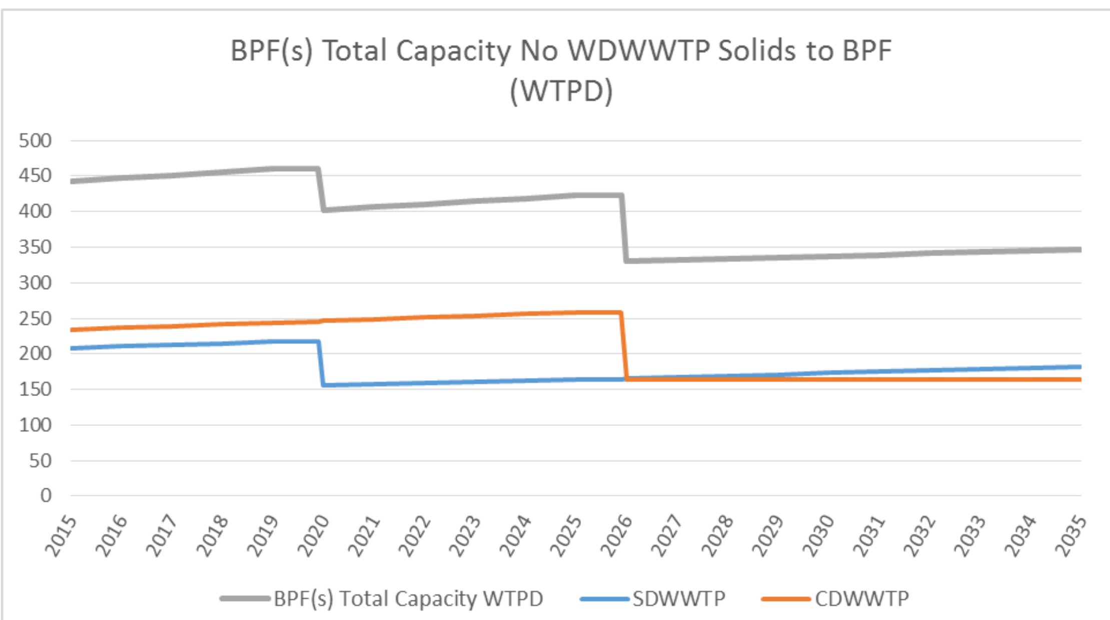

Figure 5. Projected Annual Average Wet Solids Production for the CDWWTP, SDWWTP, and Combined
WASD Biosolids Processing Facility

Peaking factors calculated from current operating data will be used to size equipment and process units. To address the 2035 design conditions, solids data from the CDWWTP and SDWWTP were analyzed to calculate the annual average day conditions compared to peak day, peak 2 week, and peak month solids production. The peaking factors used to address design conditions, other than annual average, are summarized in Table 4.

Table 4. Peaking Factors[a]
WASD Biosolids Processing Facility

Cake Production Peak Factor (Max Day/Annual Average)	Cake Production Peak Factor (Max 2 weeks/Annual Average)	Cake Production Peak Factor (Max Month/Annual Average)
1.83	1.39	1.27

Note:

[a] Derived from most recent 5-year operating records.

A single BPF may only be required to process solids from the SDWWTP, while the operation at the CDWWTP continues until contractual agreements expire. Initially the solids production rates will be lower than in the design year of 2035. The minimum amount of solids processed was estimated based on production data over the past 6 years. The minimum amount of biosolids that must be processed in the initial operating stages is presented in Table 5. These quantities are based on the lowest monthly average production over the last 6 years from each WWTP.

Table 5. Minimum Estimated Daily Solids Production – CDWWTP and SDWWTP
WASD Biosolids Processing Facility

Date	CDWWTP Including NDWWTP Solids (DTPD)	CDWWTP Including NDWWTP Solids (WTPD)	SDWWTP Solids (DTPD)	SDWWTP Solids (WTPD)
2015	35	150	27	160

Initially, a BPF at SDWWTP may process only approximately 27 DTPD (approximately 160 WTPD) if CDWWTP solids are handled separately. If solids from both WWTPs are processed, the minimum capacity of the BPF(s) would be approximately 62 DTPD (approximately 310 WTPD). The decision whether to continue to handle CDWWTP solids separately, or to combine them in a single BPF at the SDWWTP will be made by the DBFOM Provider at the Proposal Stage. The minimum and maximum amount of solids that will be treated at the BPF(s) will be set in the final contract.

