TECHNICAL MEMORANDUM

Index Number 268-W3 – Greenland Water Reclamation Facility

PREPARED FOR: JEA

PREPARED BY: CONSTANTINE ENGINEERING, INC.

DATE: TUESDAY, DECEMBER 5, 2017

Introduction & Background

JEA currently serves Duval County and portions of Nassau and St Johns Counties for wastewater service. Wastewater generated east and south of the St Johns River is currently served by the Mandarin, Arlington East, Monterrey, Blacks Ford and Julington Creek Plantation service areas. JEA does not anticipate significant growth within the Monterrey Julington Creek service areas; however, significant growth within the other service areas has been observed, and growth is projected to continue. In addition, significant development is currently planned within the area north of US Hwy 1, east of US Hwy 9B, south of Butler Boulevard, and west of Nocatee Parkway. The current JEA wastewater service areas are shown on the JEA wastewater service area map included in Appendix A.

JEA has proposed to manage wastewater utility growth south and west of the St Johns River by adding the Greenland wastewater service area, constructing a new Greenland Water Reclamation Facility (Greenland WRF) and reallocating flows as follows:

- Redirect wastewater flow handled by the Burnt Mill Pump Station from the Arlington East Water Reclamation Facility (WRF) to the Greenland WRF.
- Redirect current flow in the 9B area from the Mandarin WRF to the proposed Greenland WRF
- Transfer flow from the Nocatee development to the proposed Greenland WRF
- Collect new flow in the Greenland service area for treatment at the proposed Greenland WRF

The proposed Greenland wastewater service area is shown on the JEA wastewater service area map included in Appendix B.

The JEA Real Estate and Planning Departments worked together to identify suitable areas for the proposed Greenland WRF. For planning level purposes, the Blacks Ford WRF process and facility design was chosen as a model for cost estimating and scheduling purposes. In addition, Constantine Engineering, Inc. was retained to develop the Project Definition document and associated preliminary site plan, construction cost estimate and construction schedule.

Justification

Projected growth in southern Duval County and northern St Johns County has provided justification to begin the capital planning process to implement a new wastewater treatment and water reclamation facility near the Greenland Energy Center. Planned flow modifications and growth in wastewater generated in this area has demonstrated the need for the facility to treat 6.0 mgd (million gallons per day) once constructed. In addition, projected growth in this area justifies the proposed requirement for the facility to be planned for future expansion to 12.0 mgd. The Greenland service area wastewater growth projections are shown on Figure 1. For planning purposes, delivery of the 6.0 mgd Greenland WRF will be referred to as Phase 1, and the ultimate expansion to 12.0 mgd will be referred to as Phase 2.

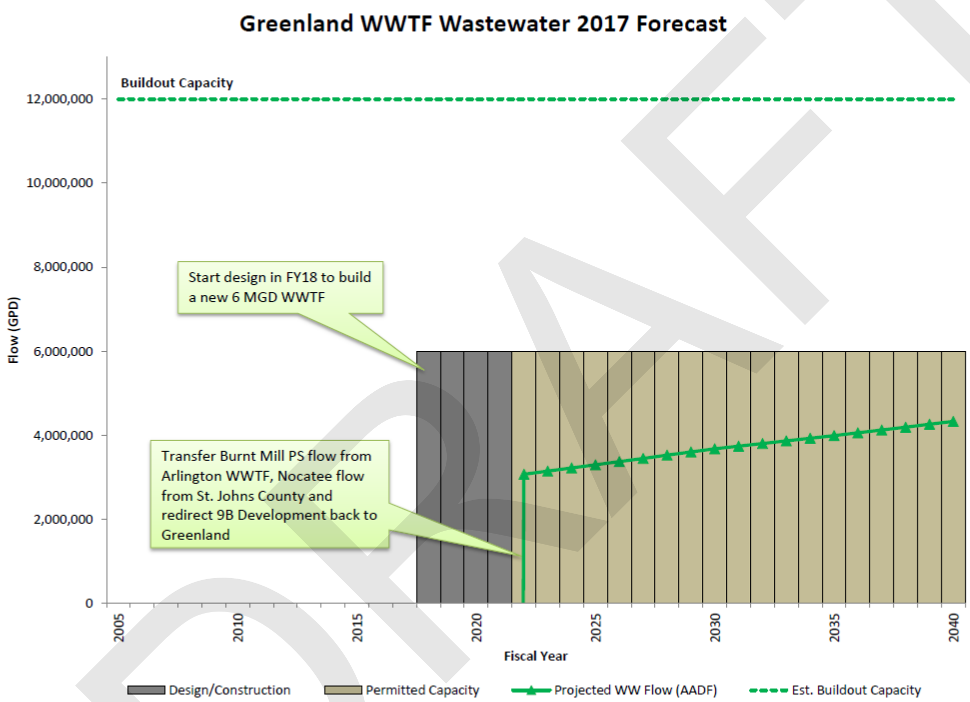

Figure 1 – Greenland WRF Forecasted Growth (from JEA Planning Dept., April 19, 2017)

In addition to growth in the amount of wastewater generated in the proposed Greenland wastewater service area, increased demand for reclaimed water used primarily for irrigation is projected for the entire area south and west of the St Johns River. Maximum reclaimed water demands presented in the SE Regional Reclaimed Water Management DRAFT Final Report (Hatch Mott MacDonald, January 28, 2016) are projected to be 12.0 mgd in 2020, 16.0 mgd in 2025, and 19.0 mgd in 2035 to meet anticipated dry-weather conditions within the Greenland service area. Therefore, this demonstrates that this facility is in the unique situation to discharge all treated effluent to the reclaimed water distribution system for beneficial reuse, and additional reclaimed water must be transferred from the other service areas to meet dry-weather demand.

Effluent Management

Although the proposed facility can treat all influent wastewater and can discharge all produced reclaimed water for beneficial reuse, other options must be considered during treatment plant upsets or extreme wet-weather conditions. Options that have been considered and may become part of the overall effluent management plan include:

- Reject effluent storage
- Normal reclaimed water storage
- Wet-weather reclaimed water storage
- Transfer to Existing Facilities with NPDES Outfalls
- APRICOT discharge

Since the facility will primarily produce reclaimed water, the above options may dictate the level of treatment required.

Reject Effluent Storage: The State of Florida requires that one-day of storage (Chapter 62-610.464 F.A.C.) be provided for effluent that does not meet reclaimed water standards unless alternate methods of disposal are available. Since the intent is for this facility to be a 100 percent reuse facility, the storage requirement will be one day of permitted flow.

Normal Reclaimed Water Storage: During normal operation, a typical reclaimed system will operate to maintain system pressure in the reclaimed water distribution system. Instantaneous demands during dry-weather periods can often far exceed peak hourly flows within a typical wastewater treatment facility. Reclaimed water storage will be required to equalize flow and provide sufficient supply during peak demand periods. Hatch Mott MacDonald recently completed a South Grid reclaimed water management study for JEA. The recommended storage volumes are shown in Table 1.

Wet-Weather Reclaimed Water Storage: In the event of extreme wet-weather events such as an extended period, tropical storm, sufficient storage will not be available. Transfer of effluent between treatment facilities for discharge via permitted outfalls will be required. However, some wet-weather storage will be required and has been recommended in the SE Regional Reclaimed Water Management Final DRAFT Report. The volumes proposed are summarized in Table 1.

Table 1: Reclaimed Water Storage Requirements (JEA SE Regional Reclaimed Water Management DRAFT Final Report (Table 8, HMM, January 28,2016)

Storage Requirement	2020	2025	2035
Daily Volume (mg)	3.5	4.0	5.5
Seasonal Volume (mg)	2.8	4.0	5.5
Annual Wet-Weather Storage	0	1.3	12.3

Transfer to Existing Facilities with NPDES Outfalls: A concept that was recommended in the SE Regional Reclaimed Water Management DRAFT Final Report is to transfer reclaimed water from other treatment facilities and discharge into the outfalls at Mandarin WRF and Arlington East WRF. A meeting was held with FDEP to determine the viability of this concept, and from a regulatory perspective, the concept is acceptable. Further discussions with JEA staff pointed out that the concept will only work during periods when reclaimed water standards are met at the treatment facility. During plant upset conditions, which have occurred in the past, the reclaimed water distribution system could not be utilized for transfer of effluent without extreme operational difficulties. Therefore, transfer to existing facilities with NPDES outfalls is viewed as a viable option, but does not eliminate the need for wet-weather and reject storage. In addition, based on current permitted capacities of Mandarin WRF and Arlington East WRF and process limitations, 1.5 mgd of outfall capacity is available at Mandarin WRF (10.0 mgd permitted capacity less 8.5 mgd process capacity without additional clarification capacity) and 5.0 mgd is available at Arlington East WRF (25.0 mgd less 20.0 mgd process capacity due to BNR improvements).

APRICOT Discharge: The State of Florida encourages the implementation of reuse of reclaimed water programs. As such, the APRICOT act of 1994 was enacted to provide limited wet-weather discharges to surface water bodies once certain conditions were met. Section 403.086(7) F.S. provides the requirements for permitting backup discharges. A backup discharge would be required in the event that storage is not available and transfer to facilities with NPDES outfalls cannot occur. An APRICOT discharge by rule sets treatment standards at a level more stringent than reclaimed water standards and are summarized as follows:

- Biochemical Oxygen Demand (CBOD5) – 5.0 mg/l
- Total Suspended Solids (TSS) – 5.0 mg/l
- Total Nitrogen (TN) as N – 3.0 mg/l
- Total Phosphorus (TP) as P – 1.0 mg/l

The rule also requires that high level disinfection be provided, which requires solids control (i.e. filtration) followed by disinfection.

