

**PREPARED FOR:** Western Wake Partners

**FROM:** CDM/Hazen and Sawyer

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**DATE:** July 22, 2005

**SUBJECT:** Western Wake Regional Wastewater Management Facilities  
Western Wake Water Reclamation Facility  
PER Technical Memorandum No. 17 – Solids Receiving/ Aerated  
Holding Tanks/ Biosolids Loading Facilities

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## INTRODUCTION

This technical memorandum (TM) is one of a series of TMs being prepared for the Preliminary Engineering Report for the Western Wake Regional Wastewater Management Facilities project. The purpose of this TM is to describe the recommended facilities for receiving and processing waste sludge at the proposed Western Wake Water Reclamation Facility (WRF). The sources of solids include waste activated sludge (WAS) from the Western Wake WRF and waste sludge transported from Apex Middle Creek WWTP.

This TM defines the process requirements for the solids receiving station, the aerated holding tanks, and the liquid biosolids loading facility. Additionally, sludge disposal alternatives for the Western Wake WRF such as land application, composting, and landfilling are evaluated. Finally, this TM describes the recommended facilities to meet the process requirements and provides an estimated cost to construct the facilities.

## PROCESS REQUIREMENTS

The basis of design for the facilities is the estimated quantity of WAS from the Western Wake WRF for an average day maximum month flow (MMF) of 18.0 mgd. Based on the results of the wastewater treatment model incorporating influent flow, BOD, suspended solids, and nutrient characterization, the expected MMF mass of solids generated is 37,500 lb/day dry solids. If the solids capture on the gravity belt thickeners (discussed in TM 16) is 95%, then 35,600 lb/day dry solids are sent to the aerated holding tanks.

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A station for accepting solids from off-site sources is discussed in this TM; however, no additional capacity in the aerated holding tanks has been assumed for these solids.

## **ALTERNATIVES EVALUATION**

The sludge management alternatives considered for the Western Wake WRF include:

- 1) land application
- 2) off-site composting (by a private contractor)
- 3) landfill disposal
- 4) potential future Class A process

The project Partners have historically relied on land application of biosolids meeting Class B EPA standards. The pathogen reduction and vector attraction reduction requirements were normally met using aerobic digestion, with lime stabilization providing a backup.

While these land application programs have been successful in the past, continued growth in Wake County has resulted in a decreasing availability of land application sites in close proximity of the existing treatment facilities. In addition, severe inclement weather events such as snow storms, ice storms, hurricanes, and severe rains, which render land application sites unsuitable for biosolids applications for extended periods, require that wastewater utilities in urban/metropolitan environments have readily-available alternatives to land application. Partially as a result of decreasing land availability and severe weather condition concerns, the Town of Cary (a Western Wake Partner) has moved away from land application for solids disposal. Instead, the Town of Cary is constructing a thermal drying facility at the South Cary WRF to produce Class A biosolids from the North Cary WRF and the South Cary WRF. In the interim, the town relies on off-site composting by a private contractor.

**Table 17-1** is a summary of estimated present worth costs for each management option for Year 2011 to Year 2020. The analysis assumes inflation rates and annual discount rates consistent with TM 32. The option for land application of biosolids has the lowest present worth cost. However, these costs do not account for future cost-escalations associated with hauling to sites located at greater distances from the water reclamation facilities, or for providing on-site storage to accommodate severe inclement weather conditions which render land applications site unsuitable for application. Because of the uncertainty associated with land availability, and the costs associated with providing sufficient storage for inclement weather; land application is not the recommended management option.

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**TABLE 17-1  
PRESENT WORTH COST ANALYSIS OF SOLIDS MANAGEMENT ALTERNATIVES**

Capital Cost Summary			
	Land Application	Composting	Landfill Disposal
Thickening	\$3,000,000	\$3,000,000	\$3,000,000
Digestion	\$8,000,000	\$4,000,000	\$4,000,000
Dewatering	--	\$1,600,000	\$1,600,000
Total Capital Cost	\$11,000,000	\$8,600,000	\$8,600,000
Operating Cost Summary			
10-yr Operating Cost	\$7,700,000 <sup>1</sup>	\$16,500,000 <sup>2</sup>	\$14,800,000 <sup>3</sup>
10-yr Present Worth Cost (2005 dollars)	\$18,700,000	\$25,100,000	\$23,400,000