3.2 Product Alternatives and Quality

WASD would like to produce at least one product that meets and exceeds the regulatory requirements found in Chapter 62-640, “Biosolids,” of the Florida Administrative Code for Class AA reusable material. Because there is a significant amount of agricultural land in the County area, it is preferred that one end-product be suitable for land application, such as a soil amendment or fertilizer, and be available for distribution and marketing. By producing material that meets this highest quality standard, WASD is committed to protecting public and environmental health to the maximum extent possible. Further, WASD’s goal for the BPF is to create a product that presents the lowest risk based on liability, costs, safety, and other criteria, in terms of long-term operations. The DBFOM Provider will also have the capability to produce a second end-product that can be safely reused or disposed of should the Class AA processing system fail or if markets for this product are unavailable. The technology used and characteristics of the second end-product shall be such that it offers flexibility for distributing this second product the market(s) for the primary product are unavailable.

Available solids quality data were reviewed and summarized for the material produced at both the CDWWTP and SDWWTP. Table 6 show the concentration of various chemical constituents in the biosolids compared with current regulatory limits, as determined by averaging information from both facilities over the period of 2009 to 2012. A ceiling limit is the maximum allowable concentration of a pollutant in biosolids that can be applied to land. The pollutant limit sets a lower pollutant concentration threshold which, when achieved, relieves the person who prepares biosolids and the person who applies biosolids, from certain requirements related to recordkeeping, reporting, and labeling. Historical data shows that average pollutant concentrations in the biosolids are below pollutant concentrations and all maximum concentrations are below regulatory ceiling limits.

Table 6. Chemical Characterization of Biosolids Compared to Regulatory Limits
WASD Biosolids Processing Facility

	CDWWTP Including NDWWTP		SDWWTP			
Pollutant[a]	**Historical Average (mg/kg)**	**Historical Maximum (mg/kg)**	**Historical Average (mg/kg)**	**Historical Maximum (mg/kg)**	**Ceiling Limit (mg/kg)**	**Pollutant Limit (mg/kg)**
Arsenic	7.1	29.6	4.9	9.8	75	41
Cadmium	6.8	24.5	2.1	6.1	85	39
Mercury	1.0	2.8	1.1	3.1	57	17
Nickel	39.4	54.4	15.1	27.4	420	420
Selenium	8.4	13.0	10.7	15.4	100	100
Molybdenum	24.4	57.3	15.3	27.3	75	-
Chromium	78.4	170.0	29.7	56.2	-	-
Zinc[b]	1,400	3,030[2]	1,360	2,000	7,500	2,800
Copper	436	571	459	709	4,500	1,500
Lead[c]	51.2	338[3]	41	331[3]	840	300

Notes:

[a] Chemical Characterization is based on data from 2010 through 2014

[b] Zinc pollutant limit was exceeded in one monitoring episode at the CDWWTP in early 2011 and Zinc has not exceeded its pollutant limit since that episode.

[c] Pollutant limit for Lead was exceeded in one monitoring episode at the CDWWTP and one monitoring episode at the SDWWTP in early 2011. Lead has not exceeded its pollutant limit at either WWTP since that episode.

The nutrient data for the material currently produced by the CDWWTP and SDWWTP are summarized in Table 7.

Table 7. Nutrient Concentrations in WASD Biosolids
WASD Biosolids Processing Facility

Pollutant[a]	**CDWWTP Ave (mg/kg)**	**CDWWTP Max (mg/kg)**	**SDWWTP Ave (mg/kg)[b]**	**SDWWTP Max (mg/kg)[b]**
Nitrogen	6.0	10.7	4.9	10.3
Phosphorus	2.3	3.9	2.0	3.9
Potassium	0.1	0.7	0.1	0.2

Table 7. Nutrient Concentrations in WASD Biosolids
WASD Biosolids Processing Facility

Pollutant[a]	CDWWTP Ave (mg/kg)	CDWWTP Max (mg/kg)	SDWWTP Ave (mg/kg)[b]	SDWWTP Max (mg/kg)[b]

Notes:

[a] Nutrient characterization is based on data from 2009 - 2014

[b] SDWWTP nutrient levels are post-composting

3.3 Siting

According to WASD, approximately 4.5 acres of the existing SDWWTP property and 4.5 acres of the existing CDWWTP property can be made available as a potential sites for thermal drying at the BPF(s). The area currently used for composting at the SDWWTP may be used by DBFOM Providers who want to offer composting as a treatment technology at the SDWWTP only. No other sites will be considered.

3.3.1 Solids Transport from CDWWTP to SDWWTP

If the DBFOM Provider decides to implement a single BPF at the SDWWTP, it will be necessary to transport the solids produced at the CDWWTP to the new BPF. At a project review workshop held October 15, 2014 at the WASD offices, a request was made to analyze, at a conceptual level two transportation alternatives; (1) trucking of dewatered cake, similar to the existing operation, and (2) installing a new, dedicated dual piping system to transport digested, liquid biosolids to the SDWWTP, where they could be combined with the solids from the SDWWTP, dewatered and sent to one BPF at the SDWWTP. A conceptual analysis comparing the capital and operating costs of these two alternatives was performed. As a result of that analysis, trucking is the recommended method to transport dewatered solids from the CDWWTP to the BPF, in the event that the DBFOM Provider proposes a single BPF at the SDWWTP.