Recommended Approach and Level of Treatment: For current planning purposes, the above options for effluent management should be implemented at the Greenland WRF. To better understand the overall effluent approach, Figure 2 provides a flow chart for envisioning how the options are interrelated. Since an APRICOT discharge is proposed, the level of treatment must meet the effluent criteria presented above. In addition, Section 403.086(7) F.S. and Chapter 62-610.860, F.A.C. cover permitting requirements that must be demonstrated to grant a limited wet-weather discharge including:

- Stream flow analysis
- Documentation to demonstrate compliance with the antidegradation policy (Rules 62-4.242 and 62-302.300, F.A.C.) since this would be a new surface water discharge
- Determination of the minimum stream dilution factor

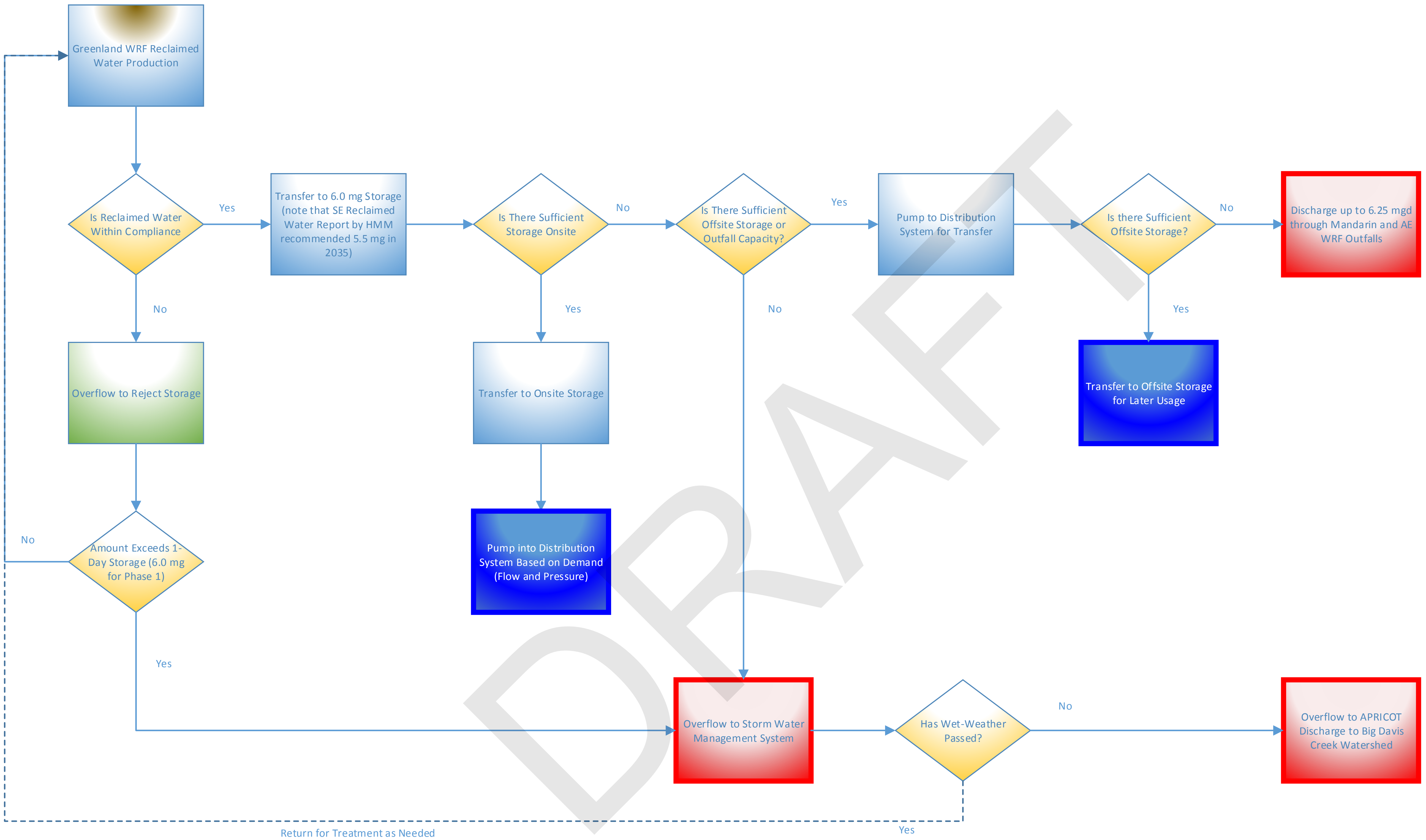

Figure 2
Greenland WRF
Effluent Management System
Proposed Process Decision Protocol

Based on a review of the area near the Greenland Energy Center, most of the area drains into the Little Davis and Big Davis Creek system. Records maintained by the St Johns River Water Management District (SJRWMD) show that Big Davis Creek may possibly have a high enough stream flow to allow a suitable surface water discharge during wet-weather periods when surface water flows are high. For planning purposes, the discharge would need to be routed to the vicinity of the box culvert where Big Davis Creek crosses US Hwy 1. Potential routes for this outfall are shown on Figure 3, but this routing will require additional review and negotiation to determine the feasibility of locating a pipeline in existing JEA utility corridors. The primary risk to JEA with the proposed discharge location is that the stream flow volume is insufficient, and the outfall must be routed further to the west closer to Julington Creek.

Process Requirements

The overall process design criteria for the Greenland WRF has been based on the design criteria that was used for the Phase 4 Blacks Ford WRF expansion at the request of JEA. The criteria were established based on historical flow and load data to the existing Blacks Ford WRF and engineering judgment. JEA planning has determined that the facility needs to have 6 mgd annual average daily flow (AADF) capacity with provisions for a planned expansion to 12 mgd AADF in the future.

Based on a review of the Blacks Ford Water Reclamation Facility, Phase 4 Expansion, Schematic Design Report (December 2014, CH2M Hill) prepared for JEA, influent flow and loading data over an 8-year period was analyzed to determine peaking factors. Based on this analysis and engineering judgement, Table 2 summarizes the recommended influent design concentrations and Table 3 summarizes the influent peaking factors proposed for Blacks Ford WRF. Although these peaking factors will be used for planning purposes for the conceptual design of the Greenland WRF, they should be verified during final design since they have a significant impact on pipe sizes and the hydraulic profile. Since the wastewater generated in the Royal Lakes area will be diverted to the Greenland WRF, this older system may justify the higher peaking factor.

Table 2 – Recommended Design Influent Concentrations

Influent Constituent	Design Value
BOD_5	175 mg/l
TSS	200 mg/l
TKN	55 mg/l
NH_3-N	40 mg/l
TP	7.0 mg/l
Temperature	18 deg C to 28 deg C

JTSHT2011 – 24X36 PLAN SHEET

FIGURE 3
PROPOSED OUTFALL OPTIONS
FOR GREENLAND WRF

Constantine Engineering
311 STATE RD. 16
ST. AUGUSTINE, FL. 32804
PH. 904-562-2185
FL. CERTIFICATE OF
AUTHORIZATION # 9816

NO.	BY	DATE	REVISIONS
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DESIGN ENGINEER
C.E. HORTENSTINE
FLORIDA REGISTRATION NO.
41029

DESIGNER:	CEH
DRAWN BY:	RAM
DATE:	AUGUST 2017
CHECKED BY:	KV
DATE:	

JEA Building Community℠

NO. SHEETS	PROJ. NO. 100436.05
SHEET NO.	DATE: AUGUST 2017
DRAWING NO.	SCALE: 1"=200'

THIS BLOCK HAS ATTRIBUTES – DO NOT EXPLODE THIS BLOCK

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Xrefs Attached=
311 STATE RD. 16
ST. AUGUSTINE, FL. 32804
PH. 904-562-2185

Table 3 – Recommended Peaking Factors

Parameter	Maximum Month to AADF	Maximum Daily to AADF	Peak Hourly to AADF
Flow	1.2	1.6	3.0
BOD_5	1.31	1.54	NA
TSS	1.35	1.73	NA
TKN	1.21	1.40	NA
NH_3-N	1.23	1.44	NA
TP	1.29	2.00	NA

The new WRF will be designed to treat an influent average daily flow of 6.0 mgd and a peak hourly flow of 18.0 mgd. Provisions for future expansion to 12.0 mgd and 36.0 mgd, respectively, also will be considered during the design. The new WRF will consist of the following major process areas and support facilities:

- Pretreatment Process
- Biological Nutrient Removal Process
- Effluent Management
- Biosolids Management
- Support Facilities

Pretreatment Process

The pretreatment process is intended to provide removal of large solids to protect downstream equipment. Pretreatment process components consist of influent flow monitoring, influent composite sampling, mechanical and manual screening, screens washing and dewatering equipment, grit removal and handling equipment, and odor control. The pretreatment facilities are designed to provide complete redundancy and have the hydraulic capacity to meet the future peak hourly flow of 36.0 mgd. In addition, the pretreatment process will allow flow to be evenly split to the downstream process. Grit removal is not proposed at this time, but should be planned for within the hydraulic profile. The overall design criteria for the pretreatment process is provided in Table 4.

Table 4 – Pretreatment Design Criteria

Process Component	Design Value	Comments
Mechanical Screen	2 units	Provide third channel for manual bar screen that will be used for the Phase 2 screen
Screen Opening	6 mm	
Screen Hydraulic Capacity	18.0 mgd each	
Channel Velocity	1.5 fps minimum	Channels shall be configured to achieve minimum velocities aty 2.0 mgd startup conditions
Piping Velocities	2.0 fps to 5.0 fps	Parallel piping may be required to achieve low flow velocities

Biological Nutrient Removal (BNR) Process
The BNR process is intended to remove or reduce organic constituents, nutrients, and suspended solids from the wastewater. Treatment will include activated sludge bioreactors, secondary clarification, and return activated sludge and waste activated sludge (RAS/WAS) pumping. The activated sludge bioreactor system should be designed to provide necessary biological treatment of the wastewater to meet permit conditions, and shall be designed to reduce carbonaceous biochemical oxygen demand (CBOD), ammonia, nitrite, nitrate and phosphorus to the prescribed effluent treatment levels once solids are removed by secondary clarification.

There are two important processes that occur in the BNR process. They include the following:

- Biological phosphorus removal
- Biological nitrogen removal

Biological Phosphorus Removal: Biological phosphorus removal occurs when a certain type of bacteria proliferates within that BNR removal process. Phosphorus Accumulating Organisms (PAOs) are a type of bacteria that store phosphorus at very high levels compared to normal activated sludge bacteria. Under anaerobic conditions, the PAOs can utilize the stored phosphorus in the presence of volatile fatty acids (VFAs), which are typically present as organic material "ferments" under anaerobic conditions and releases these VFAs. This release of phosphorus occurs at the beginning of the BNR removal process.

