TECHNICAL MEMORANDUM

CITY OF PALATKA, FLORIDA
WASTEWATER TREATMENT FACILITY
SLUDGE TREATMENT SYSTEM – ALTERNATIVES COST ANALYSIS

AYRES ASSOCIATES INC

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This Technical Memorandum is provided to document and support respective preliminary opinion of estimated probable costs to facilitate considered future improvement alternatives for the City of Palatka (City) Wastewater Treatment Facilities Sludge Processing/Treatment System(s). Per previous discussion and agreement alternatives considered include: (A) retrofit requirements to maintain the existing Anaerobic Treatment System, (B) conversion to an Aerobic Treatment System, and (C) conversion to a proprietary Chemical Treatment System provided by BCR Environmental (BCR). Retrofit of the existing Sludge Dewatering System is also included. The facilities are located at 3010 Browns Landing Road and are known as the Platt Drew Wastewater Treatment Plant (WWTP).

This Technical Memorandum is preliminary in overall context and intent, and subject to revision and/or update depending upon actual facilities that may be considered for respective improvements that may be undertaken and moved forward to formal planning and engineering phases of implementation.

EXISTING FACILITIES

The existing City WWTP facilities were originally constructed and placed into operation during October 1985. This encompassed a 3.0 MGD Secondary Wastewater Treatment facility that included the following main facilities:

- Screening and Grit Removal
- Primary Clarifier
- Aeration Basins
- Secondary Clarifiers
- Chlorine Contact Chamber
- Gravity Sludge Thickener
- Pump/Maintenance/Main Control Building
- Anaerobic Digesters/Control Building
- Sludge Dewatering/Control Building
- Chlorination Storage/Distribution
- Sludge Drying Beds
- Office/Laboratory Building

Since the original facilities above were constructed and placed into operation, modifications to the facilities have included the following:

- Existing Mechanical Bar Screen/Grit Removal equipment replacement;
- Existing Chlorination/De-chlorination equipment improvement/replacement;
- New Reclaim Water Treatment/Tertiary Filtration and Transfer Pump system and conveyance to the City Golf Course and other end users;
- Re-rating of WWTP facilities to current permitted capacity of 3.5 MGD;
- Existing Primary Clarifier drive mechanism replacement;
- Retrofit/replacement of existing mechanical aeration system to more energy efficient diffused aeration system, including new blower and controls building;
- Reclaim Water Tertiary Filtration system expansion including Filtration and Transfer Pump improvements; and
- New Chlorine Contact Chamber.

The existing Anaerobic Sludge Treatment and Dewatering Systems have been in operation for approximately 29 years without any significant replacement of its key process equipment components. The original planning period for the existing WWTP facilities was 20-years. The photos provided in **Appendix A** illustrate the deteriorated mechanical condition of the Anaerobic Sludge Treatment and Dewatering Systems.

The existing Sludge Processing/Treatment and Dewatering Systems consist of (1) Primary Clarifier sludge removal, (2) Secondary Clarifier sludge removal, (3) Gravity Sludge Thickener sludge thickening, (4) Anaerobic Digester sludge treatment, and (5) Mechanical/Gravity digested sludge dewatering. Specifics of the existing sludge handling system(s) are described following.

Primary Clarifier

Primary clarification is provided to reduce the volume of heavier organics and thus decrease the downstream 5-day carbonaceous biochemical demand ($CBOD_5$) and total suspended solids (TSS) load to the wastewater aeration system. The WWTP includes one (1) Primary Clarifier with a diameter of 60-feet and side water depth of 12-feet. Capability to bypass the Primary Clarifier is provided to accommodate any equipment failure or scheduled maintenance.

Secondary Clarifier

Secondary clarification is provided as a quiescent zone for settling of the mixed liquor suspended solids (MLSS) received from the wastewater aeration system. The settled solids are returned to the aeration system to maintain the balance of solids within the treatment system (RAS). Portions of the RAS solids are periodically wasted (WAS) to the Gravity Sludge Thickener and/or the Anaerobic Digester(s) to maintain a consistent RAS MLSS concentration. The WWTP includes two (2) rectangular clarifier units; each 139-feet in length, 28-feet in width, and side water depth of 12-feet.

Gravity Sludge Thickener

Primary/Secondary sludge concentration is accomplished by conveyance to the Gravity Sludge Thickener, which subsequently reduces the hydraulic volume of sludge that is delivered to the Anaerobic Digester(s). The WWTP includes one (1) Gravity Sludge Thickener with a diameter of 35-feet and side water depth of 12-feet.

Anaerobic Sludge Treatment System

WAS is received by the Anaerobic Digester system from the Primary Clarifier, Secondary Clarifier, or combination thereof. The system is a two (2) stage primary/secondary dual-tank process with floating covers configured with gas holder storage for each. Each digester tank is 50-feet in diameter with a side water depth of 25-feet. In Stage 1 (primary digester) the sludge is stabilized to reduce pathogens, eliminate offensive odors, and inhibit the potential for putrification of the sludge material produced during the treatment process. Sludge from Stage 1 is transferred to Stage 2 (secondary digester) for digested sludge storage and gas collection. The gas collected in the secondary digester is utilized by the gas recirculation system or is wasted by the waste gas handling system. Both digesters are similar in mechanical/gas equipment and piping general arrangement configuration, and thus operation capability to facilitate either/or to perform as the primary or secondary unit is provided. Sludge is withdrawn from the secondary digester and flows by gravity to the sludge holding tank located at the Sludge Dewatering Building.

<u>Sludge Dewatering System</u>

The anaerobically digested sludge is pumped from the Sludge Dewatering Building sludge holding tank to the Belt-filter Press. A polymer feed system is utilized to condition the sludge prior to dewatering. The Belt-filter Press consists of three dewatering zones, which includes a gravity drainage section, a mild pressure wedge, and an increasing pressure zone. The sludge is dewatered to approximately 14-18 percent solids and is discharged onto a belt conveyor for transfer into receiving transport roll-off dumpster containers. The dewatered sludge material is hauled by a 3rd party transporter (Waste Pro) to the Putnam County Landfill for final disposal. The filtrate and wash water for the Belt-filter Press operation is transferred back to the WWTP for processing/treatment. As back-up, gravity Sludge Drying Beds are provided to handle Belt-filter Press down-time or maintenance requirements.

The emphasis of this technical memorandum is to present estimated cost information to consider future sludge treatment/processing alternatives identified herein and described following.