<sup>1</sup> Assumes Land Application at 4.5 cents/gal in 2005

<sup>2</sup> Assumes Composting Facility Charge of \$35/wet ton and hauling charge of \$162.50/truckload in 2005

<sup>3</sup> Assumes Landfill Facility Charge of \$30/wet ton and hauling charge of \$162.50/truckload in 2005

It is estimated that approximately 2,300 acres will be required for a land application program serving the Western Wake WRF. This estimate is based on the following assumptions:

- 30,000 lb/day average thickened WAS from the Western Wake WRF in 2020
- 75 percent volatile solids (22,520 lb/day volatile solids)
- 40 percent reduction in volatile solids (13,960 lb/day volatile solids after digestion)
- 21,000 lb/day solids for land application at approximately 3.0 percent solids = 88,000 gpd for land application

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- Application rate = 5 tons/acre/yr (dry solids)
- Maintain three times as much permitted land as calculated to accommodate crop rotation and other availability issues

Due to the amount of land required for a land application program and the diminishing availability of land near the proposed WRF, the Western Wake Partners desire a residuals management program that includes other options such as off-site composting, thermal drying and landfill disposal.

As mentioned previously, the Town of Cary is currently contracting with an off-site private composting facility for disposal of solids generated at its two WRFs. The composting facility is located in southwestern Wake County, near the proposed location of the Western Wake WRF. Additionally, the composting contractor operates other nearby facilities in Wake County and Chatham County.

The off-site composting alternative requires that the solids be stabilized for odor potential reduction.

Also, the solids must be dewatered prior to transport to the composting facility. The facility charges a fee based on the weight of materials received and a fee per load transported.

Landfill disposal is another alternative for management of solids from the Western Wake WRF. To reduce nuisance in transportation some stabilization to reduce odors and odor potential is desirable.

Additionally, the solids must be dewatered prior to transport to the landfill. Fees associated with landfill disposal include tipping fees based on the weight of materials disposed and fees for transporting the material to the landfill.

In addition to the options described above, the potential exists for future development of a Class A Exceptional Quality biosolids alternative.

Since it is unrealistic to assume that the required land base for biosolids application will be available in Wake County or surrounding counties, it is recommended that the residuals management plan for the Western Wake WRF to include off site processing by contract composter with landfill disposal as a backup. The recommended facilities include aerated on-site storage that can provide product stabilization and some solids reduction.

## **PROPOSED FACILITIES**

### ***Solids Receiving Station***

A solids-receiving station is required for unloading solids transported from off-site sources. The

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solids receiving station will be above-ground with a quick-connect hose connection and piping into a below-ground wet well. Solids will be unloaded by gravity from a tanker truck into the wet well. Submersible pumps will transfer the solids from the wet well into the aerated holding tanks.

The solids receiving station will have a volume of 6,000 gallons to accommodate receiving one truck load. It is recommended that two submersible pumps (one duty, one standby) be installed in the wet well. Each pump should have a capacity of approximately 200 gpm so that 6,000 gallons can be transferred in 30 minutes. It is recommended that the two pump discharges join together into a common header in a valve box near the wet well. The common header will convey the received solids into one of the aerated holding tanks.

***Aerated Holding Tanks***

Aerated holding tanks are recommended for solids processing at the Western Wake WRF. It is not the intent of the aerated holding tanks to act fully as aerobic digesters meeting 40 CFR 503 Class B requirements. However, it is recommended that the aerated holding tanks be sufficiently sized to provide some of the benefits associated with aerobic digestion, including:

- 1) overall solids reduction,
- 2) reduced product odor potential

The aerated holding tanks be sized to provide 20 - 25 days of hydraulic retention. This recommendation is based on providing 400 - 500 degree-days at 20 degrees Celsius.

The expected MMF solids loading to the aerated holding tanks is 35,600 lb/day of thickened WAS from the Western Wake WRF. Assuming the thickened solids concentration will be 4 percent solids, the MMF volume of thickened WAS is 107,000 gal/day. A tank volume of 2.1 million gallons (MG) is required to provide 20 days of hydraulic retention for the Western Wake WRF solids at 4 percent solids.