The next step in biological phosphorus removal occurs in the aerobic zone. PAOs can remove dissolved phosphorus and store phosphates for later use. They can remove a relatively large amount of phosphorus on a mass basis, and this biochemical process is often referred to as a "luxury" uptake of phosphorus. Once the phosphorus is bound in the PAOs, a large portion of the phosphorus that must be removed to meet regulatory requirements is removed in the WAS. In addition, a sufficiently large inventory of PAOs is returned to the anaerobic zone in the RAS stream to continue their role in the removal process.

Biological Nitrogen Removal: Organic and ammonia-nitrogen are oxidized to form primarily nitrate in the aeration zones by nitrifying bacteria in the presence of sufficient oxygen and detention time under relatively warm temperatures. This process is called nitrification. The mixed liquor suspended solids exiting the aerobic zones will be fully nitrified under normal operating conditions, and will contain a significant amount of nitrate (NO3). The next step of nitrogen removal is to recycle this nitrate rich MLSS back to the anoxic zone so that it is available for respiration using the influent BOD as a food source for bacteria. This step is referred to as denitrification in which nitrate (NO_3) is reduced to nitrogen gas (N2) which is then released to the atmosphere.

BNR Process Configuration: The activated sludge process associated with the BNR process will consist of the following process components:

- Anaerobic Zone – Allows PAOs to proliferate under anaerobic conditions and serves as an anaerobic selector to improve settling of the return activated sludge (RAS)

- First Anoxic Zone – Removes recycled nitrate under anoxic conditions
- Aerobic Zone – Oxidizes organic material and ammonia to form carbon dioxide, nitrate and cell mass
- Second Anoxic Zone – Removes additional nitrate through endogenous respiration
- Reaeration Zone – Strips nitrogen bubbles from the activated sludge

The proposed process will be similar to the process design for the Blacks Ford WRF. Submersible mixers will be used to keep the MLSS in suspension in non-aerated reactor zones. Mechanical aerators with integral mixing devices will be used to provide oxygen to the Aerobic Zone and to maintain sufficient velocity during low flow. The use of VFDs to adjust power requirements will also be required. Motorized diverter gates will be incorporated into the process design to provide sufficient recycle of the nitrate-rich MLSS to the First Anoxic Zone. Finally, fine bubble diffused aeration will be used to remove nitrogen in the Reaeration Zone through the application of air using either centrifugal or positive displacement blowers.

Once flow is treated through the activated sludge process, the resulting mixture consists of bacteria and removed solids commonly referred to as mixed liquor. This flow stream is then split evenly to secondary clarifiers which provide a quiescent environment where the solids separate and settle. The effluent overflows long peripheral weirs for further treatment. Most of the settled solids referred to as return activated sludge (RAS) are returned to either the anaerobic zone or the anoxic zone. A portion of the solids are removed and discharged as waste activated sludge (WAS) to the Biosolids Management process for further treatment and ultimate disposal.

The Secondary Clarifiers will be designed to allow biological solids to settle in quiescent conditions. The clarifiers will have rotating rake arm mechanisms that will slowly move settled solids to the removal point. In addition, the rotating rake arm mechanism will have a scum baffle that will move floating material to a full radius scum beach and trough for removal. Removed scum will then be discharged to a scum pump station where it will be pumped to the Biosolids Management process for removal.

Two clarifiers are currently proposed for Phase 1 planning efforts. The clarifiers should be sized so that they can treat the full solids and hydraulic loading with one out of service. The clarifiers will be slightly larger than required, but will still allow adequate process performance with one unit out of service. During Phase 2, when two additional clarifiers are constructed, the solids and hydraulic loading will be well within recommended design guidelines with one unit out of service.

Removed sludge will either be pumped back to the BNR process as RAS, or will be pumped to the Biosolids Management process. The RAS pumping system will be sized to pump at a variable rate based on influent flow, and the rate will either be proportional to the influent flow rate, or it will pump at rates set by the operations staff. WAS pumping will be based on the amounts that the operations staff determine on a daily or hourly basis.

Effluent Management
Effluent management includes the following unit processes:

- Tertiary filtration
- Disinfection
- Transfer pumping to reclaimed water storage
- Reclaimed water storage
- Reject effluent diversion system
- Reject effluent storage
- Reject effluent return pumping system
- Reclaimed water pumping system

Tertiary Filtration: Membrane or cloth disk filtration will be utilized for removal of final removal of solids. The disk filtration technology utilizes cloth or membranes to strain suspended solids from the liquid stream. Solids are captured on the surface of the media, and accumulate. Over time, the solids accumulation begins to impose a head loss across the filter, and this headloss is used in various fashions to implement backwash cycles. Various methods are used for backwashing based on the individual manufacturer. In the some backwash cycles, filtered effluent is utilized as a backwash spray that sprays against the media to wash off accumulated solids. In other units, vacuum is used to pull solids off the media. In either case, the backwash cycles are intermittent, but do result in solids and washwater recycle streams that must be captured. Sufficient filter units will be provided so that acceptable treatment will occur with one unit out of service at peak flows.

Disinfection: The new UV disinfection system equipment shall be provided to disinfect (inactivate most micro-organisms such as viruses, bacteria and parasites) the clarifier effluent to limits prescribed in the permit. The UV system shall implement low or medium pressure high intensity lamps arranged in open channels where the water shall flow by gravity continuously. Lamp arrangements within the channel will be vertically configured or inclined and shall have the capacity to treat the peak hourly flow of 18 mgd. At least two channels will be provided for redundancy, and the system must be capable of full treatment with one channel out of service. In addition, sufficient banks of UV lamps will be provided to provide sufficient redundancy if one bank of lamps is out of service. By providing filtration and UV disinfection, high-level disinfection as defined by the state of Florida will be provided.

UV disinfection has been proposed for this facility based on past JEA projects. However, the use of chlorine will be considered during the design phase, which would require additional sodium hypochlorite storage and feed facilities, chlorine contact chambers, as well as different monitoring requirements.

Transfer Pumping to Storage: Vertical storage tanks will be provided which will require a pumping system for filling the tanks. For planning purposes, vertical turbine pumps driven by variable frequency drives will be provided to minimize the size of the wetwell and minimize pump starts and stops to avoid motor overheating. Operation of the pumps will be controlled based on maintaining certain water level setpoints within the wetwell by adjusting the speed of the pump operation.

Reclaimed Water Storage: As mentioned previously, reclaimed water storage will be provided for equalization of extreme system demands and for wet-weather events. The seasonal hourly peaking factor for retail customers can reach 9.6 based on a retail peaking factor of 6.0 and an overall season maximum monthly peaking factor of 1.6, based on information provided in the JEA SE Regional Reclaimed Water Management DRAFT Final Report (JEA SE RRWM DRAFT Final Report, January 28, 2016, Hatch Mott MacDonald(HMM)).

Reject Effluent Diversion System: Effluent quality will be continuously monitored for turbidity which correlates to solids concentration, and pH. If these values are above minimum compliance level, the system will be designed to automatically divert effluent to the reject storage pond. In Phase 1, the system will be configured to allow gravity flow to the pond by stopping the effluent transfer pumps. As the water level rises, it will reach an overflow weir level at which time it will overflow and gravity flow to the reject pond. Once the effluent meets compliance levels, the operations staff will place the system back into normal operation.

Reject Effluent Storage and Return Pumping System: A lined storage pond will be provided to receive and store reject effluent. In addition, a reject return pumping system consisting of self-priming non-clog centrifugal pumps will be provided to return reject effluent to the treatment system.

Reclaimed Water Pumping System: The reclaimed water pumping system will pump treated effluent into the reclaimed water distribution system serving the South Grid. Based on the JEA SE RRWM DRAFT Final Report, the pumping requirements will be significant as soon as the facility is constructed. Table 4 summarizes the pumping system requirements over the planning period from current conditions through 2035 including buildout, which has been defined as 33 percent greater demand than the demand in 2035 (page 14, JEA SE RRWM DRAFT Final Report, HMM, January 28, 2016). The high pumping rates result from the overall peaking factor for demand in excess of 4.0 for regulated users (Figure A6, JEA SE RRWM DRAFT Final Report, HMM, January 28, 2016).

Table 4 – Projected Reclaimed Water Pumping Rates for Greenland WRF

Planning Year	Required Pumping Capacity at Maximum Flow Condition	Required Pressure at Pumping Facility
2020	8,120 gpm (11.7 mgd)	101 psi
2025	10,810 gpm (15.6 mgd)	101 psi
2035	13,340 gpm (19.2 mgd)	101 psi
Buildout	15,560 gpm (22.4 mgd)	101 psi

Since these pumping rates are large and will significantly impact power requirements for this facility, the final design effort for this individual process should focus on optimizing this pumping system. The pumping rates have been based on the model results from the HMM model, that has not been calibrated. Prior to finalizing pump configurations and pump selections, JEA Planning will provide calibrated reclaimed water model data to determine the future pumping requirements for the Greenland WRF. For planning purposes prior to the final JEA modeling efforts, this facility is proposed to be similar to the Blacks Ford WRF Reclaimed Water Pumping System, although with significantly larger pumps. Horizontal split-case centrifugal pumps are proposed for this project, but consideration should be given during design to utilize vertical turbine pumps installed in suction cans to improve overall efficiency.

Biosolids Management

Biosolids management facilities are intended to prepare the sludge for land disposal or delivery to a third-party residuals management facility. The current Biosolids Management Master Plan requires biosolids generated at the Greenland WRF be truck hauled to Buckman Residuals Management Facility for thickening, anaerobic digestion to Class B stabilization and dewatering for disposal. Under this scenario, over 10 tanker truckloads would be required, and possibly over 20 truckloads if the WAS solids concentration is low. With thickening, the truck trips could possibly be reduced to two (2) to eight (8) trips per day. However, with partial to full aerobic digestion of thickened biosolids followed by dewatering using centrifuges, the trips could be reduced to as little as one (1) trip every two to three days.