ALTERNATIVE A – ANAEROBIC SLUDGE TREATMENT AND DEWATERING SYSTEM(S)

The anaerobic sludge digestion process involves decomposition of organic and inorganic matter by use of microorganisms in the absence of molecular oxygen. This is the process presently in place for the City WWTP. Major applications of this process are in the stabilization of concentrated sludge product from the treatment of municipal and industrial wastewater. Stabilization is performed to reduce health risks the sludge stream poses by destroying pathogens, reducing odors, and converting the sludge to manageable and disposable product. Anaerobic digestion is able to provide solids volume reduction capability and energy conservation by off-gas production recovery and use. Typical advantages/disadvantages include:

Advantages and Disadvantages of Anaerobic Digestion	
Advantages	**Disadvantages**
Less energy/operational costs	Higher capital costs
Less biological sludge produced	May need supplemental natural gas for heating
Methane gas produced – Recoverable energy resource	Less stable after any “toxic shock” occurrence
Mechanical dewatering results better	Susceptible to odors if process upset occurs
Existing process – City WWTP personnel familiar with	Hazards of gas handling/processing

Alternative A will retrofit the existing Anaerobic Sludge Treatment System and includes replacement with applicable new equipment/process technology, piping, miscellaneous appurtenances, and electrical/controls. Discussion with City WWTP staff indicates current sludge processing/treatment includes the following operations.

1. Primary Clarifier settled solids (primary sludge) are conveyed to the Anaerobic Digester(s) for treatment and volume reduction. Option is available to convey primary sludge to the Gravity Sludge Thickener prior to Anaerobic Digester(s), but is not the case at this time.
2. Secondary Clarifier settled solids (activated sludge) is returned to the Aeration Basin(s) (RAS) for additional treatment and/or is wasted (WAS) to the Gravity Sludge Thickener for solids concentration.
3. Gravity Thickener sludge is conveyed to the Anaerobic Digesters for treatment, volume reduction, and additional solids concentration prior to final dewatering operations.
4. Digested sludge is transferred to the Sludge Dewatering Building (Belt-filter Press) or Sludge Drying Beds for final dewatering/solids concentration.
5. Final dewatered sludge solids are captured and transferred for final disposal at the Putnam County Landfill facilities.

Under **Alternative A** it is assumed the overall WWTP wastewater and sludge processing/treatment system(s) flow patterns will remain the same as presently practiced.

Based upon this review, the following primary components related to the existing systems are in need of replacement in order to provide continued reliable and satisfactory sludge treatment and dewatering system(s) performance.

Anaerobic Digester System

The following are the primary components to be replaced/upgraded for the existing Anaerobic Digester System:

1. Replace/provide Anaerobic Digester Heat Exchanger, Covers, Recirculation/Mixer and Transfer/Pumping Systems, Gas and Process Piping, Mechanical and Control Valves, and Miscellaneous Process Appurtenances.
2. Replace/provide the existing Sludge Return Pumps (RAS/WAS) and controls due to age and condition.
3. Replace/provide integrated Electrical and Control System(s) for the above process/equipment components.

This technical memorandum does not include specific planning/design efforts; however, technological and process design advances since the original systems were placed in operation indicate alternative options are available. For the Anaerobic Sludge Treatment System these include, but are not limited, to the following:

- Fixed versus floating digester covers to include steel or concrete materials of construction;
- Membrane gas holder systems to include independent slab or existing tank mounted;
- Alternative mixing systems to include gas mixing, linear motion, mechanical, and draft tube;
- Alternative heat exchanger/boiler systems; and
- Integrated control system for the above equipment components.

Sludge Dewatering System

For the Sludge Dewatering System the following methods are readily available, with typical advantages/disadvantages indicated:

Comparison of Alternative Sludge Dewatering Methods		
Dewatering Methods	**Advantages**	**Disadvantages**
Centrifuge	Clean appearance, good odor containment, fast startup and shutdown capabilities Produces relatively dry sludge cake Low capital cost-to-capacity ratio High installed capacity to building area ratio	Internals components wear is potentially a high maintenance problem Requires grit removal and possibly sludge grinder in feed stream Skilled maintenance personnel required Moderately high suspended solids content in centrate Higher additive chemical conditioning requirements
Belt-filter Press	Low energy requirements Relatively low capital and operating costs, including additive chemical conditioning requirements Less complex mechanically and is easier to maintain High-pressure machines are capable of producing high dry sludge cake Minimal effort required for system shutdown Existing process – City WWTP personnel familiar with	High odor potential May require sludge grinder in feed system Sensitive to incoming sludge feed characteristics Automatic operation generally not advised

Comparison of Alternative Sludge Dewatering Methods (Cont.)		
Dewatering Methods	**Dewatering Methods**	**Dewatering Methods**
Recessed-plate Filter Press	Highest cake solids concentration Low suspended solids in filtrate	Batch operation required High equipment costs High labor costs Special support structure requirements Large floor area required for equipment Skilled maintenance personnel required Additional solids due to large chemical addition require disposal
Sludge Drying Beds	Lowest capital cost method where land is readily available Small amount of operator attention and skill required Low energy consumption Low to no chemical consumption Less sensitive to sludge variability Higher solids content than mechanical methods	Requires large area of land Requires stabilized sludge Design requires consideration of climatic effects Sludge removal is labor intensive
Sludge Lagoons	Low energy consumption No chemical consumption Low capital cost where land is available Least amount of skill required for operation	Potential for odor and vector problems Potential for groundwater pollution More land-intensive than mechanical methods Appearance may be unsightly Design requires consideration of climatic effects

In consideration of the above and consultation with City WWTP staff, the City is satisfied with its current mechanical Sludge Dewatering System (Belt-filter Press). This is based on previous demonstrated performance and longevity of the Belt-filter Press over the past 29 years of operation. As such, consideration of alternative methods is not presented herein. Due to noted deterioration and typical service life being exceeded, it is recommended the existing system be replaced/upgraded in-kind with similar equipment components to include:

1. Belt-filter Press;
2. Polymer Storage/Feed System;
3. Dewatered Sludge Transfer Conveyor System; and
4. Integrated Electrical and Control System(s) for the above process/equipment components.

The above recommended Sludge Dewatering System equipment components will be typical for the respective Sludge Treatment System alternatives presented herein.