It is desirable to use tank configurations that allow for efficient mixing and oxygen transfer. The proposed tank configuration is four covered, circular, prestressed concrete tanks with a 70-ft. diameter and a sidewall depth of 29 feet. At an average sidewater depth of 26-ft, the nominal volume of each tank is 0.75 MG. The four tanks will be spaced approximately 30-ft apart in two staggered rows. Space will be reserved for two additional tanks to accommodate future expansion of the WRF.

Decant piping will be provided for the aerated holding tanks. The purpose of decanting the storage tanks is to provide additional thickening of the solids by settling the solids in the tank and decanting

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the supernatant. Thickening of the solids can provide an increased solids residence time without requiring additional tank volume. Additionally, the decant system serves as a backup to the gravity belt thickeners.

The recommended decant piping system includes a telescoping valve, adjustable to multiple depths on the aerated holding tanks. The decant piping will be tied into a common header and should flow by gravity to the centrate/ filtrate storage tank.

***Tank Mixing and Aeration Equipment***

Mixing and aeration equipment is required to maintain nearly homogenous, aerobic conditions in the aerated holding tanks. A robust, submerged aeration system, such as jet aeration is recommended.

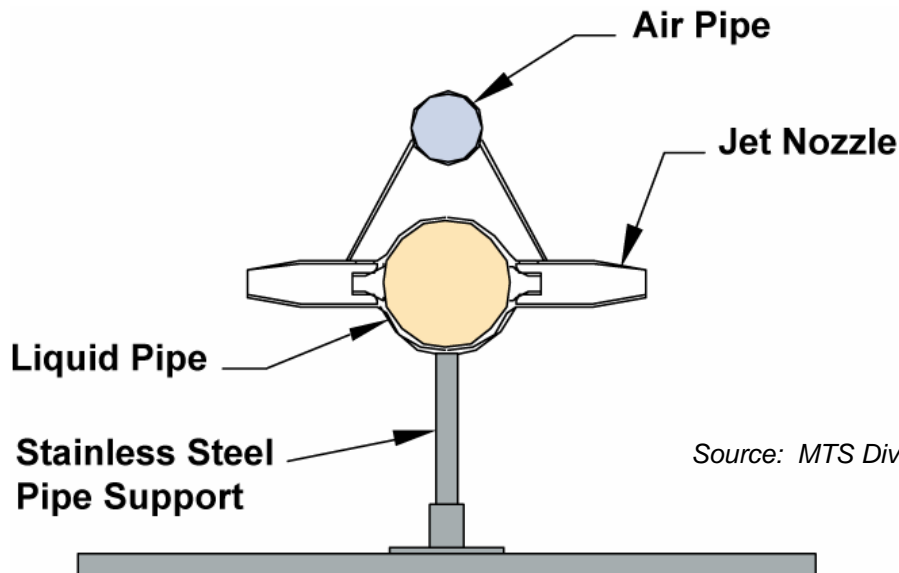
Figure 17-1 is a section view of the piping and jet aeration nozzles. A liquid pipe, with jet nozzles, is placed along the floor of the tank. An air pipe is located above the liquid pipe. The air pipe also has connections to the jet nozzles. Under normal conditions, a blower provides pressurized air to the air pipe which forces air into the jet nozzles. A recirculation pump provides a continuous flow of liquid through the liquid pipe and jet nozzles. The turbulence created in the nozzle decreases the resistance to oxygen transfer from the air into the liquid. At the same time, the jet nozzles provide a high velocity stream of liquid entering the tank. The effect is to create a rolling pattern to mix and aerate the tank.

The expected loading of solids to the aerated holding tanks is 35,600 lb/day (MMF). The volatile solids content is assumed to be 75 percent resulting in a volatile solids loading of 26,700 lb/day (MMF) to the aerated holding tanks. The aeration system is conservatively sized assuming 50 percent volatile solids reduction.

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Source: MTS Division of North American Filtration

**Figure 17-1: Section View of Jet Aeration System Piping and Nozzles**

Figure 17-2 is a proposed layout for the jet aeration and mixing system for the aerated holding tanks. Each tank is equipped with a single header arranged in a "Y" configuration with a single recirculation pump.

Recirculation pumping is provided by belt-driven centrifugal pumps. The estimated centrifugal pump size is 7,200 gpm at 29-ft. TDH for each pump. It is recommended that each centrifugal pump be dedicated to one recirculation header. Additional pump components would be maintained on-site for repairs in the event of a pump failure.