SECTION 4

4 Process Screening and Evaluation

In biosolids processing, there are many technologies and operational approaches that can be used to produce a specified reusable end-product. Some of the technologies, such as anaerobic digestion, have been in use for decades. Other technologies are emerging that have demonstrated success in some locations; however, they do not have a track record in commercial applications that would warrant significant consideration. Further, some technologies are more applicable to certain size facilities, or facilities using certain liquid stream treatment processes. Finally, the process of anaerobic digestion at the WASD facilities is already in use, supports other processes and equipment, and will continue to be used. Because it is established, functions well in the overall biosolids processing trains, and produces a source of energy (biogas), discontinuing anaerobic digestion use was not considered.

The purpose of screening technologies is to go from the large set of available alternatives to a "shortlist" of those that warrant more detailed consideration. For this process, WASD performed an initial screening to identify technologies that are either applicable or not applicable to WASD's goals. Technologies not applicable to WASD's goals were discussed so the WASD and CH2M understands and agrees to the reason(s) they were not considered further. Factors that make those technologies not applicable to WASD include the following:

1. Lack of demonstrated operating track record at similar sized facilities
2. Processes that could not likely be operated successfully by WASD personnel in the future should WASD decide, or be required, to take over operations
3. Processes that could not produce a high-quality Class AA biosolids product for reuse

Following the initial screening, technologies that were not eliminated in the first screening were further analyzed. The process is described in this section.

4.1 Initial Screening

During the scope definition workshop, CH2M presented a range of treatment solutions that could be applied to the biosolids from WASD's wastewater facilities. This range of alternatives is shown in Figure 6. As shown, there are six general categories under the heading of solids stabilization. Given the size requirements, type of facilities that are currently in use, and desired end-products, many of these technologies in the initial screening step were removed from further consideration.