Anaerobic Digester System – Estimated Costs

Budget pricing quotes for the referenced equipment components were solicited and received from multiple process equipment vendors in developing the preliminary opinion of estimated probable costs presented herein. Construction/installation pricing was developed in consultation with an experienced wastewater treatment construction contractor. Annual O&M cost estimates were derived by evaluating the estimated electrical power requirements per proposed equipment horsepower rating, the City’s current Utility Fund (Operating Expenses) budget data, and discussion with WWTP operations staff.

Based on the foregoing, the following preliminary opinion of capital and O&M estimated probable costs are presented for the Anaerobic Digester System. The higher overall comparative total capital cost estimate is used as detailed in **Appendix B**.

Anaerobic Digester System – Capital Costs:	$2,857,500
Anaerobic Digester System – Annual O&M Costs:	$78,500

To provide an economic analysis of the considered alternatives a simple present worth (PW) calculation is provided. The preliminary estimated PW for the above capital and annual O&M costs is presented using the following assumptions:

Planning Period (n):	20-years
Planning Period Interest Rate (i):	5%
Equipment/System Salvage Value (s):	$0
Interim Component Major Replacement:	None

The PW is calculated based on the following capital and annual O&M costs relationship:

PW = Capital Cost + [(Annual O&M Cost) x (*P/A, i%, n*)]

(*P/A, i%, n*) is the factor applied for a uniform series event whereby the annual O&M costs are assumed to be constant over a specific a period (*n*) at an interest rate (*i*), which then determines a PW value for that period.

For this PW calculation the (*P/A, i%, n*) factor $= \frac{(1+i)^n - 1}{i(1+i)^n} = \frac{(1 + 0.05)^{20} - 1}{.05(1 + .05)^{20}} = 12.46$

In comparing the considered alternatives presented herein, this calculation will be provided for each alternative. The lowest alternative PW cost is the resultant economically preferred alternative.

For **Alternative A**, the preliminary estimated PW value for the Anaerobic Digester System is: $3,835,610.

<u>Sludge Dewatering System – Estimated Costs</u>

Budget pricing quotes for the referenced equipment components were solicited and received from multiple process equipment vendors in developing the preliminary opinion of estimated probable costs presented herein. Construction/installation pricing was developed in consultation with an experienced wastewater treatment construction contractor. Annual O&M cost estimates were derived by evaluating the estimated electrical power requirements per proposed equipment horsepower rating, the City's current Utility Fund (Operating Expenses) budget data, and discussion with WWTP operations staff.

Based on the foregoing, the following preliminary opinion of estimated probable costs are presented for the Sludge Dewatering System. Note, the higher overall comparative total capital cost estimate is used as detailed in **Appendix B**.

Sludge Dewatering System – Capital Costs:	$727,500
Sludge Dewatering System – Annual O&M Costs:	$74,500

For the considered alternatives presented herein, the preliminary estimated PW for the Sludge Dewatering System is: $1,655,770. The calculation method is the same as shown previously for the Anaerobic Sludge Treatment System.

<u>Anaerobic Sludge Treatment and Dewatering System(s) Costs</u>

For **Alternative A**, the overall sludge processing/treatment and dewatering preliminary opinion of estimated probable costs and present worth value is summarized as follows:

Alternative A Anaerobic Sludge Treatment and Dewatering System(s) Estimated Costs Summary			
System Description	**Capital Costs**	**Annual O&M Costs**	**Present Worth**
Anaerobic Sludge Treatment System	$2,857,500	$78,500	$3,835,610
Sludge Dewatering System	$727,500	$74,500	$1,655,770
Anaerobic Sludge Treatment and Dewatering – Total	**$3,585,000**	**$153,000**	**$5,491,380**

ALTERNATIVE B – AEROBIC SLUDGE TREATMENT AND DEWATERING SYSTEM(S)

Alternative B will replace and convert the existing anaerobic sludge treatment process technology to aerobic sludge treatment process technology. This conversion was previously considered by the City in 2009 but did not proceed to any formal budgetary determination or actions to implement.

Aerobic digestion is typically used to treat (1) waste activated sludge, (2) mixtures of waste activated sludge or trickling filter sludge and primary sludge, or (3) waste sludge from extended aeration process. Aerobic digestion is used cost-effectively for WWTP facilities less than 5 MGD design capacity. Aerobic digestion uses oxygen/mixing methodology for pathogen destruction and stabilization. Typical advantages/disadvantages include:

Advantages and Disadvantages of Aerobic Digestion	
Advantages	**Disadvantages**
Less capital costs	Higher energy/operation costs
Easy to control process, easy start-up	No recoverable energy potential
Better quality return effluent - Low ammonia and $CBOD_5$	Not typically used for primary sludge due to high O_2 demand
Less odor potential	Temperature variability impacts operating performance
Standard process used throughout Florida	Stabilized sludge may be more difficult to dewater

This alternative will require dismantling and removal of the current anaerobic system equipment components and replacement with new aerobic system equipment. It is assumed capability to perform same within the existing anaerobic tank(s) system is available. Alternative aerobic treatment system options considered include the following:

- Surface Bridge and Float Mount Mechanical Mixer/Aeration system(s), and
- Mechanical Blower and Coarse Bubble Diffused Air system.

Under this **Alternative B** it is assumed the overall WWTP wastewater and sludge processing/treatment systems flow pattern will remain the same as for **Alternative A**, which will include utilizing the Primary Clarifier unit for solids and $CBOD_5$ capture/reduction prior to conveyance of the wastewater stream to the aeration process. However, flexibility to optimize/modify the wastewater aeration and aerobic sludge treatment system performance is available via by-pass of the Primary Clarifier unit by diverting flow from the influent Mechanical Bar Screen/Grit Removal unit directly into the Aeration Basin units. This can be accomplished through the existing Primary Clarifier by-pass channel and system of slide gates. This flow pattern is typical for wastewater treatment facilities that utilize aerobic sludge treatment and do not have a primary clarification unit. It is noted that should by-pass of the Primary Clarifier unit be implemented this will likely result in higher energy costs for additional aeration/mixing requirements due to increase of solids/$CBOD_5$ loading to the Aeration Basins.

In addition to the specific aerobic system process components, other facilities/improvements will be required to provide utilization of the existing 2-digster tanks for sludge process/treatment and conveyance to the existing Sludge Dewatering Building. These include, but are not limited to:

1. New Blower Building;
2. Transfer/Pumping Equipment;
3. Replacement of existing Sludge Return Pumps (RAS/WAS) and Controls;

4. Process Piping Modifications; and
5. Related Miscellaneous Equipment, and Controls.

Similar to **Alternative A**, it is assumed specific requirements related to the above will need to be determined during the subsequent planning/design phase.