Based on the direction taken at Mandarin WRF, aerobic digestion followed by dewatering is proposed for the Greenland WRF. Also, to reduce aerobic digester size, mechanical thickening of the WAS stream is proposed. The proposed Biosolids Management Facilities will consist of the following unit processes:

- WAS Storage
- WAS Thickening
- Aerobic Digestion
- Centrifuge Dewatering

The proposed biosolids management processes will provide a relatively conservative approach that will meet the requirement for dewatered Class B biosolids cake suitable for land application. The overall approach will need to be coordinated with the current biosolids master planning activities to verify the most economical approach. Elimination of thickening will require larger aerobic digesters, and the elimination of dewatering will result in more truck hauling trips. A life-cycle cost analysis should be performed to verify that the most appropriate approach is chosen. In addition, truck trips will need to be considered based on the site selected for the Greenland WRF.

WAS Storage: Although thickening of WAS directly from the RAS/WAS system is an option that may be considered during final design, providing an aerated WAS holding tank does provide additional operational flexibility. Thickening operations during the weekend are typically avoided due to reduced staffing levels. However, direct thickening of WAS could be considered for cost reduction. For planning level efforts, an aerated WAS storage tank is proposed to allow the operations staff the flexibility of wasting sludge intermittently without too much concern for downstream unit processes. The WAS storage tank will be sized for Phase 2 to allow storage of WAS over a 2-day period. Therefore, this holding tank will be slightly oversized for Phase 1, so this should be addressed further with JEA during final design.

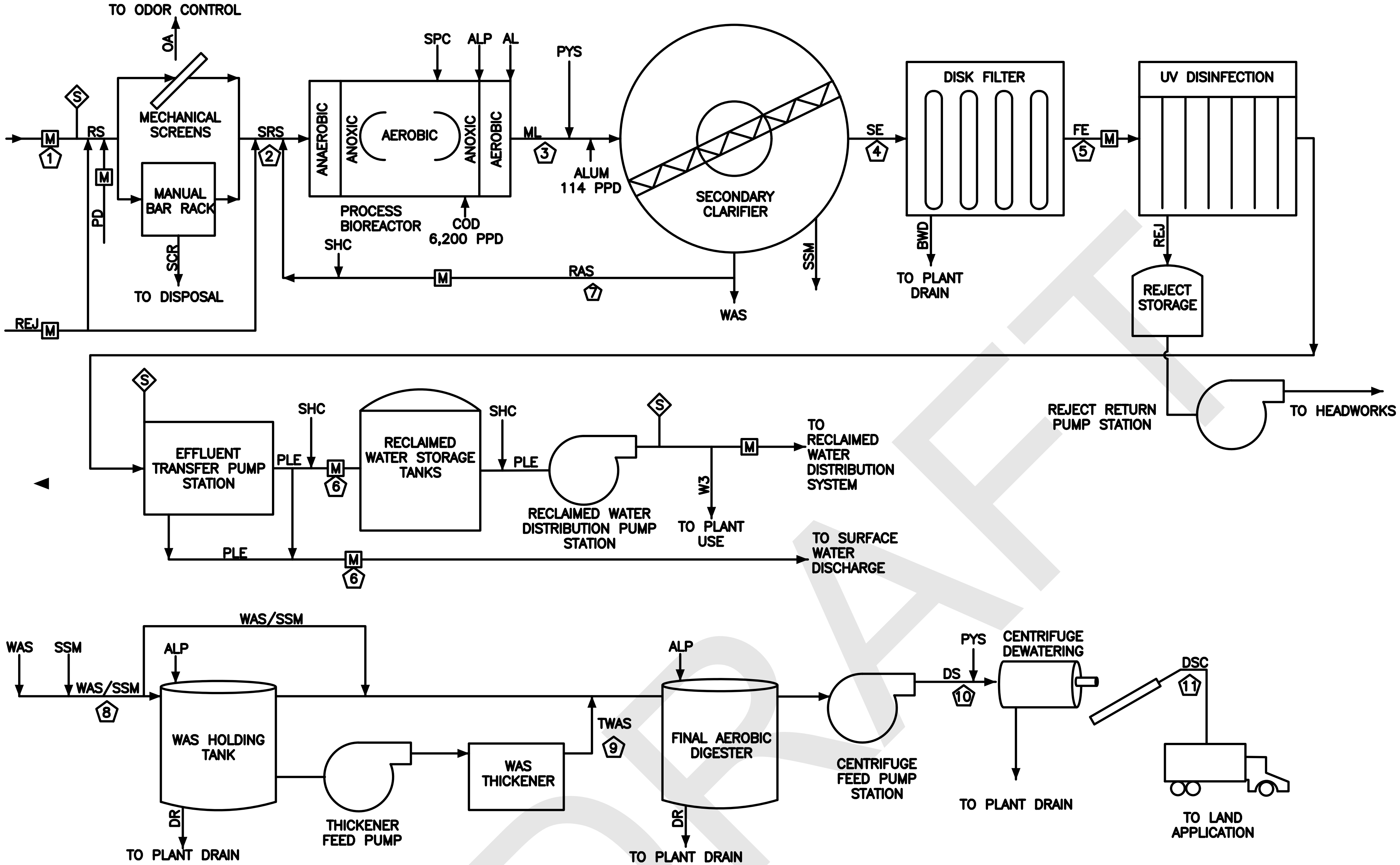
WAS Thickening: The TSS concentration of WAS is typically less than 10,000 mg/l. For aerobic digestion, which is proposed for this facility, a solids retention time (SRT) of 28 days is typically sufficient to achieve a volatile solids destruction of 38 percent. By thickening WAS from 10,000 to 40,000 mg/l, the required volume for a 28-day SRT is reduced by a factor of four. The current process requirement for Phase 2 will be to provide three digesters (two will be constructed in Phase 1). At 10,000 mg/l and to achieve a 28-day SRT, each digester would have a volume of 2.2 million gallons. At 40,000 mg/l, the digester volume would drop to 0.55 million gallons. At a construction cost of roughly $0.50 per gallon, the cost savings would be $2.4 million in addition to the capital and operating cost reduction in aeration requirements.

Aerobic Digestion: In aerobic digestion, WAS is maintained in an aerobic environment. As the readily available food source declines, bacteria begin to consume their own protoplasm and enter into endogenous respiration. Over time, the volatile material of the biomass is reduced and the resulting digested sludge becomes relatively stable and does not typically exhibit signs of regrowth of indicator organisms. At this point, it will have met Class B stabilization standards as defined by the state of Florida and EPA. Class B biosolids can be land applied in certain areas of Florida under certain restrictions. The primary requirement for aerobic digestion is to provide aeration to maintain dissolved oxygen concentrations above 1.0 mg/l. The demand for oxygen is equal to the oxygen required to consume 38 percent of the volatile solids. For applications with less solids, often the energy requirement for aeration is greater than the oxygen demand for respiration.

An overall process flow diagram and mass balance for the overall process configuration which incorporates pretreatment, biological nutrient removal, effluent management and biosolids management is shown on Figure 4. A summary of the proposed process design criteria and a list of major process equipment and motor sizes is included in Appendix C as well as the BioWin model output supporting the mass balance. Vendor quotes for process equipment is provided in Appendix D. It should be noted that this information has been provided to support preparation of the overall construction cost estimate for financial planning, to provide a conceptual design for development of a preliminary site plan for real estate planning and acquisition, and to allow for the development of an approach to supplying electrical power to the facility.

Support Facilities
Support facilities include the following:

- Buildings - administration/laboratory building and maintenance building
- Chemical storage and feed
- Electrical system and emergency generators
- Instrumentation and Controls



MASS BALANCE

	1	2	3	4	5	6	7	8	9	10	11
	INF	SRS	ML	SE	FE	PLE	RAS	WAS	TWAS	DS	DSC
FLOW (MGD)	6.00	9.00	9.00	6.00	6.00	6.00	2.83	0.17	0.026	0.026	0.0044
CBOD (MG/L)	175.0	691.5	608.3	2.9	1.3	1.3	1,820.5	1,820.5	11,444.1	2,576.6	14,461.5
CBOD (PPD)	8,757.0	51,901.0	45,659.0	146.1	64.1	64.1	42,966.9	2,581.0	2,481.5	558.7	530.7
TSS (MG/L)	200.0	2,315.6	2,292.5	6.9	0.7	0.7	6,898.8	6,898.8	43,390.5	34,589.6	194,173.2
TSS (PPD)	10,008.0	173,806.7	172,075.1	345.3	34.5	34.5	162,827.1	9,781.1	9,408.8	7,500.4	7,125.4
TKN (MG/L)	55.0	144.5	114.1	2.4	2.1	2.1	337.8	337.8	2,113.6	1,734.8	7,828.4
TKN (PPD)	2,752.2	10,842.4	8,564.3	120.6	105.1	105.1	7,972.4	478.9	458.3	376.2	287.3
NH3-N (MG/L)	40.0	27.6	0.03	0.03	0.03	0.03	0.03	0.03	0.03	403.7	403.7
NH3-N (PPD)	2,001.6	2,073.2	2.25	1.50	1.50	1.50	0.71	0.04	0.01	87.5	14.8
TN (MG/L)	55.0	144.6	114.6	2.9	2.6	2.6	338.3	338.3	2,114.1	1,734.8	7,828.4
TN (PPD)	2,752.2	10,855.2	8,601.9	145.6	130.6	130.6	7,984.6	479.6	458.4	376.2	287.3
TP (MG/L)	7.0	91.8	91.7	1.2	1.0	1.0	273.0	273.0	1,712.3	1,712.5	8,247.5
TP (PPD)	350.3	6,886.8	6,886.0	60.0	47.5	47.5	6,444.1	387.1	371.3	371.3	302.7

FIGURE 4
PROCESS FLOW & MASS BALANCE DIAGRAM
GREENLAND WRF
JEA

Constantine Engineering

Buildings: For planning purposes, similar buildings as those under construction at the Blacks Ford WRF are proposed. The overall form and function will need to be determined during the final design process, but similar sized buildings are proposed. At a minimum, a maintenance building for receiving major process equipment and an administration/laboratory building for support of the operations staff are proposed for the Greenland WRF.

