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DATE: July 22, 2005

SUBJECT: Western Wake Regional Wastewater Management Facilities
Western Wake Water Reclamation Facility
PER Technical Memorandum No. 18 – Biosolids Dewatering Facilities

INTRODUCTION

This TM is one in 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 present the preliminary engineering information and data for the biosolids dewatering facilities.

Sludge dewatering is part of the solids processing strategy developed for the Western Wake Water Reclamation Facility (WRF). A summary of the strategy, presented in TM 16 on Figure 16-1, is as follows:

1. Collect settled solids from the secondary clarifiers, at the WAS/RAS pump station.
2. Pump WAS to the Thickening/Dewatering Building,
3. Thicken WAS with gravity belt thickeners (GBTs),
4. After thickening, hold solids under aerobic conditions,
5. Dewater the solids with centrifuges, and
6. Transport dewatered solids to private composting facility, Cary dryer, or landfill.

PROCESS REQUIREMENTS

The basis of design for the dewatering facilities are the maximum monthly flows and loads and the solids mass balance, which were presented in TM 16 on Figure 16-2. The processes discussed in this memorandum are as follows:

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1. Influent biosolids from aerated holding tanks to dewatering centrifuges (Process Step 4)
2. Centrate from the centrifuges (Process Step 5)
3. Centrifuge cake biosolids (Process Step 6).

Operating Strategy

Two centrifuges sized to handle 1,400 pounds per hour (lb/hr) each are recommended in order to process all of the digested biosolids in one 16-hour shift operating seven days a week.

Biosolids Transfer/Centrifuge Feed Pumps

The solids in the aerated holding tanks will be fed to the centrifuges for dewatering. The centrifuge feed pumps are described in TM 17.

Centrifuges

Centrifuges are recommended over belt filter presses for the following reasons.

1. Centrifuges typically have a smaller footprint compared to belt filter presses.
2. Centrifuges have much less water use than belt filter presses.
3. Centrifuges require less operator attention compared with belt filter presses.
4. Centrifuges typically produce a dryer cake than belt filter presses.
5. Centrifuges are totally enclosed, which facilitates odor control.

The disadvantages of centrifuges compared to belt filter presses are primarily that centrifuges consume more energy and require higher doses of polymer. Centrifuges will be used based on the stated benefits above.

The recommended centrifuge sizing is based on an influent biosolids concentration of 3.1 percent solids. Based on the maximum month flow of 18 million gallons per day (mgd), approximately 107,000 gallons per day (gpd) of digested biosolids can be expected. The centrifuge feed pumps, located in the Centrifuge Feed Pump Station, will feed the centrifuges. These pumps should be sized to load each centrifuge at 120 gallons per minute (gpm). Assuming the biosolids are dewatered to produce a 20 percent cake, the centrate volume will be approximately 90,000 gpd. Similarly, the dewatered cake produced would be approximately 26,200 dry pounds per day.

The centrifuges will be housed on the second story of the Thickening/Dewatering Building. The building will be designed with two truck lanes below the centrifuges to collect cake from the centrifuges. As the solids are dewatered, cake will drop out of each centrifuge continually through

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an opening at the bottom of the centrifuge. The openings will be approximately 30-in by 16-in. A slide gate under each centrifuge cake discharge chute will control the cake discharge into the trucks. When the gate is open, cake can drop directly into the bed of the truck. The gate will be closed when the centrifuge is not in operation.

Polymer System

A polymer system dedicated to the centrifuges to aid in the coagulation of solids will be provided. It is recommended that a three-tank system – one liquid bulk tank and two makeup tanks be installed to store, prepare, and deliver polymer to the centrifuges. Totes (260 gallons) of emulsion polymer were considered for this application to be consistent with practices at the North and South Cary Water Reclamation Facilities. However, one tote was estimated to last only two and a half days at the maximum month capacity of 18 mgd assuming a conservative dose of 30 pounds of polymer per dry ton of solids. A bulk tank is recommended to reduce the amount of operator attention the tote polymer system would require.

The bulk tank will be located on the first floor of the building. The two makeup tanks will be located on the second floor near the dewatering area.

Bulk tanks are typically sized to hold 30 days worth of polymer. Based on the maximum month flow, the estimated required size of the bulk tank is 3,000 gallons. Truckload deliveries of polymer are available in volumes 1,500 gallon and greater. The tank would be located near an external wall such that deliveries can be made by having a truck pull up close to the Thickening/Dewatering Building and fill the tank using an external hard-piped connection to the tank. A 5,000-gallon bulk tank is recommended to allow a large factor of safety when scheduling deliveries of polymer and also remain above the 1,500-gallon minimum truckload delivery size.

Two makeup tanks of 2,500 gallons each are set up to cycle back and forth, each preparing one batch of polymer for the GBTs while the other is used as the feed source to the GBTs. A progressive cavity polymer transfer pump will transfer bulk polymer from the bulk tank to the makeup tanks. A rotameter will tie-into the bulk polymer piping to simultaneously mix the polymer with water from the potable water system, dilute the polymer, and fill the makeup tank. The makeup tank will dilute the emulsion polymer to a concentration of approximately 0.5 to 1 percent polymer by volume. After a batch of polymer is prepared in the makeup tank, the effluent from the tank is further diluted with water to the appropriate concentration (typically 0.1 to 0.6 percent polymer by volume). Diluting the polymer to this range of concentrations will allow the polymer to properly unwind and function as designed. The dilution process is a two-step process in order to minimize the tank volume needed for the makeup tanks.