Aerobic Digester System – Estimated Costs

Budget pricing quotes for the above referenced equipment components were solicited and received from multiple process equipment vendors in developing the preliminary opinion of estimated probable costs presented herein. Construction/installation pricing was developed in consultation with an experienced wastewater treatment construction contractor. Annual O&M cost estimates were derived by evaluating the estimated electrical power requirements per proposed equipment horsepower rating, the City's current Utility Fund (Operating Expenses) budget data, and discussion with WWTP operations staff.

Based on the foregoing, the following preliminary opinion of capital and O&M estimated probable costs are presented for the Aerobic Digester Sludge Treatment System. The higher overall comparative total capital cost estimate is used as detailed in **Appendix B**.

Aerobic Digester System – Capital Costs: $2,280,000
Aerobic Digester System – Annual O&M Costs: $138,500

For **Alternative B**, the preliminary PW value for the Aerobic Digester System is: $4,005,710. The calculation method is the same as shown previously for **Alternative A**.

Sludge Dewatering System – Estimated Costs

The Sludge Dewatering System estimated capital, operation and maintenance, and present worth value costs for **Alternative B** are as detailed and presented for **Alternative A**, summarized as follows:

Sludge Dewatering System – Capital Costs: $727,500
Sludge Dewatering System – Annual O&M Costs: $74,500
Sludge Dewatering System – Present Worth: $1,655,770

Aerobic Sludge Treatment and Dewatering System(s) Costs

For **Alternative B**, the overall sludge processing/treatment and dewatering preliminary opinion of estimated probable costs and present worth value is summarized as follows:

Alternative B Aerobic Sludge Treatment and Dewatering System(s) Estimated Costs Summary			
System Description	**Capital Costs**	**Annual O&M Costs**	**Present Worth**
Aerobic Sludge Treatment System	$2,280,000	$138,500	$4,005,710
Sludge Dewatering System	$727,500	$74,500	$1,655,770
Aerobic Sludge Treatment and Dewatering – Total	**$3,007,500**	**$213,000**	**$5,661,480**

ALTERNATIVE C – PROPRIETARY CHEMICAL SLUDGE TREATMENT SYSTEM

Alternative C will replace the existing anaerobic sludge treatment process methodology with proprietary chemical sludge treatment technology. BCR Environmental (BCR) previously approached the City proposing its system to replace the current sludge processing/treatment system and is being considered in this evaluation of alternatives. The BCR sludge treatment systems are known as CleanB™, CleanB-AC™, and Neutralizer®. The BCR CleanB™ System is reported to produce Class B quality end-product biosolids. The other two BCR systems produce Class A/EQ quality end-product biosolids. Only the BCR CleanB™ System is evaluated in this technical memorandum. Typical advantages/disadvantages include:

Advantages and Disadvantages of BCR CleanB™ System	
Advantages	**Disadvantages**
Less capital costs	Proprietary / sole source process
Small footprint/space requirement	May reduce WWTP operation/performance flexibility by eliminating existing treatment unit processes
Less mechanical process components	Increased loading conditions to aeration system
Faster stabilization process	No recoverable energy
Potentially less overall operation costs	On-site chemical storage/handling
Eliminates need for typical sludge digestion process	No biological solids volume reduction
Less odor potential	Lower sludge feed concentration to dewatering – Concern for achieved final % solids results
	Not familiar to City WWTP personnel

The BCR CleanB™ Sludge System is reported to treat municipal wastewater sludge that achieves compliance with Class B regulatory requirements for beneficial reuse in accordance with 40 CFR Part 503. The CleanB™ System facilitates sludge treatment by use of two chemicals: sulfuric acid (50%) and sodium Chlorite (15%), which are combined in BCR's patented generating system to produce chlorine dioxide on-site. The chlorine dioxide is injected into the sludge stream for disinfection and deodorization. For comparison purposes the end product results of the CleanB™ process (Class B stabilized sludge material) is at least equivalent to that produced by the previous described anaerobic and aerobic systems methodologies.

The BCR CleanB-AC™ System includes a supplemental second stage to enhance the results of its CleanB™ System by use of an accelerated aerated static pile composting method, producing a stabilized Class A/EQ product. The process provides a recycle composted material product with potential marketable value to various end-users; and eliminates need for hauling to and disposal at the Putnam County Landfill, as presently practiced. Conversely, the end-product would require alternative reuse disposal options to be determined and implemented.

The BCR Neutralizer® System is a two-stage chemical treatment system. Untreated sludge material (WAS) is conveyed through the Neutralizer® System where they are treated with a chemical injection system for treatment/stabilization. The processing time is approximately 8-hrs and the final product yields a treated, odor free stabilized Class A/EQ product suitable for use as a commercial fertilizer material; and similar to the BCR CleanB-AC™ System eliminates need for hauling to and disposal at the Putnam County Landfill, as presently practiced. Conversely, the end-product would require alternative reuse disposal options to be determined and implemented.

As indicated, only the BCR CleanB^{TM} System is included for alternatives comparison under this technical memorandum. Discussions with BCR indicate their other proprietary systems may not be cost-effective for the City at this time. This is based upon present wastewater flow conditions and additional capital and operation/maintenance costs that would be incurred.

In accordance with specified sludge delivery conditions required by BCR to receive/process the City's WWTP waste sludge material for treatment through its CleanB^{TM} System, the following are noted considerations to accommodate same. There is opportunity to modify these considerations during the planning/design phase, which in turn may effect a reduction in the overall estimated costs presented herein to implement this alternative.