Chemical Storage and Feed: The following chemicals are proposed for use at the Greenland WRF:

- Alum (sodium aluminate) – Alum will be fed to the MLSS stream prior to clarification for further phosphorus removal
- Carbon source – A carbon source will be fed to the Second Anoxic Zone to enhance nitrate removal
- Sodium hypochlorite – Sodium Hypochlorite will be fed to treated effluent prior to storage to prohibit biological regrowth during storage and transport of reclaimed water
- Polymer – Cationic polymer will be fed to WAS prior to thickening and to stored WAS prior to dewatering to enhance flocculation and improve water release

The storage and feed facilities will be similar in design to Blacks Ford, and will be sheltered from the weather. The typical design criteria of providing one month of storage to meet the maximum month average daily flow demand.

Electrical System: The conceptual design for the electrical system has been developed to stay within JEA's service size limit of 2,500 kVA. In addition, the conceptual design of the power distribution system allows for a balanced load to each service in Phase 1 and in Phase 2. Due to the size of the proposed reclaimed water pumps, a separate medium voltage (4,160 V) service will be required for this Reclaimed Water Pumping System. The Phase 1 Electrical Building will provide automatic transfer power distribution switchgear and motor control centers for electrical service for all Phase 1 electrical loads except for the Reclaimed Water Pumping System. The Phase 1 service will be 480-volt, 3-phase, with a 2,500-kVA pad-mounted service transformer, and the Reclaimed Water Pumping System will be a separate 4,160 volt, 3 phase medium voltage service with a 2,500-kVA pad-mounted service transformer.

In Phase 2, an additional Phase 2 Electrical Building will provide electrical automatic transfer power distribution switchgear and motor control centers to provide electrical service to the Phase 2 BNR equipment, Secondary Clarifiers, RAS pumps and WAS pumps. Additionally, to balance the electrical loads between the three electrical services, electrical service to the UV, Effluent Transfer PS, Maintenance Building and Operations Building will be transferred from the Phase 1 Electrical Building to the Phase 2 Electrical Building.

For emergency power, a 2,000-kW, 480-volt emergency power generator is proposed for the Phase 1 Electrical Building. A 1,500-kW, 4,160-volt emergency power generator is proposed for the Reclaimed Water Pumping System. Finally, a third 2000-KW, 480-volt standby generator will be provided for the Phase 2 Electrical Building. It should be noted that redundant process equipment will not be provided emergency power in most, if not all, cases.

Electrical loads are summarized in Table 5, and the electrical load calculations are included as Appendix E.

Table 5 – Electrical Power Requirements

Phase	Electrical Building	Total Connected Load	Peak Demand	Standby Power Load
1	Phase 1 Electrical Building	3,975 amps	2,883 amps	1,918 kW
1	Reclaimed Water Pumping Station	2,611 amps	1,389 amps	1,389 kW
2	Phase 1 Electrical Building	3,443 amps	2,656 amps	1,767 kW
2	Reclaimed Water Pumping Station	2,611 amps	1,389 amps	1,389 kW
2	Phase 2 Electrical Building	3,428 amps	2,570 amps	1,710 kW

The major electrical equipment for Phase 1 will be located inside the climate controlled Phase 1 Electrical Building. Power to the new facilities will be 480/277 volt, 3-phase service from a new JEA 2,500 kVA pad mounted transformer, located adjacent to the electrical building. The electrical equipment associated with the UV and Effluent Transfer PS will be located in a climate controlled electrical building located adjacent to the UV and Effluent Transfer PS facilities.

The electrical power distribution system will employ a service entrance rated double ended main switchgear with Normal Main-Tie-Generator-Tie-Normal Main configuration. The main switchgear normal source main breakers, tie breakers, and generator source breaker will be electrically operated draw-out power air circuit breakers with LSIG trip functions. Each normal source main breaker shall be normally closed. Each tie breaker and the generator source breaker shall be normally open. Upon loss of normal power, the main switchgear automatic transfer logic shall sequentially open the first normal source main breaker, open the second normal source main breaker, start the standby generator, sense available power from the standby generator, close the generator source breaker, close the first tie breaker, then close the second tie breaker. Upon loss of power to only one main breaker, the switchgear automatic transfer logic shall operate in the same manner except only the affected main and tie breakers shall be included in the transfer sequence. Each main switchgear breaker will also be capable of manual operation to allow one section of the power distribution system to be de-energized for maintenance and repair without turning off power to the entire treatment facility.

Based on preliminary load information, the main switchgear will be rated at 3200 amps. The switchgear will distribute the incoming utility power to the Motor Control Centers (MCC's) and the power distribution panels. Variable frequency drives will be utilized to control the speed of the surface aerators, RAS pumps, and the centrifuge feed pumps.

Standby power will be provided from a diesel-engine driven standby generator through the main switchgear. Based on the preliminary peak demand calculations, the standby generator shall be 2,000 KW. The starting of the standby generator and transferring of power will occur automatically anytime normal utility power is lost.

The reclaimed water pump station electrical service and power distribution system shall be independent of the WRF electrical service. The reclaimed water pump station electrical equipment will be located within the reclaimed water pump building inside a climate controlled electrical room. Power to the reclaimed water pump station will be 480/277 volt, 3-phase service from a new JEA 2,500 kVA pad mounted transformer, located adjacent to the pump station building.

The electrical power distribution system will employ a service entrance rated double ended main switchgear with Normal Main-Tie-Generator-Tie-Normal Main configuration. The main switchgear normal source main breakers, tie breakers, and generator source breaker will be electrically operated draw-out power air circuit breakers with LSIG trip functions. Each normal source main breaker shall be normally closed. Each tie breaker and the generator source breaker shall be normally open. Upon loss of normal power, the main switchgear automatic transfer logic shall sequentially open the first normal source main breaker, open the second normal source main breaker, start the standby generator, sense available power from the standby generator, close the generator source breaker, close the first tie breaker, then close the second tie breaker. Upon loss of power to only one main breaker, the switchgear automatic transfer logic shall operate in the same manner except only the affected main and tie breakers shall be included in the transfer sequence. Each main switchgear breaker will also be capable of manual operation to allow one section of the power distribution system to be de-energized for maintenance and repair without turning off power to the entire treatment facility.

Based on preliminary load information, the main switchgear will be rated at 3,000 amps. The switchgear will distribute the incoming utility power to the Motor Control Centers (MCC's) and the power distribution panels. Variable frequency drives will be utilized to control the speed of the reclaimed water pumps.

Standby power will be provided from a diesel engine driven standby generator through the main switchgear. Based on the preliminary peak demand calculations, the rating of the standby generator shall be 1500 KW. The starting of the standby generator and transferring of power will occur automatically anytime normal utility power is lost.

For Phase 2, the major electrical equipment will be located inside the climate controlled Phase 2 Electrical Building. Power to the new facilities will be 480/277 volt, 3-phase service from a new JEA 2500 kVA pad mounted transformer, located adjacent to the electrical building. The Phase 2 electrical loads shall include the new biological nutrient removal facilities, secondary clarifiers, RAS pumps and WAS pumps. Additionally, electrical loads shall also be added to the Phase 1 facilities including the headworks, filters, effluent transfer pump, and solids handling equipment. To balance the loads between the Phase 1 electrical service and Phase 2 electrical service, the following loads shall be transferred to the new Phase 2 electrical equipment: UV, effluent transfer pumps, maintenance building, and operations building.

The Phase 2 electrical power distribution system will employ a service entrance rated double ended main switchgear with Normal Main-Tie-Generator-Tie-Normal Main configuration. The main switchgear normal source main breakers, tie breakers, and generator source breaker will be electrically operated draw-out power air circuit breakers with LSIG trip functions. Each normal source main breaker shall be normally closed. Each tie breaker and the generator source breaker shall be normally open. Upon loss of normal power, the main switchgear automatic transfer logic shall sequentially open the first normal source main breaker, open the second normal source main breaker, start the standby generator, sense available power from the standby generator, close the generator source breaker, close the first tie breaker, then close the second tie breaker. Upon loss of power to only one main breaker, the switchgear automatic transfer logic shall operate in the same manner except only the affected main and tie breakers shall be included in the transfer sequence. Each main switchgear breaker will also be capable of manual operation to allow one section of the power distribution system to be de-energized for maintenance and repair without turning off power to the entire treatment facility.

Based on preliminary load information, the Phase 2 main switchgear will be rated at 3200 amps. The switchgear will distribute the incoming utility power to the Motor Control Centers (MCC's) and the power distribution panels. Variable frequency drives will be utilized to control the speed of the surface aerators and RAS pumps.

Standby power will be provided from a diesel engine driven standby generator through the main switchgear. Based on the preliminary peak demand calculations, the rating of the Phase 2 standby generator shall be 2000 KW. The starting of the standby generator and transferring of power will occur automatically anytime normal utility power is lost.

Instrumentation and Controls: Instrumentation Control Panels with JEA standard Siemens S7 PLCs shall be located in the following climate controlled areas: Operations Building, Phase 1 Electrical Building, UV & Effluent Transfer PS Electrical Building, Reclaimed Water Pump Station Electrical Room, and the future Phase 2 Electrical Building. Each instrumentation control panel will be equipped with a JEA standard Simatic HMI touch panel Operator Interface Terminal with a minimum 12-inch display.

An Ethernet local area network shall be installed using single mode fiber optic cable to interconnect each of the PLCs. JEA standard Scalence Ethernet switches with fiber ports shall be used for the Ethernet network. Profinet/Profibus PD communications shall be utilized for PLC to variable frequency drive communications and PLC input/output communications with field instrumentation capable of Profibus DP communications.

The Human Machine Interface (HMI) to the plant supervisory control and data acquisition system shall be developed using JEA standard Siemens WinCC. The WinCC version and latest service pack to be used for the development will be as directed by JEA at the time of the integration. The WinCC application will be configured with WebNavigator which will allow client applications to view the HMI through Web based applications

Real Estate Requirements and Overview

The preliminary real estate requirements were identified to the JEA Real Estate Department in a memo prepared by JEA Water/Wastewater System Planning dated April 17, 2017. The JEA Real Estate Department identified two parcels that were possible candidates for acquisition. The two parcels are as follows:

- Parcel D-1 – The parcel is north of the Greenland Energy Center and west of US Hwy 9B and is owned by DDI, Inc.
- Parcels B/C – The adjacent parcels are located northwest of the Greenland Energy Center in the Philips Industrial Park. Parcel B is owned by Jensen Civil Construction, Inc. and parcel C is owned by the Duval County School Board.