It is recommended that enclosures be provided for the pumps. One enclosure should be provided between two tanks with two pumps in the enclosure.

The air requirement of the jet aeration system is approximately 1,300 scfm at 12.0 psig per tank. It is recommended that 4 multistage, centrifugal blowers be used. Under normal conditions, each blower would be dedicated to a tank, but the blowers will have reserve capacity in the event one of the blowers is out of service. This requires 4 centrifugal blowers each rated for 1,800 scfm to meet the air requirement. It is recommended to locate the blowers inside a room of the thickening/dewatering building.

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***Centrifuge Feed Pumps***

As described in TM 18, centrifuges are recommended to dewater the residuals prior to final disposal. If off-site composting or landfill disposal is the selected disposal option, then the material must meet certain requirements with respect to percent cake solids. As an example, many landfills require materials to pass a paint filter test as a prerequisite for acceptance.

Under normal operating conditions it is expected that thickened WAS will be stored in the aerated holding tanks. The effluent from the aerated holding tanks will be dewatered using the centrifuges.

Centrifuge feed pumps are required to convey the residuals from the aerated holding tanks to the centrifuges. Three progressing cavity pumps designed for pumping wastewater sludges are recommended. Each pump should be capable of delivering 300 gpm to the centrifuge inlet. It is recommended that one pump be dedicated to each of the two centrifuges, and a third pump be provided as a standby. The pumps can be located in a centrifuge feed pump station adjacent to the aerated holding tanks. It is recommended to provide an above-ground enclosure for the centrifuge feed pumps.

***Liquid Biosolids Loading Facility***

To accommodate off-site transportation of solids from the aerated holding tanks, a liquid biosolids loading facility will also be provided. A pipeline from the aerated holding tanks will be used to convey the solids to an overhead truck loading station. A pump station equipped with two centrifugal pumps, each capable of pumping 600 gpm, is recommended to pump the biosolids through the pipeline into a tanker truck. The pumps will be controlled from an operator's platform located at the loading facility.

The recommended facility will be located outdoors, along a roadway near the aerated holding tanks.

It is recommended the facility include a containment area for collecting spills. Spills collected in the containment area should be returned to the sanitary sewer system to be processed through the treatment facilities.

**SUMMARY**

Table 17-2 is a summary of the equipment and facilities recommended in this TM. In general the TM describes the solids receiving station, the aerated holding tanks, the centrifuge feed pumps, and the liquid biosolids loading facility. The equipment and facilities shown in Table 17-1 are the basis of the cost estimate at the end of this TM.

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**ELECTRICAL REQUIREMENTS**

It is recommended that the electrical requirements for the equipment described in this TM be provided from the electrical facilities described in TM 16. In summary, the motor control centers (including starters) for the motors for the equipment described in this TM are located in the electrical room of the thickening/ dewatering building. Local disconnects and local start/stop controls will be provided near each pump or blower motor.

**INSTRUMENTATION & CONTROLS**

Instrumentation and controls (I&C) of the equipment and processes described in this TM are recommended to be included as part of the overall plant I&C. In general, all equipment should be capable of either automatic or manual control. It is recommended to provide controls for the blowers and the recirculation pumps at a jet mixing and aeration control panel as well as local controls at each piece of equipment. Controls for the centrifuge feed pumps will need to be integrated with the operation of the centrifuge decanters.

**ESTIMATED CAPITAL COSTS**

The estimated cost of the equipment and facilities described in this TM are shown in Table 17-3. The cost estimate follows the guidelines established in TM 32.