1. BCR indicates preference to receive WAS only to its CleanB^{TM} System to achieve optimal performance. This requires the Primary Clarifier unit be by-passed from the Mechanical Bar Screen/Grit Removal unit to the Aeration Basin units, and thus no longer be used for its intended purpose of solids/$CBOD_5$ capture and reduction. Understanding is the BCR CleanB^{TM} System basis of preferred design conditions is to accept WAS material; not primary sludge containing higher solids/$CBOD_5$ concentrations as well as incidental inert sand and/or grit material that can interfere with the BCR chemical treatment process. Typically, primary clarification will remove approximately 50-75% suspended solids and 25-40% $CBOD_5$. Thus, it is anticipated by-passing the Primary Clarifier will increase solids and $CBOD_5$ loading to the Aeration Basin and Secondary Clarifier units, resulting in increased energy costs to provide adequate mixing and dissolved oxygen demand requirements.
2. WAS from the Secondary Clarifier units is currently conveyed to the Gravity Sludge Thickener unit by the existing Sludge Return Pumps (RAS/WAS) located in the Pump, Maintenance and Main Control Building. Thickened WAS is then sent to the Anaerobic Digester System where it is mixed with Primary Clarifier sludge for volatile suspended solids (VSS) volume reduction and stabilization. Information from City WWTP staff indicates solids concentration of 2-3% is being achieved through the existing Anaerobic Digester System prior to dewatering by the existing Belt-filter Press unit; and is without certain equipment components operating as initially designed and constructed due to wear and deterioration. In considering the previous presented sludge treatment system alternatives, an efficiently operated anaerobic sludge treatment system can result in 3-5% solids and aerobic sludge treatment system can achieve 1-2% solids.
3. For the BCR chemical treatment technology WAS influent solids concentration not to exceed 2% will be required for the CleanB^{TM} System. WAS sludge typically ranges from 0.5% to 1% solids. WAS to the Gravity Sludge Thickener, as currently practiced, will be by-passed and not required as recommended by BCR for the CleanB^{TM} system.
4. As previously described, the existing processing/treatment of stabilized sludge solids via anaerobic digestion is conveyed to the Sludge Holding Tank at the Sludge Dewatering Building, and then transferred to the Belt-filter Press unit for final solids dewatering. If the current system is replaced under this alternative whereby WAS is processed directly to the BCR CleanB^{TM} System, the existing Belt-filter Press Feed Pumps will not be required. As such, the existing WAS pumping/piping components will require modification for conveyance directly to the BCR CleanB^{TM} System, and should include, but not be limited to, the following considerations:
   A. The sludge feed source to the BCR CleanB^{TM} System is important as related to impacts upon existing WWTP process and pumping/piping/control systems. For the City WWTP facility and discussion with BCR, it is assumed the CleanB^{TM} System will receive influent waste sludge from the existing Sludge Return Pumps (WAS), as previously described. Replacement of these units with new pumps/controls is recommended due to their age and mechanical

condition. A new piping system will be required to connect these pumps to the BCR CleanB™ System. It is recommended this be further evaluated during the planning/design phase to assure process flow requirements will be achieved for the BCR CleanB™ System influent feed (flow volume and pressure) and simultaneously maintain flexible WAS/RAS transfer and continuous operation conditions for existing other WWTP processes/units.

B. The proposed BCR CleanB™ System for the City is indicated to provide capacity to accept WAS up to 270 GPM at <2% solids. The existing Sludge Return Pumps are horizontal centrifugal variable speed units rated at 1,700 GPM and, according to WWTP staff, currently run continuously in the 600-700 GPM range. This will exceed the maximum influent flow capacity of the BCR CleanB™ System. Therefore, for direct feed of WAS to the BCR CleanB™ System a new pumping/piping configuration will be required, and may include consideration of alternative flow control methods, separate pumps, or combination thereof.

C. Option may include consideration of continued conveyance of the WAS to the Gravity Sludge Thickener, transfer to the Sludge Holding Tank at the Sludge Dewatering Building, and then feed to the BCR CleanB™ System for solids stabilization and the Belt-filter Press unit for final solids dewatering. The existing Belt-filter Press Feed Pumps have been replaced during the past few years and are horizontal progressive cavity variable speed units rated at 100 GPM. For this option to be implemented, additional determinations needed will include, but not limited to, the following:

   I. Sludge Thickener Pumps currently discharge to the Anaerobic Digesters. Digested Sludge Transfer Pump currently discharges from the Anaerobic Digesters to the Dewatering Building Sludge Holding Tank. Thus, new piping system from Sludge Thickener Pumps to Dewatering Building Sludge Holding Tank and determination of adequate flow/pressure available will be required.
   II. Confirm existing Belt-filter Press Feed Pumps are of adequate flow rate and pressure or need replacement to feed through BCR CleanB™ System and Belt-filter Press unit.
   III. Confirm if mixing/aeration is needed at Dewatering Building Sludge Holding Tank and/or if WAS blending is required to maintain BCR requirement of not to exceed 2% feed solids to CleanB™ System.

   This option will need to be further assessed during the planning/design phase to determine overall viability with respect to CleanB™ System performance, overall WWTP operations, and cost savings that may be effected.

D. To expand on 4.C above, option is available to consider utilizing the Gravity Sludge Thickener and/or the Anaerobic Digester tanks for permanent/temporary WAS holding purposes prior to conveyance to the BCR CleanB™ System to facilitate desired sludge feed rate and quality, processing/treatment interruptions, and/or incurred maintenance requirements. Flexibility to simultaneously maintain continuous RAS loading conditions to the wastewater aeration system operation must be maintained per current practice to provide treatment optimization and flexibility. Mixing/aeration may be required in these holding tanks to prevent sludge quality degradation conditions that may occur over extended periods of time of not being able to process/treat the WAS for any reason. Blending of new WAS flow may be required to maintain the <2% solids feed to the BCR CleanB™ System. This option will need to be further assessed during the planning/design phase to determine overall viability with respect to CleanB™ System performance, WWTP operations, and cost savings that may be effected.

E. In discussion with BCR, option of blending primary sludge and WAS prior to feed to the CleanB™ System may be acceptable up to a 50/50 ratio. This option will need to be further assessed during the planning/design phase to determine overall viability with respect to CleanB™ System performance, WWTP operations, and cost savings that may be effected.