Parcel D-1: Parcel D-1 is owned by DDI, Inc. and is approximately 124 acres in size. Portions of this site are jurisdictional wetlands, and development in these areas would need to be avoided. However, the configuration of the site will most likely impact some of the wetland areas, and wetlands impact and mitigation would be expected. The site is in the northwest quadrant of the recently constructed interchange at US Hwy 9B and E-Town Parkway. The portion of the parcel adjacent to this interchange will most likely be retained by DDI, Inc. for commercial development.

Portions of the parcel is located in flood zone AO, which corresponds to areas where 100-year shallow flooding occurs (1 to 3 feet). Accurate site elevations will be required to ensure that critical structures are above the flood level to avoid any disruption in service.

Current planning will be to connect to the existing force main located within the T-Line easement to the west along E-Town Parkway. This will require an increase in the proposed force main currently proposed to serve development to the east. Connections to the electrical and reclaimed water system will also be to the south and west of this site.

Parcel B/C: Parcel C is a 43.7-acre parcel owned by the Duval County School Board. Phase 1 and Phase 2 assessments were performed in 2013 and 2014 by AerostarSES, and the reports submitted to JEA found no evidence of environmental problems with the site. However, the report noted and the area can be seen on historical aerial photographs that a past borrow pit was filled with excavated material, so the geotechnical impacts within this are not known. Additional geotechnical investigation would be required to determine if this area would pose structural problems for the proposed site.

Parcel B/C would require truck access through the Philips Industrial Park. Although this area does have truck traffic, the development is zoned light industrial and may impact traffic. The site is zoned light industrial (IL), and would require a zoning exception application. Essential services such as wastewater treatment are permissible uses by exception through the current City of Jacksonville zoning code.

Portions of the parcel is in a flood zone AO, which corresponds to areas where 100-year shallow flooding occurs (1 to 3 feet). Accurate site elevations will be required to ensure that critical structures are above the flood level to avoid any disruption in service.

Utility service for the site will be provided from the south along the E-Town Parkway. Parcel B/C and Parcel D-1 are shown in Figure 5. A conceptual site plan for Parcel B/C is shown on Figure 6, and a conceptual site plan for Parcel D-1 is shown on Figure 7. Both conceptual site plans have been developed to support the financial planning for this project, and to verify property requirements. Additional engineering effort will be required to progress either site plan to the Schematic Design level. Information associated with Parcel B/C is included in Appendix F and the information associated with Parcel D-1 is included in Appendix G.

The proposed APRICOT discharge for the Greenland WRF is currently being evaluated. The preferred outfall location will be somewhere between the Greenland WRF and the discharge point shown previously on Figure 3. However, the discharge location is dependent on meeting certain criteria that are under review. A phased approach using existing JEA and FDOT storm water management systems may also be allowed. A conservative approach was chosen to develop the project budget that will provide an outfall at Big Davis Creek on the west side of US Highway No. 1. The final approach and location of the outfall will be determined and provided to the selected engineering consulting firm. Additional property may be needed in addition to the JEA transmission line property and the property for the Greenland WRF.

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POTENTIAL SITES FOR THE PROPOSED
GREENLAND WRF

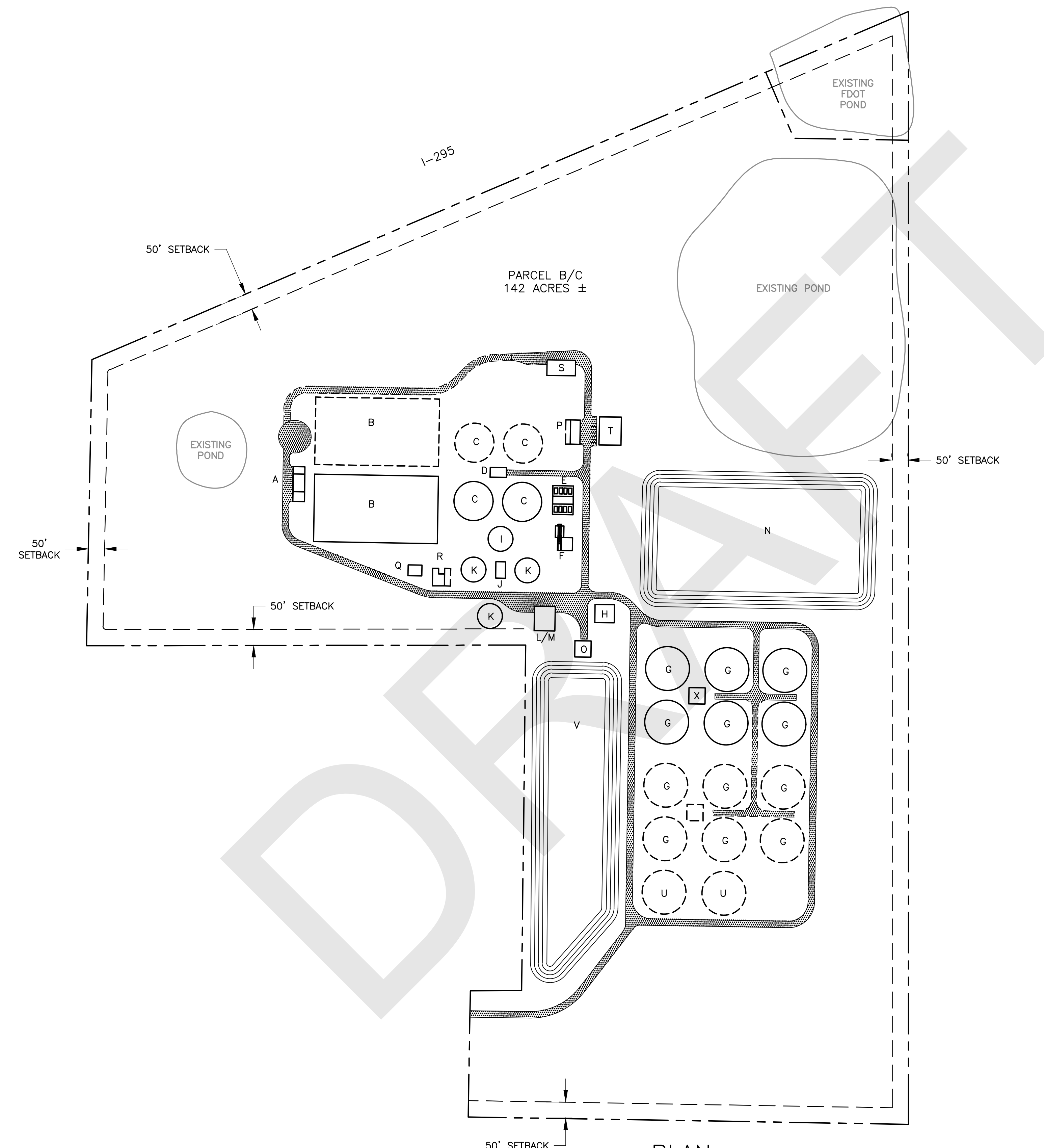
DATE: AUGUST 2017

PROJ. No.: 100436.05

FIGURE 5

PARCEL B/C - PROPOSED SITE PLAN

GREENLAND WRF



PLAN
SCALE: 1" = 200'
0 200 400
GRAPHIC SCALE

	LEGEND
A	HEADWORKS/ODOR CONTROL/BNR SPLITTER BOX
B	BIOLOGICAL NUTRIENT REMOVAL SYSTEM
C	SECONDARY CLARIFIERS
D	RAS/WAS PUMP STATION AND CLARIFIER SPLITTER BOX
E	TERTIARY FILTRATION SYSTEM
F	UV DISINFECTION SYSTEM AND EFFLUENT TRANSFER PUMP STATION
G	RECLAIMED WATER STORAGE TANKS (DAILY AND WET WEATHER)
H	RECLAIMED WATER PUMP STATION
I	WAS STORAGE TANKS
J	WAS THICKENING SYSTEM
K	AEROBIC DIGESTERS
L	CENTRIFUGE FEED PUMPS
M	CENTRIFUGE DEWATERING BUILDING
N	REJECT EFFLUENT STORAGE POND
O	REJECT RETURN PUMP STATION
P	CHEMICAL STORAGE AND FEED BUILDING
Q	ELECTRICAL BUILDING
R	EMERGENCY GENERATOR
S	MAINTENANCE BUILDING
T	OPERATION BUILDING
U	REJECT EFFLUENT STORAGE TANK
V	STORMWATER MANAGEMENT
X	EFFLUENT STORAGE TANK CONTROL SYSTEM