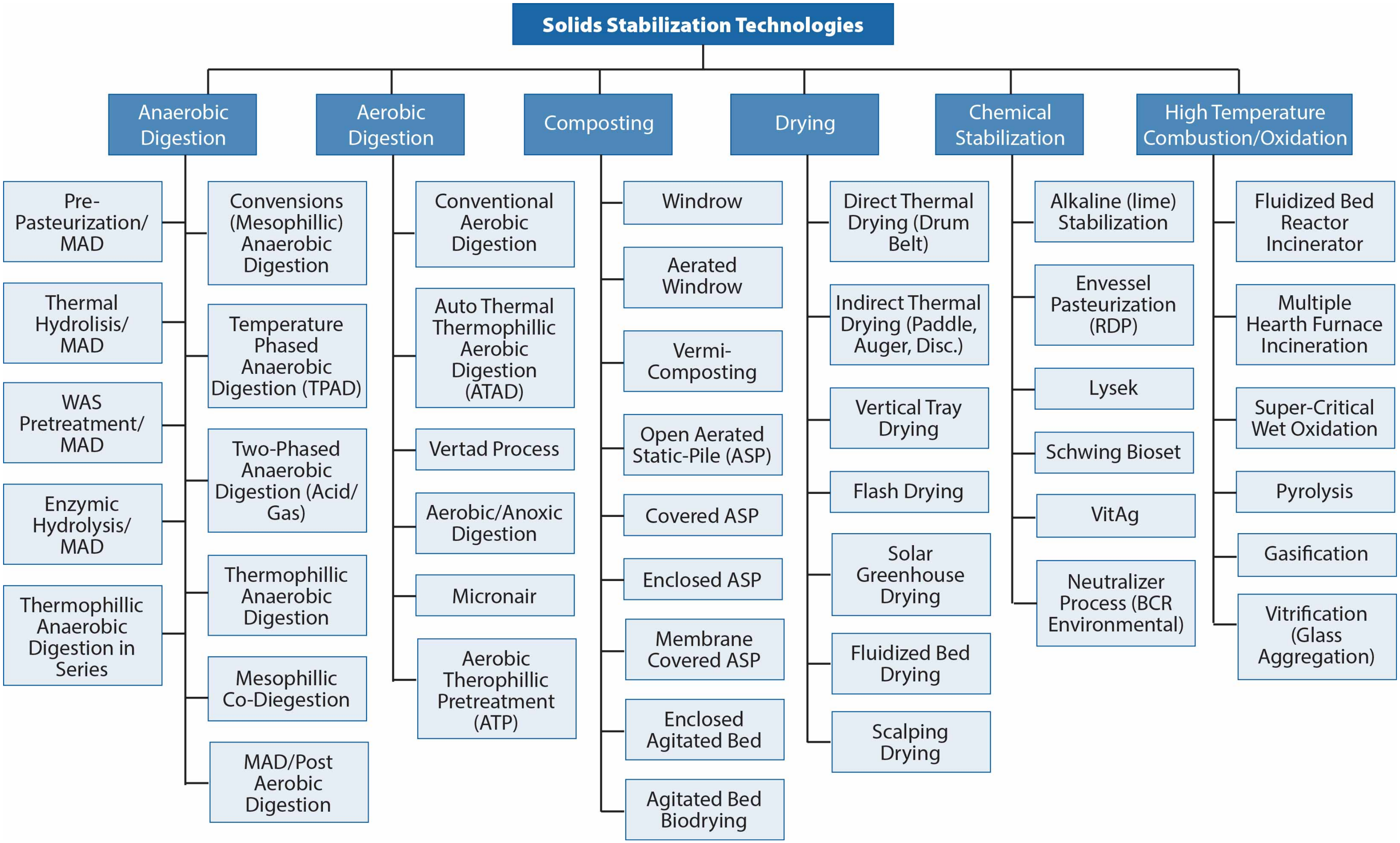

Figure 6. Possible Range of Alternatives
WASD Biosolids Processing Facility

Digestion processes, either anaerobic or aerobic, is not in the BPF scope because WASD already uses anaerobic digestion, which will continue to be used at both the CDWWTP and SDWWTP. Initially the list was narrowed to composting, thermal drying, chemical stabilization, and high-temperature combustion/oxidation, based on applicability to the existing conditions. Figure 7 shows the remaining technologies described in more detail.