5. The WAS material will pass through the BCR CleanB™ System for treatment/stabilization. The resultant stabilized sludge material from the BCR CleanB™ System will be conditioned with polymer and conveyed to the Belt-filter Press unit for final dewatering.
6. By previous discussion herein, the reduced solids feed concentration to the Belt-filter Press unit from the BCR CleanB™ System in processing WAS only may result in lower % solids achieved as compared to the other sludge treatment alternatives. Further, this may affect polymer type and usage rate for conditioning prior to the Belt-filter Press unit application and/or higher dewatered product disposal hauling costs. To the contrary, BCR predicts higher dewatering efficiency will be realized with the resultant BCR CleanB™ System processed/treated sludge product and polymer dosage may actually be reduced. There is option to consider sludge thickening prior to Belt-filter Press unit feed for final dewatering to improve its efficiency. This has not been considered from an additional cost standpoint as BCR has not recommended same as needed to supplement their system, but it remains an option. Conversely, BCR has indicated there will be significantly lower operation and maintenance costs incurred by the CleanB™ System as compared to the other alternatives. This may in turn off-set the additional process/cost concerns of lower % solids feed to the belt-filter press unit from the BCR CleanB™ System. This option will need to be further assessed during the planning/design phase to determine overall viability with respect to CleanB™ System performance, WWTP operations, and cost savings that may be effected.
7. Due to the age and deteriorated condition of the existing Anaerobic Sludge Treatment System, dismantling and removal of the primary/secondary tank mechanical/electrical/control components is recommended to be included under this alternative, as was for the other alternatives. This would include removal/demolition of the tank covers and internals, removal of all solids material, performing tank structure cleaning/repair, and securing of the tank structures in order to maintain for future other use.
8. If the Primary Clarifier and Gravity Sludge Thickener Units are by-passed and not required for the BCR CleanB™ System, consideration to remove all biological materials, clean, and perform required maintenance repair for future other use is recommended.

In summary, per that described above, to provide modification of the existing sludge processing/treatment system to accommodate the BCR proposed CleanB™ System, the following is assumed as required and is reflected by the estimated costs presented herein, unless otherwise noted:

1. Furnish and install of BCR process equipment and associated support systems to include CleanB™ System components, piping, chemical tanks, enclosures, and controls.
2. Furnish and install support building and site work requirements.
3. Furnish and install connection to WAS, to include new/modified piping, pumps, and controls.
4. Furnish and install connection to existing support systems to include WAS access, reclaim/reuse water, potable water, electrical, and communications.
5. Demolition, cleaning, rehabilitation, and abandonment of existing sludge processing/treatment units and tanks.
6. Other possible options include blending of primary sludge/WAS and/or utilize the existing Gravity Sludge Thickener and Anaerobic Digester tanks to facilitate desired feed configuration, sludge quality, and/or flow rate conditions. As stated, these options are not included in the costs presented herein as further evaluation to consider same will be required in consultation with BCR during the planning/design phase.

BCR CleanB^{TM} System – Estimated Costs

Budget pricing quotes for the above referenced equipment components were solicited and received from BCR and other support/equipment vendors in developing the preliminary opinion of estimated probable costs presented herein. Construction/installation pricing was developed in consultation with an experienced wastewater treatment construction contractor. Annual O&M cost estimates were derived by evaluating the estimated electrical power requirements per proposed equipment horsepower rating, the City's current Utility Fund (Operating Expenses) budget data, and discussion with WWTP operations staff.

Based on the foregoing, the following preliminary opinion of capital and O&M estimated probable costs is presented for the BCR proposed CleanB^{TM} System, including anticipated other required WWTP modifications as presented herein:

BCR CleanB^{TM} System – Capital Costs:	$2,430,000
BCR CleanB^{TM} System – Annual O&M Costs:	$89,500

For **Alternative C**, the preliminary estimated PW value for the BCR CleanB^{TM} System is: $3,545,170. The calculation method is the same as shown previously for **Alternative A**.

Sludge Dewatering System – Estimated Costs

The Sludge Dewatering System estimated capital, operation and maintenance, and net present value costs for **Alternative C** are as detailed and presented for **Alternative A**, summarized as follows:

Sludge Dewatering System – Capital Costs:	$727,500
Sludge Dewatering System – Annual O&M Costs:	$74,500
Sludge Dewatering System – Present Worth:	$1,655,770

BCR CleanB^{TM} Sludge Treatment and Dewatering System(s) Costs

For **Alternative C**, the overall sludge treatment and dewatering preliminary opinion of estimated probable costs and present worth value is summarized following:

Alternative C BCR CleanB^{TM} Sludge Treatment and Dewatering System(s) Estimated Costs Summary			
System Description	**Capital Costs**	**Annual O&M Costs**	**Present Worth**
BCR CleanB^{TM} Sludge Treatment System	$2,430,000	$89,500	$3,545,170
Sludge Dewatering System	$727,500	$74,500	$1,655,770
BCR CleanB^{TM} System Treatment and Dewatering – Total	**$3,157,500**	**$164,000**	**$5,200,940**

SUMMARY OF SLUDGE TREATMENT AND DEWATERING SYSTEMS PRELIMINARY ESTIMATED OPINION OF PROBABLE COSTS

Following is the overall comparative summary of Sludge Treatment and Dewatering Systems Preliminary Estimated Opinion of Probable Costs and rank by Present Worth Value for the considered alternatives presented herein:

Sludge Treatment System(s) Preliminary Estimated Opinion of Probable Costs Summary				
Alternative	**Capital Costs**	**Annual O&M Costs**	**Present Worth**	**Rank**
Alternative A Anaerobic System	$2,857,500	$78,500	$3,835,610	**2**
Alternative B Aerobic System	$2,280,000	$138,500	$4,005,710	**3**
Alternative C BCR CleanB^{TM} System	$2,430,000	$89,500	$3,545,170	**1**

Sludge Treatment and Dewatering System(s) Preliminary Estimated Opinion of Probable Costs Summary				
Alternative	**Capital Costs**	**Annual O&M Costs**	**Present Worth**	**Rank**
Alternative A Anaerobic System and Dewatering	$3,585,000	$153,000	$5,491,380	**2**
Alternative B Aerobic System and Dewatering	$3,007,500	$213,000	$5,661,480	**3**
Alternative C BCR CleanB^{TM} System and Dewatering	$3,157,500	$164,000	$5,200,940	**1**

CAPITAL COSTS FUNDING OPTIONS

At this time funding options appear to be limited to the State Revolving Fund (SRF) alternative, which encompasses a low interest loan situation. There may be opportunity to pursue grant funds through other agencies. Overall, the following appear to be the most applicable but will need additional research and evaluation to determine respective opportunities available to the City to pursue.

- Clean Water State Revolving Fund Loan Program (CWSRF) – Loans
- Drinking Water State Revolving Fund Loan Program (DWSRF) – Grants and Loans
- Small Community Wastewater Facilities Grants Program – Grants
- Community Budget Issue Requests (CBIR) – Legislative Grants

Others may include:

- St. Johns Water Management District (SJRWMD) Cost Sharing
- USDA Rural Development
- Florida State Legislature Special Appropriation Request
- Small Community Grants

Another source of funding may include the City assessing its ability to increase the current user rate structure to generate matching funds to pursue grants and/or low interest loan alternatives.