——— PHASE 1
— — — PHASE 2

FIGURE 6

DATE: AUGUST 2017
PROJ. No.: 100436.05
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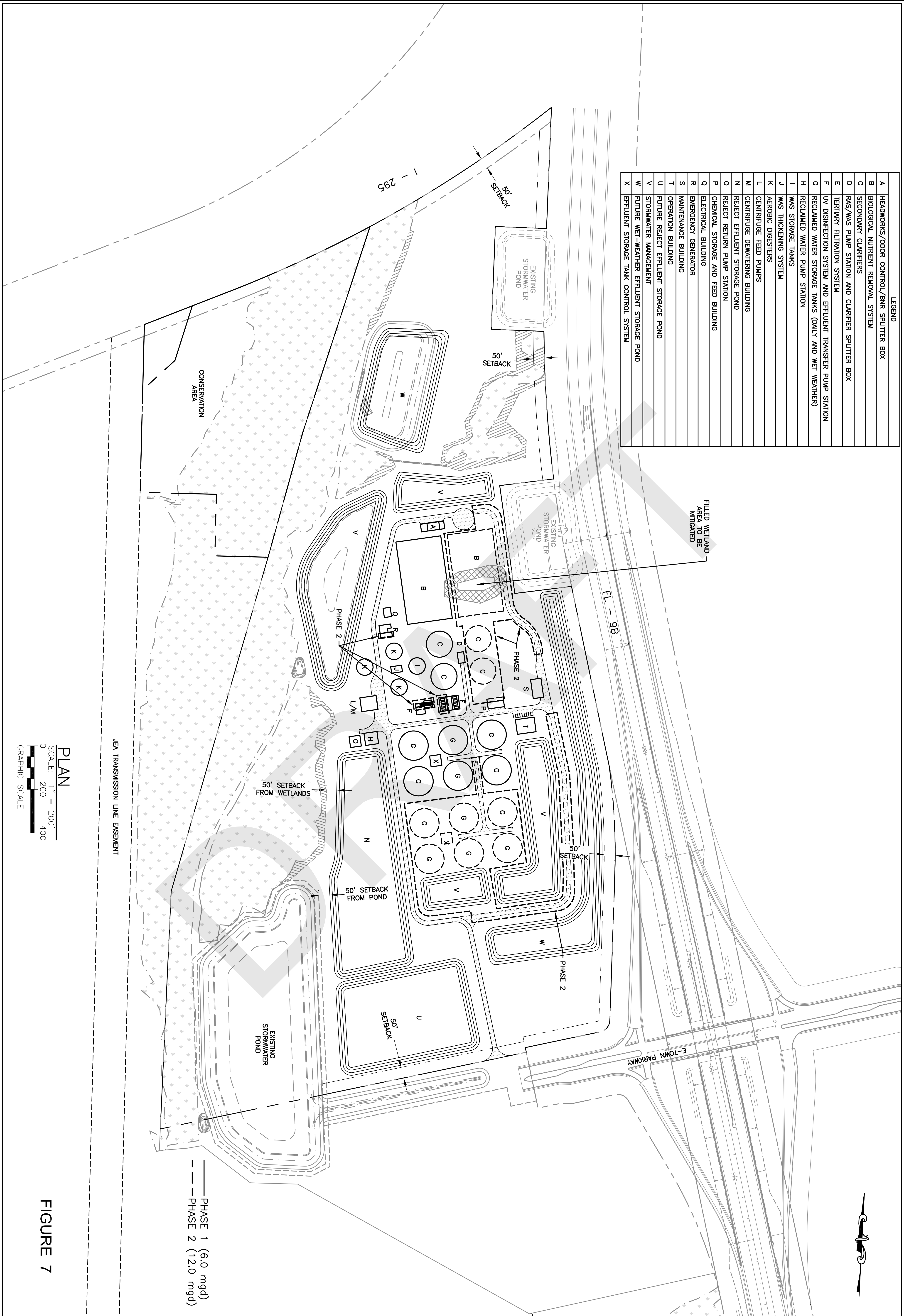

FIGURE 7

LEGEND

A	HEADWORKS/ODOR CONTROL/BNR SPLITTER BOX
B	BIOLOGICAL NUTRIENT REMOVAL SYSTEM
C	SECONDARY CLARIFIERS
D	RAS/WAS PUMP STATION AND CLARIFIER SPLITTER BOX
E	TERTIARY FILTRATION SYSTEM
F	UV DISINFECTION SYSTEM AND EFFLUENT TRANSFER PUMP STATION
G	RECLAIMED WATER STORAGE TANKS (DAILY AND WET WEATHER)
H	RECLAIMED WATER PUMP STATION
I	WAS STORAGE TANKS
J	WAS THICKENING SYSTEM
K	AEROBIC DIGESTERS
L	CENTRIFUGE FEED PUMPS
M	CENTRIFUGE DEWATERING BUILDING
N	REJECT EFFLUENT STORAGE POND
O	REJECT RETURN PUMP STATION
P	CHEMICAL STORAGE AND FEED BUILDING
Q	ELECTRICAL BUILDING
R	EMERGENCY GENERATOR
S	MAINTENANCE BUILDING
T	OPERATION BUILDING
U	FUTURE REJECT EFFLUENT STORAGE POND
V	STORMWATER MANAGEMENT
W	FUTURE WET-WEATHER EFFLUENT STORAGE POND
X	EFFLUENT STORAGE TANK CONTROL SYSTEM

Constantine Engineering

PARCEL D-1 - PROPOSED SITE PLAN

GREENLAND WRF

DATE: AUGUST 2017

PROJ. No.: 100436.05

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Preliminary Project Design Requirements

General Site Development Criteria

Both parcels currently under consideration are partially situated in FEMA Flood Zone AO, Depth 2, which corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. The depth is averaged along the cross section and then along the direction of flow to determine the extent of the zone. This area is associated with the Big Davis Creek Tributary 1. To meet minimum design requirements for the City of Jacksonville, a topographical survey for either site will be required and the survey shall include, at a minimum, the following:

- Identification of all waterbodies, water surface elevations, top and bottom of banks, buffers, associated conservation easements, wetland identification, and flood zone delineation.
- Boundary survey including property lines, easements, building setbacks, landscape buffers, encroachments, rights-of-way with road names and jurisdiction, adjoining property owners, and real estate numbers, and zoning.
- All opposing and adjacent driveways and entrances shall be shown.
- Topographic survey shall be provided on minimum 1' contours based on NAVD 88 datum and a minimum 25' beyond property line.
- Location of any above ground natural or manmade features, pavements, fences, signage, etc.
- Location and associated elevations of any storm water retention or conveyance infrastructure.
- All trees 6" DBH and greater shall be surveyed.

Design of a wastewater treatment facility will require extensive an extensive geotechnical evaluation to determine structural foundation design requirements. Geotechnical borings shall include, at a minimum, soil type, groundwater elevation, and recommendations for foundation design for each significant building or process tank.

Permitting requirements will also include a jurisdictional wetland survey (portions have been completed for Parcel D-1) in conformance with the US Army Corps of Engineers requirements. Should development require wetland filling, mitigation shall be required.

The following is a list of development requirements and permits that will most likely be applicable to both sites:

- City of Jacksonville Site Plan Review
- City of Jacksonville Application for Zoning Exception
- City of Jacksonville Rezoning Application (possible if Owner requests)
- FDOT Encroachment Permit (for Parcel D-1)
- St. Johns River Environmental Resource Permitting (ERP) [Lower St Johns River Basin]
- NPDES Permit for Construction Related Activities

- Florida Department of Environmental Protection (DEP) Domestic Wastewater Facility Permit
- US Army Corps of Engineers Wetland Determination and Permit

General Architectural and Structural Design Criteria
All architectural and structural design must conform to all state, county, and local codes, laws, ordinances, and zoning regulations and design guidelines as provided for by the City of Jacksonville, Florida, and as mentioned herein. The latest version of the following pertinent codes for building design should be followed for design:

- Florida Building Code
- Florida Mechanical Code, Second Edition
- Florida Plumbing Code, Second Edition
- Florida Fuel Gas Code, Second Edition
- Florida Chapter 11, Accessibility Provisions
- Florida Chapter 13, Energy Provisions
- International Fire Code
- National Fire Protection Association
- National Electric Code

The code data shall be located on the drawings with the first-floor plan. The code data may be located elsewhere, provided a note is given on the first-floor plan stating the location of the code data by drawing number. The buildings shall also be designed to meet the requirements of the Florida Building Code (latest edition), including Chapter 11, Florida Accessibility Code for Building Construction.

General Process and Mechanical Design Criteria
The general process and mechanical design shall meet the requirements set forth by the Florida Department of Environmental Protection. At a minimum, general design criteria must meet the criteria set forth in the latest versions of the following documents:

- WEF Manual of Practice No. 8, Design of Municipal Wastewater Treatment Plants
- 10-States Standards
- EPA Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability
- JEA Water and Wastewater Standards Manual, January 2017

Scope

This project definition document presents the justification, wastewater treatment facility requirements, the site development requirements, real estate requirements, and overall facility design guidelines. In summary, JEA should proceed with the following actions:

- Property acquisition
- Retain a consulting engineering firm qualified in the design of advanced wastewater treatment facilities
- Continue with effluent management evaluations to ensure that the environmental permitting process does not delay design and construction activities

Although the conceptual design does provide an overall process layout and approach to unit process design, the following items still require further consideration:

- Confirm that the approach chosen for biosolids management matches the final biosolids management plan.
- Confirm the reclaimed water pumping requirements (flow and pressure) due to the significant impact on electrical power and electrical service requirements.
- Further evaluate the amount of reclaimed water storage required during wet-weather periods and how it relates to other options for effluent management including the proposed APRICOT outfall and discharge to Big Davis Creek.

This document provides the overall conceptual design to allow funding under JEA's Capital Project Allocation/Project Delivery Process. The Project Definition report provides the deliverables necessary to proceed with the procurement process to return the services of a qualified engineering firm to provide professional engineering services required for the development of construction documents and to obtain the necessary regulatory permits. The information provided in this document is not intended to relieve the selected engineering firm from any responsibility or liability associated with the professional services required to provide process, site/civil, structural, architectural, electrical, mechanical, instrumentation and controls design for the bidding and construction of the proposed Greenland WRF.

Implementation Schedule

The proposed schedule has been developed in collaboration with JEA. The overall schedule based on the traditional delivery schedule is shown below, and a detailed schedule is provided in Appendix H.

Implementation Schedule (Traditional Design)

Project Name	2017	2018				2019		
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
Procurement of Engineer Duration = 150 Days	■	■						
Engineering – Design Duration = 210 Calendar Days			■	■	■			
Procurement – Bid Duration = 210 Calendar Days					■	■	■	
Construction Duration = 720 Calendar Days								■

Project Name	2019	2020				2021		
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
Procurement of Engineer Duration = 150 Days								
Engineering – Design Duration = 210 Calendar Days								
Procurement – Bid Duration = 210 Calendar Days								
Construction Duration = 720 Calendar Days	■	■	■	■	■	■	■	

To accelerate the delivery of this project, JEA may consider a the selection of a Construction Manager at Risk (CMAR) as an alternative approach to deliver this project. Under this approach the following steps may be considered:

- JEA would select the Engineer to perform the design under the professional services contract
- At the 30% (conceptual) design stage, JEA would select the CMAR based on price and/or qualifications
  - Price elements that could be considered for CMAR selection could include preconstruction costs (support during engineering), markup percentages, rate schedules, and general conditions
- CMAR could negotiate a guaranteed maximum price (GMP) with JEA at any stage during design. Note that the less developed the design, the more the CMAR would need contingency monies in the GMP.
- CMAR would work with the designer to allow for early packages to be released such as sitework and long lead equipment items while the designer progresses and delivers the final design.
- The designer may oversee the CMAR performance during construction on behalf of JEA.