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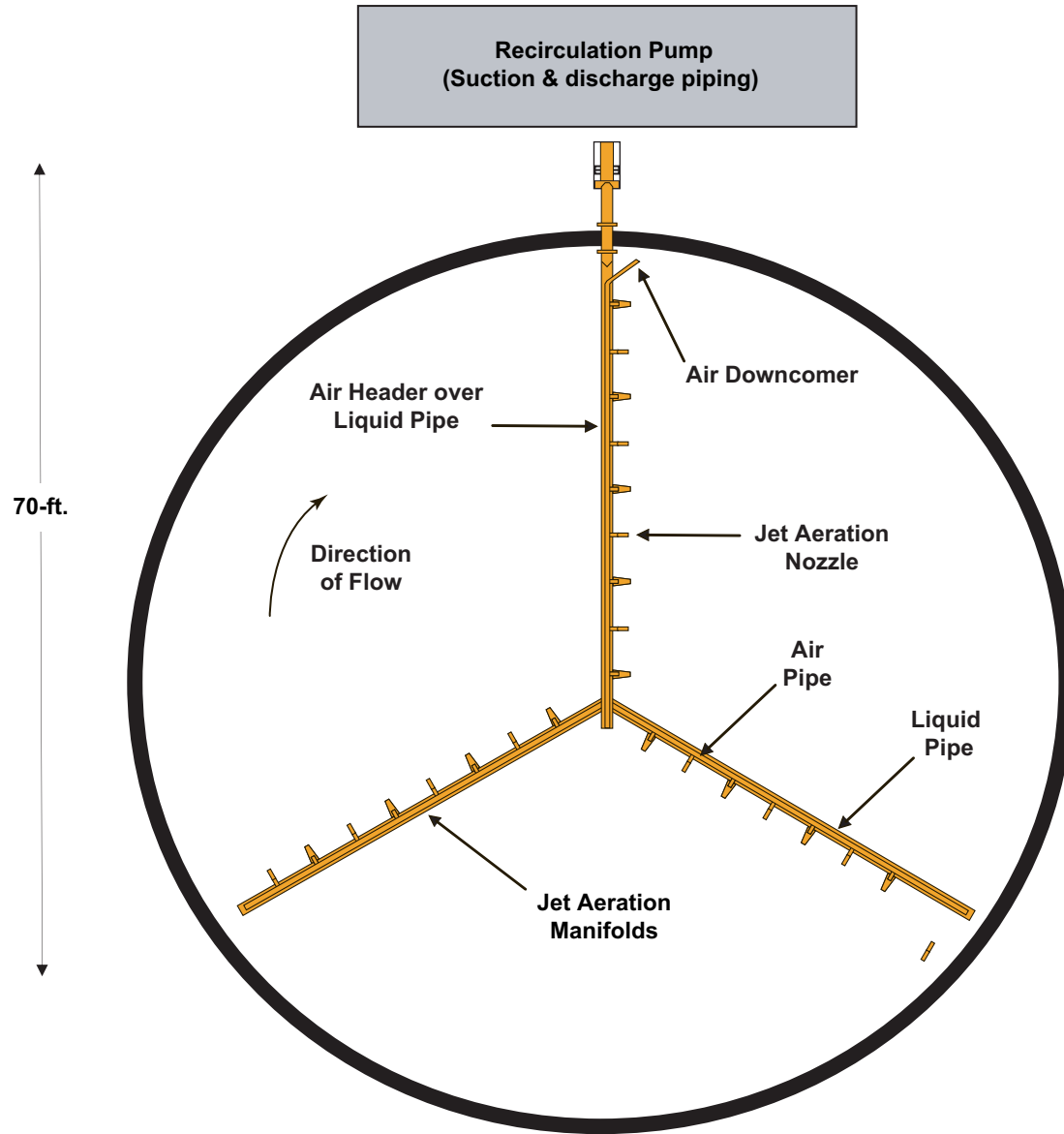
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**TABLE 17-3**  
**PRELIMINARY COST ESTIMATE**

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Solids Receiving Station	
Manhole	\$10,000
Pumps	\$60,000
Piping	\$18,000
Aerated Holding Tanks (provide quantities!)	
Sitework	\$98,000
Prestressed Concrete Tanks	\$1,900,000
Aeration and Mixing System for Tanks	
Jet Aeration Headers	\$1,080,000
Pump Enclosures	\$75,000
Blowers	\$405,000
Centrifuge Feed Pumps	<i>Included in TM 18</i>
Liquid Biosolids Loading Pumps	\$80,000
Air and Sludge Piping	\$374,000
Electrical	\$100,000
<b>Subtotal</b>	<b>\$4,200,000</b>
Construction Contingencies	\$630,000
Engineering and Construction Services	\$483,000
Legal and Financial	\$265,650
<b>Total Construction Cost</b>	<b>\$5,578,650</b>

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WESTERN WAKE REGIONAL WASTEWATER  
MANAGEMENT FACILITIES  
Proposed Layout For Mixing and Aeration System  
for Aerated Holding Tanks