APPENDIX A

EXISTING SLUDGE PROCESSING / TREATMENT SYSTEM(S) PHOTOS

SLUDGE DIGESTERS / CONTROL BLDG

DIGESTER COVER / PIPING

DIGESTER TANK (EAST) EXTERIOR

DIGESTER COVER / COMPRESSOR HOUSE

DIGESTER TANK (WEST) EXTERIOR

DIGESTER COMPRESSOR HOUSE (INTERIOR)

DIGESTER SLUDGE HEATER UNIT

DEWATERING BLDG SOUTH

DIGESTER SLUDGE RECIRCULATION PUMP

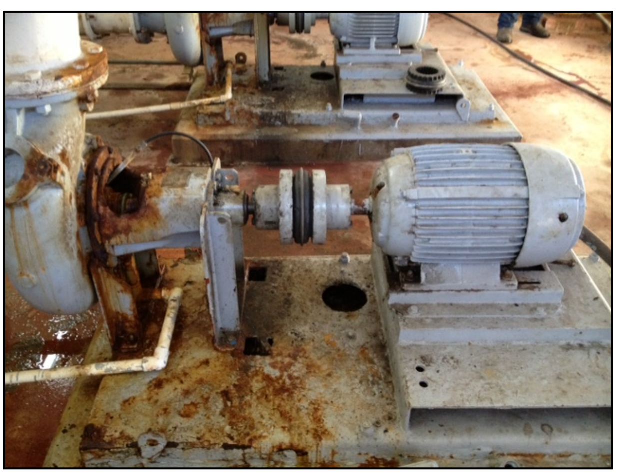
BELT-FILTER PRESS FEED PUMPS

DEWATERING BLDG NORTH

SLUDGE DEWATERING POLYMER FEED SYSTEM

BELT-FILTER PRESS

BELT-FILTER PRESS DEWATERED SLUDGE DISCHARGE TO CONVEYOR



SLUDGE RETURN PUMPS

APPENDIX B

PRELIMINARY OPINION OF PROBABLE COST ESTIMATES

CAPITAL COSTS
OPERATION & MAINTENANCE COSTS

City of Palatka, Florida

Wastewater Treatment Facility

Sludge Treatment Sysytem - Alternatives Cost Analysis

Preliminary Opinion of Estimated Probable Costs - Capital Costs

Alternative A - Anaerobic Treatment System / Alternative B - Aerobic Treatment System

September 19, 2014

TABLE 1

Alternative A - Anaerobic Digester Sludge Treatment System

Item No.	Item Description	Walker Process Equipment	OVIVO
1	Furnish Anaerobic Digester Process Equipment/Controls	$ 500,000	$ 600,000
2	Install Anaerobic Digester Process Equipment & Existing Cover - Removal/Demolition	$ 250,000	$ 250,000
3	Furnish & Install Replacement Sludge Return Pumps (RAS/WAS)	$ 80,000	$ 80,000
4	Existing Sludge/Solids Removal / Clean & Inspect Digester Tank Structures	$ 150,000	$ 150,000
5	Digester Tank Structures Rehab	$ 50,000	$ 50,000
6	Furnish & Install Misc Appurtenances - Removal/Replacement	$ 100,000	$ 100,000
7	Furnish & Install Process/Gas Piping - Removal/Replacement	$ 375,000	$ 375,000
8	Furnish & Install Electrical/Instrumentation - Removal/Replacement	$ 300,000	$ 300,000
9	**Subtotal - Furnish & Install Anaerobic Digester System**	$ 1,805,000	$ 1,905,000
10	Furnish & Install - Contingency (25%)	$ 451,250	$ 476,250
11	**Subtotal - Furnish & Install Anaerobic Digester System + Contingency**	$ 2,256,250	$ 2,381,250
12	Engineering/Construction Administration (20%)	$ 451,250	$ 476,250
13	**Total - Anaerobic Digester System - Capital Costs**	**$ 2,707,500**	**$ 2,857,500**

TABLE 2

Alternative B - Aerobic Digester Sludge Treatment System

Item No.	Item Description	Aeration Industries	Universal Blower / Alfa Laval
1	Furnish Aerobic Digester Process Equipment/Controls	$ 300,000	$ 395,000
2	Aeration System Blower Building	N/A	$ 85,000
3	Install Aerobic Digester Process System/Equipment & Existing Cover Removal/Demolition	$ 200,000	$ 200,000
4	Furnish & Install Replacement Sludge Return Pumps (RAS/WAS)	$ 80,000	$ 80,000
5	Existing Sludge/Solids Removal / Clean & Inspect Digester Tank Structures	$ 150,000	$ 150,000
6	Digester Tank Structures Rehab & Floor Mods for Diffuser System	$ 50,000	$ 60,000
7	Furnish & Install Misc Appurtenances Removal/Replacement	$ 75,000	$ 75,000
8	Furnish & Install New Process Piping & Remove Existing Process/Gas Piping	$ 225,000	$ 225,000
9	Furnish & Install Electrical/Instrumentation - Removal/Replacement	$ 250,000	$ 250,000
10	**Subtotal - Furnish & Install Aerobic Digester System**	$ 1,330,000	$ 1,520,000
11	Furnish & Install - Contingency (25%)	$ 332,500	$ 380,000
12	**Subtotal - Furnish & Install Aerobic Digester System + Contingency**	$ 1,662,500	$ 1,900,000
13	Engineering/Construction Administration (20%)	$ 332,500	$ 380,000
14	**Total - Aerobic Digester System - Capital Costs**	**$ 1,995,000**	**$ 2,280,000**

City of Palatka, Florida
Wastewater Treatment Facility
Sludge Treatment Sysytem - Alternatives Cost Analysis
Preliminary Opinion of Estimated Probable Costs - Capital Costs
Alternative C - BCR CleanB Chemical Sludge Treatment System
September 19, 2014