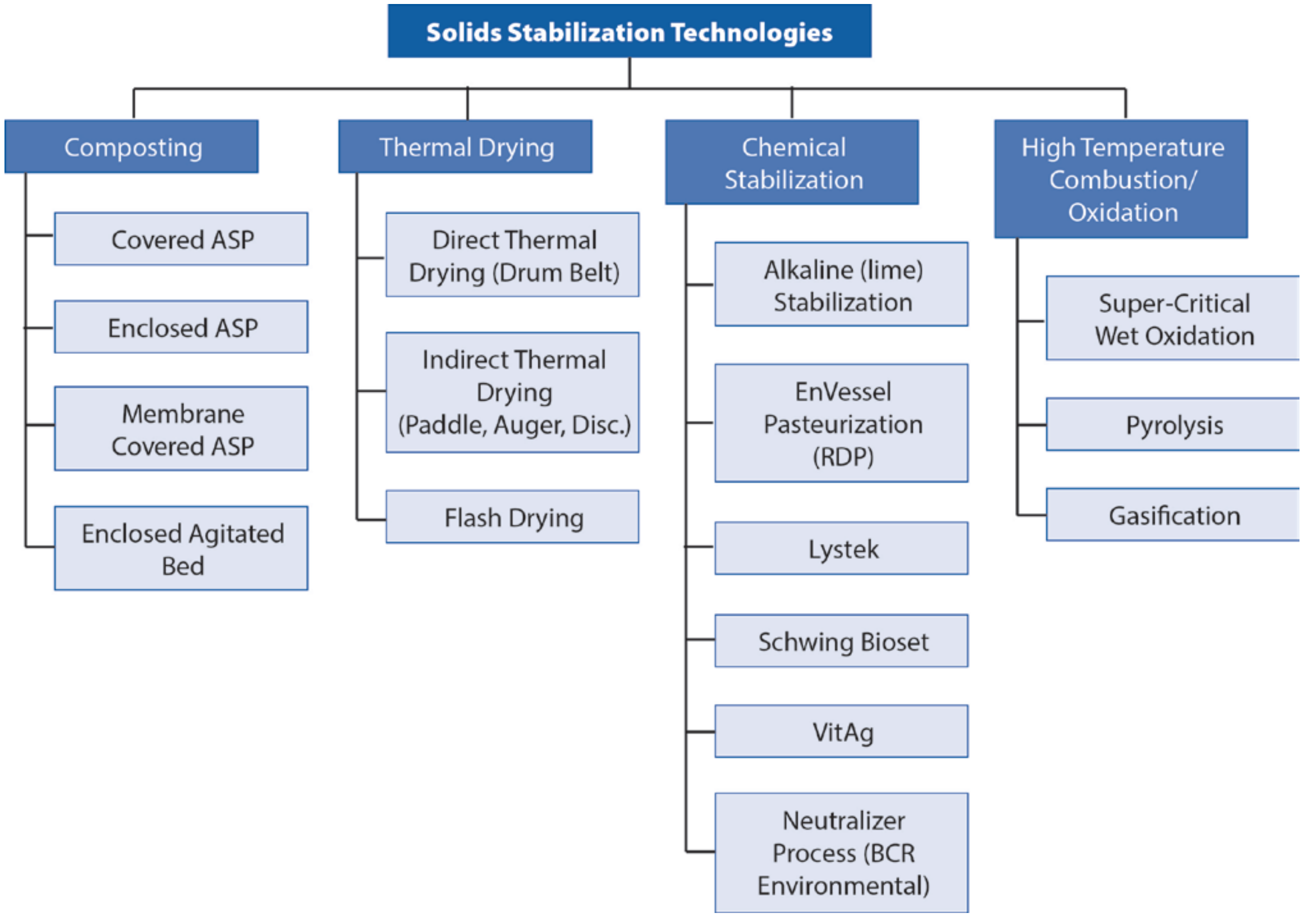

Figure 7. Results of Initial Screening
WASD Biosolids Processing Facility

Based on the WASD staff preferences, chemical stabilization and high-temperature combustion or oxidation processes are not applicable to WASD because of concerns with chemical handling and safety, lack of familiarity with these processes, and less operational experience. Since there is a possibility that WASD staff could eventually operate the facilities, processes using high temperatures and pressures were not considered. There is also a concern that these systems will have higher capital and operating costs. Figure 8 presents the remaining processes to be considered in more detail after this screening.

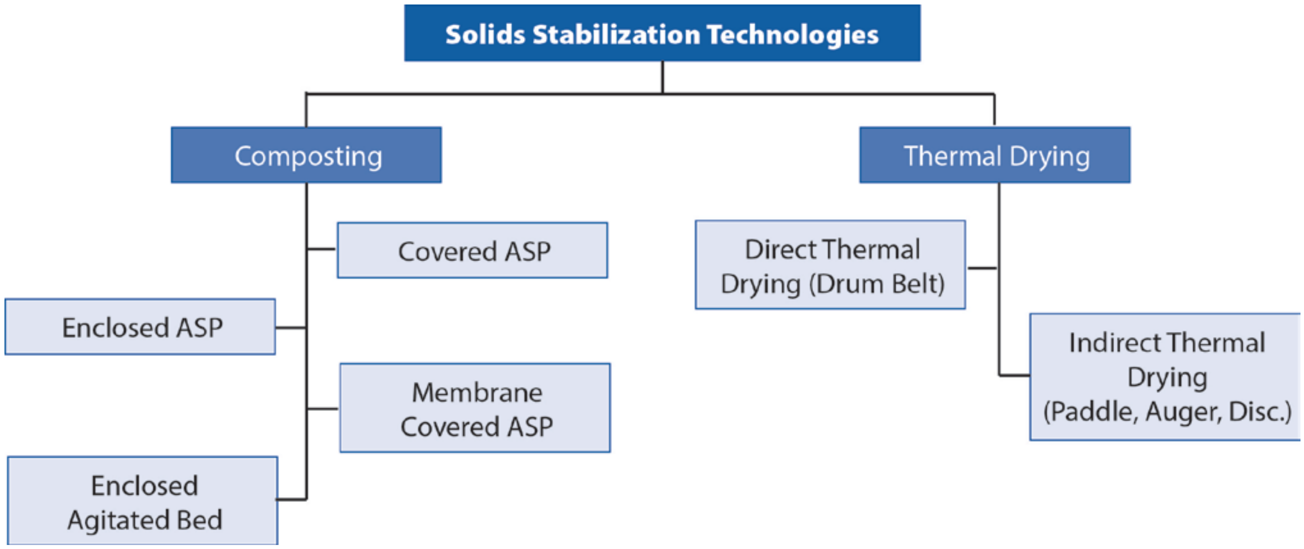

Figure 8. Alternatives for Detailed Consideration
WASD Biosolids Processing Facility

Generally, composting and thermal drying are the two preferred technologies for consideration. For composting and thermal drying technologies, the variations described in this section are applicable to WASD, and it is WASD's intent to identify and use the most cost-effective and sustainable technology for the new BPF or BPFs. Further, thermal drying is considered to be the only technology applicable to the CDWWTP site, should the DBFOM Provider choose to build a BPF there. Composting cannot be considered at the CDWWTP plant site due to odor concerns and insufficient land area available. The DBFOM Providers will be encouraged to select the technological variations they believe best suit the application for WASD.

4.1.1 Composting

There are several variations available for implementing a composting approach, which is considered to be a viable technology for the SDWWTP site only. One major variation is the use of mixing during the composting process. Aerated static pile (ASP) processes are based on constructing compost piles in a prescribed manner and aerating them over the composting period. They employ fixed aeration systems, such as aerated trenches or pipes with blowers. Because of aeration, the compost pile is not physically mixed over the composting period. Covered and fully enclosed variations use large structures either open on the sides (covered) or with walls (enclosed) to protect the compost operation from the elements. Because of the abundant rainfall in South Florida, some type of cover is required for consistent, day-to-day operations. A cover could take the form of a building or membrane. Covered membrane systems use large "tarps" made of water-shedding fabric that allow air passage, but contain the pile. Agitated bed systems use fixed aeration systems and a mixer that continuously mixes the compost pile to keep the material uniform, minimize clumps, and maintain porosity for aeration. The mixer causes these systems to be more complex and mechanical than ASP composting facilities, which utilize rolling-stock equipment more heavily.