Using this approach, the overall project delivery may be accelerated as shown in the following schedule:

Implementation Schedule (CMAR)

Project Name	**2017**	**2018**				**2019**				**2020**			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Procurement of Engineer Duration = 150 Calendar Days													
Engineering – Design Duration = 210 Calendar Days													
Engineering - Civil/Sitework and Long Lead Items Duration = 180 Calendar Days													
Engineering - All Other Disciplines Duration = 180 Calendar Days													
Procurement – CMAR Selection for Alternate Delivery Duration = 180 Calendar Days													
Overall CMAR Delivery of WWTP Duration = 900 Calendar Days													
Civil/Sitework Construction and Long Lead Items Duration = 270 Calendar Days													
Construction of Other Disciplines Duration = 540 Calendar Days													
Startup and Commissioning Duration = 90 Calendar Days													

Expenditure Forecast (CMAR)

Greenland WRF	**2017**	**2018**				**2019**	
	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Procurement of Engineer	$ 10,000	$10,000					
Engineering – Design			$4,498,072	$4,518,072			
Engineering - Civil/Sitework and Long Lead Items				$6,326,490	$6,326,490		
Procurement – CMAR Selection for Alternate Delivery			$10,000	$10,000			
CMAR - Civil/Sitework Construction and Long Lead Items				$7,950,271	$7,970,271	$7,970,271	
CMAR - Construction of Other Disciplines						$3,964,248	$3,964,248
Startup and Commissioning							
TOTAL	**$ 10,000**	**$ 10,000**	**$4,508,072**	**$18,804,834**	**$14,296,762**	**$11,934,520**	**$ 3,964,248**
	2019		**2020**				**Total**
	Q3	Q4	Q1	Q2	Q3	Q4	
Procurement of Engineer							**$20,000**
Engineering – Design							**$9,016,145**
Engineering - Civil/Sitework and Long Lead Items							**$12,652,980**
Procurement – CMAR Selection for Alternate Delivery							**$20,000**
CMAR - Civil/Sitework Construction and Long Lead Items							**$23,890,814**
CMAR - Construction of Other Disciplines	$3,964,248	$3,964,248	$3,964,248	$3,964,248	$3,964,248		**$27,749,737**
Startup and Commissioning						$ 1,650,324	**$1,650,324**
TOTAL	**$ 3,964,248**	**$ 3,964,248**	**$ 3,964,248**	**$ 3,964,248**	**$ 3,964,248**	**$ 1,650,324**	**$ 75,000,000**

Project Management & Delivery

Stage	Project Definition	10% Schematic Design	30% Conceptual Design	90% Detail Design	100% Final Design	Bid	Construction
To Project Delivery							

OPB Established Trend Trend Trend

Cost Estimate and Expenditure Forecast (Current $)

The overall opinion of probable cost is presented below. The detailed Project Definition level opinion of probable cost is provided in Appendix I. The cost estimate should be used to set the overall capital improvement budget, and the estimate is within the accuracy range required by JEA (+50%/-30%). It should be noted that property acquisition is not included in these costs.

Cost Estimate and Expenditure Forecast (Current $)

ACTIVITY/ DESCRIPTION	SUB-TOTAL	TOTAL
Contractor Direct Cost	$ 47,810,289	$ 47,810,289
Contractor Indirect Cost		$ 12,430,675
Overhead and Profit	$ 6,215,338	
Miscellaneous-General/Special Conditions	$ 4,781,029	
Supplemental Work Allowance (3% max)	$ 1,434,309	
JEA Cost and Engineering		$ 14,759,036
Engineering and Post Design Services (15%)	$ 9,036,145	
Project Management (3%)	$ 1,807,229	
Services During Construction - JEA Inspector (5%)	$ 3,012,048	
Project Support (1.5%)	$ 903,614	
Total Project Cost*		$ 75,000,000

***A 30% CONTINGENCY IS RECOMMENDED FOR APPLICATION TO THE TOTAL PROJECT COST**

LEGEND			
A	Headworks/ Odor Control/BNR Splitter	$	2,298,857
B	Biological Nutrient Removal System	$	5,223,075
C	Clarifiers - 120 Dia ea	$	2,268,061
D	RAS/WAS Clarifier Splitter Structure	$	818,462
E	Tertiary Filtration System/Effluent Filters	$	1,924,878
F	UV, Effluent Transfer PS	$	2,470,716
G	Reclaimed Water Storage Tanks	$	5,183,107
H	Reclaimed Water Pump Station	$	1,234,205
I	WAS Storage Tanks	$	354,479
J	WAS Thickening System	$	761,702
K	Aerobic Digesters	$	1,131,445
L	Centrifuge Feed Pumps	$	307,835
M	Centrifuge Dewatering Building Phase 1	$	2,744,853
N	Reject Effluent Storage Pond 6 MG	$	325,603
O	Reject Return Pump Station	$	544,769
P	Chemical Storage and Feed Building	$	321,801
Q	Electrical Building	$	938,545
R	Emergency Generator	$	1,268,144
S	Maintenance Building	$	1,015,464
T	Operations Building	$	2,367,949
U	Future Effluent Storage (Not included in Phase 1)	$	-
V	Stormwater Management Pond	$	4,805,446
X	Effluent Storage Control System	$	346,773
	Other	**$**	**9,154,120**
	Outfall to Big Davis Creek	$	2,127,398
	Plant Drain Pump Station	$	236,962
	Paint	$	462,365
	Electrical	$	2,290,043
	SCADA	$	2,558,214
	Sales Tax 7%	$	1,479,138
	Subtotal	**$**	**47,810,289**
	Overhead and Profit	$	6,215,338
	Miscellaneous-General/Special Conditions	$	4,781,029
	Supplemental Work Allowance (3% max)	$	1,434,309
	Construction & Closeout Subtotal	**$**	**60,240,964**
	Engineering and Post Design Services (15%)	$	9,036,145
	Project Management (3%)	$	1,807,229
	Services During Construction - JEA Inspector (5%)	$	3,012,048
	Project Support (1.5%)	$	903,614
	Total Project Cost*	**$**	**75,000,000**

***A 30% CONTINGENCY IS RECOMMENDED FOR APPLICATION TO THE TOTAL PROJECT COST**

The anticipated quarterly expenditure is provided below for planning purposes.

PROJECTED EXPENDITURE FORECAST BY FISCAL YEAR	**2017**	**2018**				**2019**			
QUARTER	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
JEA Cost & Engineering 10%	$903,614								
JEA Cost & Engineering 30%		$1,807,229							
JEA Cost & Engineering Final			$3,162,651	$3,162,651					
Construction, Engineering Services					$438,116	$438,116	$438,116	$438,116	$438,116
Construction Cost							$9,946,839	$4,815,791	$5,394,064
Project Closeout									
TOTAL	**$903,614**	**$1,807,229**	**$3,162,651**	**$3,162,651**	**$438,116**	**$438,116**	**$10,384,955**	**$5,253,907**	**$5,832,181**

PROJECTED EXPENDITURE FORECAST BY FISCAL YEAR	**2020**				**2021**				**Total**
QUARTER	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	
JEA Cost & Engineering 10%									$903,614.46
JEA Cost & Engineering 30%									$1,807,228.92
JEA Cost & Engineering Final									$6,325,301.22
Construction, Engineering Services	$438,116	$438,116	$438,116	$438,116	$438,116	$438,116			$4,819,277.12
Construction Cost	$6,150,085	$5,748,855	$7,244,660	$7,605,752	$7,381,248	$5,614,215			$59,901,510.98
Project Closeout						$1,243,068			$1,243,067.51
TOTAL	**$6,588,201**	**$6,186,972**	**$7,682,776**	**$8,043,868**	**$7,819,365**	**$7,295,399**	**$0**	**$0**	**$75,000,000**

Risks

The primary risks to JEA are related to land acquisition, overall project cost, facility delivery schedule and environmental permitting issues.

Land Acquisition: Two sites are currently under consideration for the Greenland WRF. In addition, support utilities and the APRICOT outfall will require sufficient space within existing easements for installation. Property acquisition activities for the Greenland WRF site should proceed without delay. In addition, further evaluation of existing transmission line easements and other available corridors should be completed to determine whether additional property must be acquired for utilities.

Overall Project Cost: Excess capacity within the construction industry has been reduced over the past few years. This has been demonstrated in higher than anticipated construction costs in the water and wastewater industry. In addition, material prices have escalated over the past few years, and this has also impacted construction project costs. The primary risk to JEA from a financial perspective is that the overall cost of the project will exceed planning level budgets that must be in place for the project to proceed.

Facility Delivery Schedule: The Greenland WRF must be in place prior to significant development within the Greenland service area can occur. The schedule is aggressive, and could be delayed for issues that may arise during design, permitting, bidding or construction. To mitigate these risks, JEA is proceeding with the identification of the necessary steps to permit the APRICOT discharge that will be required for wet-weather conditions. This effort should be completed prior to the selection of a design engineering firm. Since the construction schedule is aggressive, alternative methods for delivery should be considered including CMAR (Construction Manager at Risk). Other options that may be available to JEA to ensure that the schedule is met is the early procurement of process equipment that may have lengthy delivery schedules.

Environmental Permitting Issues: Difficulties with facility permitting have traditionally had a negative impact on schedule and public perception. As mentioned above, JEA is proceeding with the permitting requirement evaluation to limit the potential impact that the permitting process may have on the overall project schedule. Permitting of the Greenland WRF will require public notification, and the risk exists that this facility will be viewed negatively by the public. It is recommended that a public education and outreach program should be considered to minimize the potential for public opposition.

Revision History

Name	Date	Version	Revision Notes