TABLE 3 Alternative C - BCR CleanB Chemical Sludge Treatment System			
Item No.	**Item Description**	**BCR System Only**	**BCR System + Exist Rehab**
1	Furnish & Install CleanB System including Chemical Tanks, Electrical, & Controls	$ 764,000	$ 764,000
2	Furnish & Install CleanB System Support Systems / Pole Barn	$ 116,000	$ 116,000
3	Furnish & Install Replacement Sludge Return Pumps (RAS/WAS)	$ 80,000	$ 80,000
4	Existing Anaerobic Digester Cover - Removal/Demolition	NA	$ 150,000
5	Existing Anaerobic Equipment/Piping System - Removal/Demolition	NA	$ 60,000
6	Existing Sludge/Solids Removal / Clean & Inspect Digester Tank Structures	NA	$ 150,000
7	Digester Tank Structures Rehab for Future Use	NA	$ 50,000
8	Furnish & Install Misc Site Work / Existing Equipment Upgrade/Mods	$ 100,000	$ 100,000
9	Furnish & Install Misc System Support Appurtenances (Utilities/Electrical/Control/Communications)	$ 150,000	$ 150,000
10	**Subtotal - Furnish & Install BCR CleanB Chemical Sludge Treatment System**	$ 1,210,000	$ 1,620,000
11	Furnish & Install - Contingency (25%)	$ 302,500	$ 405,000
12	**Subtotal - Furnish & Install BCR CleanB Chemical Sludge Treatment System + Contingency**	$ 1,512,500	$ 2,025,000
13	Engineering/Construction Administration (20%)	$ 302,500	$ 405,000
14	**Total - BCR CleanB Chemical System - Capital Costs**	**$ 1,815,000**	**$ 2,430,000**

City of Palatka, Florida

Wastewater Treatment Facility

Sludge Treatment Sysytem - Alternatives Cost Analysis

Preliminary Opinion of Estimated Probable Costs - Capital Costs

Alternative(s) A / B / C - Sludge Dewatering System

September 19, 2014

TABLE 4 Alternative(s) A / B / C - Sludge Dewatering System			
Item No.	**Item Description**	**Ashbrook Simon-Hartley**	**PHOENIX Process Equipment**
1	Furnish Sludge Belt Filter Press - Replacement/Controls	$ 280,000	$ 360,000
2	Furnish Dewatered Sludge Conveyor System - Replacement/Controls	$ 60,000	$ 15,000
3	Furnish Polymer Storage/Feed System - Replacement/Controls	$ 30,000	$ 5,000
4	Install Belt Press, Conveyor, Polymer Systems - Removal/Replacement	$ 40,000	$ 40,000
5	Furnish & Install Misc Appurtenances - Removal/Replacement	$ 15,000	$ 15,000
6	Furnish & Install Electrical/Instrumentation - Removal/Replacement	$ 50,000	$ 50,000
7	**Subtotal - Furnish & Install Sludge Dewatering System**	$ 475,000	$ 485,000
8	Furnish & Install - Contingency (25%)	$ 118,750	$ 121,250
9	**Subtotal - Furnish & Install Sludge Dewatering System + Contingency**	$ 593,750	$ 606,250
10	Engineering/Construction Administration (20%)	$ 118,750	$ 121,250
11	**Total - Sludge Dewatering System - Capital Costs**	**$ 712,500**	**$ 727,500**

City of Palatka, Florida
Wastewater Treatment Facility
Sludge Treatment Sysytem - Alternatives Cost Analysis
Preliminary Opinion of Estimated Probable Costs - Annual Operation & Maintenence Costs
Alternative A - Anaerobic Treatment System / Alternative B - Aerobic Treatment System
September 19, 2014

TABLE 5 Alternative A - Anaerobic Digester Sludge Treatment System		
Item No.	**Item Description**	**Cost**
1	Utilities - Electricity	$ 10,000
2	Utilities - Natural Gas/Other	$ 15,000
3	Personnel/Labor	$ 20,000
4	Building Maintenance	$ 2,000
5	Equipment Maintenance - Routine/Daily	$ 20,000
6	Equipment Maintenance - Annual	$ 10,000
7	Chemicals	$ -
8	Training	$ 500
9	Miscellaneous Other	$ 1,000
10	**Total - Anaerobic Digester System - Annual Operation & Maintenance Costs**	**$ 78,500**

TABLE 6 Alternative B - Aerobic Digester Sludge Treatment System		
Item No.	**Item Description**	**Cost**
1	Utilities - Electricity	$ 65,000
2	Utilities - Natural Gas/Other	N/A
3	Personnel/Labor	$ 25,000
4	Building Maintenance	$ 2,000
5	Equipment Maintenance - Routine/Daily	$ 25,000
6	Equipment Maintenance - Annual	$ 20,000
7	Chemicals	$ -
8	Training	$ 500
9	Miscellaneous Other	$ 1,000
10	**Total - Aerobic Digester System - Annual Operation & Maintenance Costs**	**$ 138,500**

City of Palatka, Florida

Wastewater Treatment Facility

Sludge Treatment Sysytem - Alternatives Cost Analysis

Preliminary Opinion of Estimated Probable Costs - Annual Operation & Maintenence Costs

Alternative C - BCR CleanB Chemical Sludge Treatment System

September 19, 2014

TABLE 7 Alternative C - BCR CleanB Chemical Sludge Treatment System		
Item No.	**Item Description**	**Cost**
1	Utilities - Electricity	$ 20,000
2	Utilities - Natural Gas/Other	N/A
3	Personnel/Labor	$ 15,000
4	Building Maintenance	$ 2,000
5	Equipment Maintenance - Routine/Daily	$ 15,000
6	Equipment Maintenance - Annual	$ 10,000
7	Chemicals	$ 26,000
8	Training	$ 500
9	Miscellaneous Other	$ 1,000
10	**Total - BCR CleanB Chemical System - Annual Operation & Maintenance Costs**	**$ 89,500**

City of Palatka, Florida
Wastewater Treatment Facility
Sludge Treatment/Processing Sysytem - Alternatives Cost Analysis
Preliminary Opinion of Estimated Probable Costs - Annual Operation & Maintenence Costs
Alternative(s) A / B / C - Sludge Dewatering System
September 19, 2014

TABLE 8
Alternative(s) A / B / C - Sludge Dewatering System

Item No.	Item Description	Cost
1	Utilities - Electricity	$ 3,000
2	Utilities - Natural Gas/Other	N/A
3	Personnel/Labor	$ 25,000
4	Building Maintenance	$ 1,500
5	Equipment Maintenance - Routine/Daily	$ 20,000
6	Equipment Maintenance - Annual	$ 15,000
7	Chemicals	$ 8,500
8	Training	$ 500
9	Miscellaneous Other	$ 1,000
10	**Total - Sludge Dewatering System - Annual Operation & Maintenance Costs**	**$ 74,500**