4.1.2 Thermal Drying

The major differences in thermal drying technology follow:

- In direct drying systems the materials to be dried (biosolids in this case) are directly exposed to the heat source

- With indirect drying the heat is transferred from one form, such as heated oil or fluid, to the material through a conducting medium

An example of direct drying is a belt dryer in which dewatered biosolids are distributed evenly on a moving surface that passes near a heat source, such as heated air from a waste heat source or low temperature burner that allows the biosolids to be heated and dried. An example of indirect drying is a system where the biosolids are mixed with an auger that contains a circulating hot fluid. The heat is transferred through the mixer and the heat source is not directly exposed to the biosolids.

There is some waste heat available at the SDWWTP and the CDWWTP from cogeneration facilities that use internal combustion engines to produce electricity. This waste heat from cogeneration is available in two forms; medium-grade heat at approximately 190 degrees Fahrenheit (^oF) and high-grade heat at 470 ^oF. The internal combustion engines use digester gas produced at the CDWWTP and SDWWTP, plus landfill gas from the solid waste disposal facility (South Dade Landfill) that is next to the SDWWTP.

At the SDWWTP, the Cogeneration Facility is designed to use all of the gas produced from those two sources and the waste heat produced by the engines is available for other uses. The high-grade heat is available in a closed-loop, hot oil system. The medium-grade heat is available from a recirculating hot water system. Currently, the high-grade heat is used to operate an adsorption chiller for the facility and the medium-grade heat is used to heat the anaerobic digesters. The amount of high-grade heat allocated to the absorption chiller is 1.8 mmBTU/hr and the medium-grade heat currently allocated to the existing anaerobic digesters is approximately 3.1 mmBTU/hr. Any unused heat is dissipated into the atmosphere or the effluent stream.

The predicted 2015 gas usage by the cogeneration facility at SDWWTP is approximately 590 standard cubic feet per minute (scfm) from the digesters and 575 scfm from the landfill for a total gas flow of 1,165 scfm. At these gas flows, the heat balance estimates available heat to be 37.8 mmBTU/hr. During the startup and early months of operation, the availability of these quantities of gas has been problematic. Thus, the actual production of electricity and waste heat has been less than predicted. Assuming the predicted quantity of heat is available from the two gas sources (37.8 mmBTU/hr), approximately 14.1 mmBTU/hr of electrical energy equivalent is produced; 13.6 mmBTU/hr of waste heat is available and system losses account for the remaining 10.1 mmBTU/hr. The 13.6 mm BTU/hr would be split 7.9 mmBTU/hr to the high-grade system and 5.7 mmBTU/hr to the medium-grade system. At these production and use levels, after the chiller and digester heat demands are satisfied, the amount of potentially available high-grade waste heat is approximately 6.1 mmBTU/hr and medium grade heat is approximately 2.6 mmBTU/hr.

The design heat balance in the year 2035 for the SDWWTP cogeneration system is based on using 900 scfm of both digester gas and landfill gas for a total gas flow of 1,800 scfm, representing approximately 58.3 mmBTU/hr total available heat to the cogeneration engines. Accounting for losses in the cogeneration equipment, this converts to 21.7 mmBTU/hr of electricity and 20.9 mmBTU/hr of waste heat. The 20.9 mmBTU/hr would be split with 8.7 mmBTU/hr going into the high-grade heat system and 12.2 mmBTU/hr going to the medium-grade system. Assuming that heat consumption by digestion does not change significantly, the available heat would be 6.9 mmBTU/hr in the high-grade system and 9.1 mmBTU/hr in the medium-grade system.

Table 8 summarizes the estimated available waste heat for startup and the design year at the SDWWTP. At startup there will be 4 cogeneration engines. A fifth engine will be added as gas production increases, which is estimated to be in 2020.

Table 8. Anticipated Waste Heat Availability at SDWWTP
WASD Biosolids Processing Facility

Condition	Waste Heat Produced (mmBTU/hr)[a]	Waste Heat Used (mmBTU/hr)	Total Available Waste Heat (mmBTU/hr)	Available High-Grade Waste Heat (mmBTU/hr)	Available Medium-grade Waste Heat (mmBTU/hr)
Initial Startup, 2015	13.6	4.9	8.7	6.1	2.6
Design Year, 2035	20.9	4.9[b]	16.0	6.9	9.1

Notes:

[a] mmBTU/hr = million British thermal units per hour

[b] Assuming no changes to digestion and gas production systems from 2015.