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The recommended makeup tank size, 2,500 gallons, prepares enough polymer for one hour of centrifuge run time at the maximum recommended hydraulic loading rate of 150 gpm per centrifuge. Having two tanks allows for 24-hour operation, as there is no waiting for polymer to batch and/or disruption of the belts. The centrifuges were sized for the average day maximum month flow; however, if the plant were to expand in the future the centrifuges could be run more than 16 hours a day instead of adding another unit.

Three progressive cavity pumps with variable speed output are recommended to feed the polymer to the centrifuges. Each centrifuge will have a dedicated pump and the third pump will be manifolded to the others as a backup unit. The output speeds of the pumps are estimated to be between 9 and 22 gpm. One progressive cavity pump is also needed to transfer polymer from the bulk tank to the makeup tank.

Centrate Handling

Centrate from the centrifuges will be discharged below the centrifuges and flow by gravity into a filtrate/centrate storage tank outside the new Thickening/Dewatering Building. This arrangement was described in detail in TM 16, as GBT filtrate is also conveyed to the same tank.

Ancillary Equipment

There are several additional items that will be housed in the Thickening/Dewatering Building that relate to the centrifuges. These items include but are not limited to the following:

1. Water booster pumps
2. Bridge crane in centrifuge processing area
3. Odor control provisions for centrifuge processing area and centrifuge polymer room

SUMMARY

Table 18-1 provides a summary of all the equipment recommended for solids dewatering.

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**TABLE 18-1
DEWATERING EQUIPMENT LIST**

Sludge Transfer/Centrifuge Feed Pumping

Number	3 (1 standby)
Type	Progressive cavity
Capacity per Unit (gpm)	100-150 (120 design rate)
hp	30

Biosolids Dewatering

Type	Centrifuges
Quantity	2
Design Hydraulic Loading Rate per unit, gpm	120
Feed Sludge Concent. (mg/l)	31,000
Operating Schedule (hr/day)	16
Processing Rate (dry lb/day)	27,600
Dewatered Sludge Conc. (%)	20

Dewatering Polymer System

Type	Liquid emulsion
Quantity of Bulk Tanks	1
Quantity of Mixing Tanks	2
Days of storage in bulk tank	30
Hydraulic residence time, mixing tanks (hr)	1
Volume of bulk tank, gal	5000
Volume of mixing tank, gal	2500
Activity	40%
Specific gravity of polymer	1.3
Dosing range (lb polymer/dT solids)	6 - 30
Polymer concentration Leaving Mixing Tank (v/v, %)	0.76%

Dewatering Polymer Feed Pumps

Type	Progressive cavity
Quantity	3 (1 standby)
Capacity, gpm	0.4 - 2.0
Horsepower	3

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Dewatering Post-Dilution Stand

Dilution rate, gpm	11 to 14
Polymer concentration to centrifuges (v/v, %)	0.48%

PROPOSED FACILITIES

The proposed layout for the Thickening/Dewatering Building was presented in TM 16 on Figure 16-5. The Thickening/Dewatering Building will contain the following key functions:

1. Solids thickening area
2. Centrifuge dewatering area
3. Polymer preparation and storage area
4. Control room
5. Electrical room
6. Blower room
7. Monorail for thickening area
8. Bridge crane for dewatering area

The building will be two-storied with most of the equipment located on the first floor. The second floor will house the centrifuges; centrifuge polymer feed facilities, and a control room. The centrifuge area will be structurally supported with columns but will not have an enclosed first floor below it. Instead, there will be drive-through access for a truck below the centrifuges so cake from the centrifuges can be loaded and hauled away for disposal. Additional details and a cost estimate are discussed in TM 16.

INSTRUMENTATION AND CONTROLS

Controls for the centrifuges and centrifuge feed pumps will be by a programmable logic controller (PLC) in the Thickening/Dewatering Building in the solids dewatering area. A touch screen monitor will be the user interface. The second-story control room will also have the ability to operate the centrifuges and centrifuge feed pumps. In order to transfer control signals from one location to another, the operator will need to enter a password. The default operations center for thickening will be in the solids dewatering area.

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ESTIMATED CAPITAL COSTS

The estimated capital costs for dewatering operations are shown in Table 18-2. These costs include the mechanical and instrumentation costs associated with dewatering. The structural cost of the building is presented in TM 16. These costs are expressed without contingencies, engineering and construction administration, and legal and financial fees and are referred to as the base cost. Therefore, the base cost for the dewatering facilities (less building structure) is \$1,420,000. An itemized list of these expenses is shown in Table 18-2. Operations and maintenance costs are presently being developed.

**Table 18-2
PRELIMINARY COST ESTIMATE**

	\$	-
Building ¹		
Centrifuges	\$	700,000
Centrifuge Feed Pumps	\$	183,000
Bridge crane	\$	81,000
Equipment Installation	\$	245,000
Polymer System	\$	144,518
Instrumentation	\$	67,676
Subtotal	\$	1,421,193
Construction Contingencies	\$	213,179
Engineering and Construction Services	\$	163,437
Legal and Financial	\$	89,890
Total Construction Cost	\$	1,887,700

¹See TM No. 16, \$1,800,000.