If a DBFOM Provider chooses to use this heat in their process, it will be their responsibility to provide the equipment and systems to collect and use it.

There is also a cogeneration system using digester gas at the CDWWTP, but at the time of issuance of this RFQ, information on the quantity and type of waste heat at the CDWWTP for potential use in a thermal drying system at the CDWWTP has not been made available. More information on the potential for waste heat is expected to be provided in the RFP.

4.2 Project Capital Cost Considerations

A key part of the project delivery approach using a DBFOM Provider model is the business case evaluation. A critical component of that evaluation will be the estimated capital and operating costs. At the point where there are two main technologies being considered, a conceptual order-of-magnitude cost for construction and operations is required to allow WASD to assess the financial aspects of the project. The DBFOM Providers will provide detailed costs with their final proposals. Until then, WASD will continue planning for delivery of the design, construction, and operation of the BPF based on a DBFOM Provider arrangement. Because anticipated capital and O&M costs vary significantly and are dependent on decisions that have yet been made, capital and operating costs for the BPF(s) are not addressed in this BDM. A Business-Case Evaluation (BCE) for implementation of the BPF(s) is under development by WASD. The BCE will be updated as needed as cost information is received from DBFOM Providers and the design of BPF(s) is further refined.

As the project moves forward and DBFOM Providers become more involved, it is anticipated that the cost estimates for capital and operations of the BPF(s) will become more accurate, and the potential for variation will be reduced.

Phasing of some project elements may be appropriate to control expenses and to match expected solids production rates from the CD and SD WWTPs. The phasing decisions will be made by the selected DBFOM Provider based on capacity and growth rates provided in this BDM.

4.2.1 Composting

The capital cost for composting facilities is highly dependent on how much of the existing SDWWTP composting operation is incorporated into the new composting system. Further, WASD will have to decide how the existing facilities will be transferred to the selected DBFOM. For example, the facilities could be made available at no cost to the DBFOM, assuming that this will result in the lowest cost alternative for WASD. Or, the facilities could be leased to DBFOM, which would more accurately reflect the true cost for implementing the BPF, but could result in higher costs. Finally, WASD could transfer ownership of the facilities to the DBFOM so that the solids handling site and equipment is completely in the control of the DBFOM. This approach would require that a value of the total asset be established and that value incorporated into the overall cost for composting.

The range of alternatives for implementing composting goes from a relatively simple upgrade of the existing facility to a full, new state-of-the-practice facility. The relatively simple upgrade would include covering the composting areas with a roof to reduce the weather-related impacts on the system. This approach could be implemented at a fairly low cost, assuming as much of the existing composting equipment and facilities would be re-used. At the other end of the spectrum, if the DBFOM has to completely construct the composting process with new aeration equipment, solids handling, odor control and site support infrastructure (roadways, lighting, stormwater systems, etc.) then the costs would be similar to those experienced at other, new “greenfield” composting facilities.

4.2.2 Thermal Drying

If thermal drying is implemented, this system will be completely new since this technology has not been used at the CDWWTP or the SDWWTP. WASD will provide the site via some form of lease or sale transfer, similar to the composting alternative. Since the footprint of thermal drying is much smaller than composting, it is expected that some form of composting operation will continue at the SDWWTP. WASD has dedicated approximately 4.5 acres for a thermal drying facility at the CDWWTP and also at the SDWWTP. The design concept for this process configuration is based on having at least two thermal dryer units at each site, with the facility sized to meet maximum month design conditions with all dryers in service and average day design conditions with one dryer out of service. The thermal drying facilities would have air pollution control equipment to comply with air pollution control regulations. For the SDWWTP-only dryer option, the dewatered material would arrive from the CDWWTP by truck and be unloaded into feed hoppers. Material from the SDWWTP would be conveyed from the dewatering facilities at that site. It will be the DBFOM Provider’s choice whether to combine SDWWTP cake solids with the CDWWTP cake solids prior to thermal drying.

Dried product would be stored onsite for up to 5 days prior to being trucked offsite for use. Dried product storage capacity for at least 5 days at design conditions will be provided to account for poor weather, transport problems, or similar issues.

4.2.3 Biosolids Transport

Two alternatives were evaluated for transporting the biosolids produced at the CDWWTP to the new BPF. Based on this planning-level evaluation, it was decided that trucking would be used. The DBFOM Provider shall be responsible for the trucking operation.

4.3 Operating Cost Considerations

The operational resources needed for the two technologies are significantly different. Composting is “low-tech” with a minimal amount of complex equipment that requires high-level maintenance. Conversely, thermal drying is fairly complex requiring high temperature and material handling system management that processes solids much more quickly.

4.3.1 Composting

Composting, especially ASP composting, is relatively labor intensive requiring construction and tear down of compost piles. The staff should understand the concepts and theories being applied. Equipment used is typical of light earthwork machinery. Composting requires a much larger area than thermal drying; therefore, there is a high amount of vehicle/equipment traffic at this size of facility. The operating costs include a significant rolling stock/fuel-based component. Composting requires electricity to power the aeration systems, and, depending on the composting system used, electric motors may power portions of the material handling system. It is possible to automate portions of the process.

Compost time and temperature monitoring can be implemented. The amount of time at a given temperature can be recorded in the plant data system and used to show compliance with the time/temperature requirements. Odor control can represent a significant operating cost depending on the type of system(s) needed and the level of odor control required. Operating costs include labor, power, equipment, other utilities, and supplies.

4.3.2 Thermal Drying

Thermal drying requires a source of heat to operate the dryer. The type of dryer technology employed will depend on the heat source used. Heat can be provided directly by the combustion of natural gas or other fuels. Dryers that use this approach are typically the indirect type, where the heat is used to warm another media that is then exposed to the biosolids. Often these dryers run at relatively high temperatures. The other potential heat source to operate the dryer is “waste heat,” provided it is available. Waste heat by definition is the heat produced from some other source that is typically not used in the main process. It is usually allowed to flow to a heat sink, such as the atmosphere, via cooling towers. As noted above, waste heat is available at the CDWWTP and SDWWTP from the engine casings and exhaust systems of the cogeneration engines.

With the extent of these heat sources unconfirmed, the potential cost range for operations is relatively broad. Operating costs will vary significantly depending on the source of heat used in the thermal drying process and whether waste heat can be used. Staffing is typically less with thermal drying than with composting, since thermal drying systems are more automated. Most of the material handling is mechanized and does not require operators to be involved continually. Because thermal drying is a higher temperature, shorter retention time process, it is very important to measure and control the thermal drying step. Tracking the amount of water removed is important in terms of final product quality. While fewer staff are needed with thermal drying systems, they are typically more highly trained than composting system operators and computer monitoring systems are more complex.

At this level of design, the operating costs for thermal drying are estimated to be slightly higher than composting if waste heat is not used, and slightly lower if it is. Establishing a firm cost for operations will be part of the proposal process involving the DBFOM Providers.

5 Recommendations

There are various processes that could be applied to the BPF(s) for WASD. Based on the screening process that accounted for both monetary and non-monetary concerns, it was concluded that DBFOM Providers offering composting or thermal drying systems would be considered, within the limits established by this BDM. These systems can produce end-products that meet the requirements for Class AA material, are in wide use in the industry, and do not require highly specialized operating staffs. This decision is based on the following factors:

- Operating track record of these systems in similarly sized applications
- Ability of WASD staff to operate these technologies (should this become necessary over the course of operations)
- Ability to produce a high-quality reusable product that can be sold to several markets such as agriculture, fertilizer production, bio-fuel production and others

By selecting two different technologies, WASD can further diversify its biosolids products and potentially identify an appropriate balance of technologies to employ for biosolids processing in the future. These two technologies offer the DBFOM Providers flexibility while limiting the technologies to reliable and proven processes that have a high probability of operating success based on similar installations.

The recommended method for transporting biosolids from the CDWWTP to a BPF at the SDWWTP (if required) is via truck. If a the DBFOM Provider elects to implement a BPF based on thermal drying at the CDWWTP, then the necessity for transporting dewatered biosolids from the CDWWTP will be reduced or eliminated. Transporting thermally dried biosolids from the CDWWTP would require substantially fewer trucks than transporting dewatered cake solids. The CDWWTP digesters and dewatering facilities would continue operation with upgrades as needed. Either dewatered cake or thermally-dried biosolids would be loaded into trucks at the CDWWTP for transport to other locations. In the event that dewatered biosolids need to be transported from either of the two WWTPs to the other WWTP, it is expected that the DBFOM Provider will implement dewatered cake unloading, storage and handling facilities for these solids at one or both BPF(s).

5.1 Recommended Technologies

Thermal drying and composting are the two recommended technologies. Thermal drying would have a much smaller footprint than composting, and could be located on the SDWWTP site as shown in Figure 2, and at the CDWWTP as shown in Figure 3. Composting onsite at SDWWTP would require use of most of the existing composting area and improvements. The composting improvements are expected to include enclosures or covers to allow operation during rainy season, revisions to the aerations systems, and upgrades for the instrumentation and controls.

5.2 Recommended Project Delivery

The contract vehicle for implementing this project is highly dependent on the County's preferences and procurement requirements. A full-service DBFOM contract that provides for completing the planning steps, design engineering, permitting construction services, operations, and financing is the recommended and anticipated approach. As the procurement process progresses, the contract type, and services to be included will be further defined by the County and CH2M, and an RFP will be issued with more detailed information.

SECTION 6

6 References

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