MANATEE COUNTY

NRWRF EXPANSION TO 12.5 MGD AADF CONCEPTUAL ENGINEERING REPORT - FINAL

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Prepared for:

Manatee County Utilities Department
4410 66th Street West
Bradenton, FL 34210

Prepared by:
McKim & Creed, Inc.
551 North Cattlemen Road, Suite 106
Sarasota, FL 34232
CA License No. 29588
Michael D. Nixon FL PE No. 87439

McKim & Creed Project No.: 01024-0221

MICHAEL D. NIXON
LICENSE
No 87439
STATE OF FLORIDA
PROFESSIONAL ENGINEER

Digitally signed by MICHAEL D NIXON
Date: 2023.04.07 14:37:20-04'00'

THIS ITEM HAS BEEN DIGITALLY SIGNED AND SEALED BY MICHAEL NIXON, PE ON THE DATE ADJACENT TO THE SEAL.

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LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation	Definition
AACE	Association for the Advancement of Cost Engineering
AADF	Annual Average Daily Flow
AOR	Actual Oxygen Requirement
ASHT	Aerated Sludge Holding Tank
AWT	Advanced Wastewater Treatment
BOD_5, BOD	Biochemical Oxygen Demand, Five Day
$CaCO_3$	Calcium Carbonate
CAR	Capacity Analysis Report
CAS	Conventional Activated Sludge
$CBOD_5$	Carbonaceous Biochemical Oxygen Demand, Five Day
CE	Clarified Effluent
CER	Conceptual Engineering Report
COD	Chemical Oxygen Demand
DI	Ductile Iron
DIP	Ductile Iron Pipe
DMR	Discharge Monitoring Report
EOR	Engineer of Record
EQ	Equalization
F.A.C.	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FE	Filtered Effluent
FRP	Fiber-reinforced Plastic
FSB	Flow Splitter Box
GPH	Gallons per Hour
GPM	Gallons per Minute
GPD	Gallons per Day
HSPS	High Service Pump Station
IR	Internal Recycle
LSPS	Low Service Pump Station
MCMRS	Manatee County Master Reuse System
MDF	Maximum Daily Flow
MGD	Million Gallons per Day
ML	Mixed Liquor
MLE	Modified Ludzack-Ettinger
MLSS	Mixed Liquor Suspended Solids
MLVSS	Mixed Liquor Volatile Suspended Solids
MM	Maximum Month
MMADF	Maximum Month Average Daily Flow
M3MADF	Maximum Three Month Average Daily Flow
MOPO	Maintenance of Plant Operations

Abbreviation	Definition
NaOCl	Sodium Hypochlorite
NH_3-N	Ammonia as nitrogen
NO_3-N	Nitrate as nitrogen
NO_2-N	Nitrite as nitrogen
NRCY	Nitrified Recycle
NWRF, NRWRF	North Water Reclamation Facility
OPCC	Opinion of Probable Construction Cost
PAR	Public Access Reuse
PD PS	Plant Drain Pump Station
PF	Peaking Factor
PFD	Process Flow Diagram
PHF	Peak Hourly Flow
RAS	Return Activated Sludge
RCW	Reclaimed Water
SCFM	Standard Cubic Feet per Minute
SE	Secondary Effluent
SEWRF	Southeast Water Reclamation Facility
SND	Simultaneous Nitrification-Denitrification
SOR	Standard Oxygen Requirement (at standard conditions)
SRS	Screened Raw Sewage
SRT	Solids Retention Time
SWWRF	Southwest Water Reclamation Facility
SVI	Sludge Volume Index
TKN	Total Kjeldahl Nitrogen
TMRADF	Three-Month Rolling Average Daily Flow
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
VSS	Volatile Suspended Solids
WAS	Waste Activated Sludge
WEF	Water Environment Federation

SECTION 1 INTRODUCTION

Manatee County (County) owns and operates the North Regional Water Reclamation Facility (NRWRF), which is located at 8500 69th St. E. in Palmetto, Florida within a historically agricultural portion of the County that has been undergoing increased development and growth in recent years. The NRWRF currently has a permitted capacity of 7.5 million gallons per day (MGD) at three-month rolling average daily flow (TMRADF) conditions. Per the Florida Department of Environmental Protection requirements for Rule 62-600.405 of the Florida Administrative Code (F.A.C.), water reclamation facilities (WRF) like the NRWRF must be evaluated routinely to support the prompt planning, design, and construction of wastewater facilities necessary to provide proper treatment and reuse or disposal of domestic wastewater and management of biosolids. All flow projections made for the NRWRF through the capacity analysis reports (CAR) sent to the Florida Department of Environmental Protection (FDEP) have indicated that the NRWRF's designed capacity of 7.5 MGD TMRADF was not expected to be exceeded until 2031. However, since the most recent CAR in 2020, influent flows to the NRWRF have increased at an accelerated rate in the past few years and it is expected that expansion of the facility may be required sooner. In addition, the recent 2022 Wastewater Collection System Master Plan Updates Workshop indicated that the flow was projected to reach the permitted capacity in the year 2026.

1.1 PURPOSE OF THE REPORT

The County has requested that McKim & Creed prepare a conceptual engineering report (CER) to determine the needs at the NRWRF to expand to 12.5 MGD annual average daily flow (AADF) treatment capacity while maintaining Class I Reliability. This CER includes preliminary site plans showing the potential arrangement of the recommended improvements and AACE Class 4 conceptual costs to support CIP planning for those improvements. The intent of this CER is to support the identification and development of the capital improvements projects necessary to increase the capacity of the NRWRF to 12.5 MGD AADF. The County also requested this CER include a conceptual flow projection update and evaluation of facility expansion to 10 MGD AADF. This CER focuses on both the liquid treatment unit processes and biosolids processes of the NRWRF to show the feasibility for such an expansion at the existing site.

As part of this treatment evaluation for the expansion of the existing NRWRF MLE process to 12.5 MGD AADF, the County also requested the evaluation and identification of recommended improvements needed to expand the NRWRF with improvements to meet advanced wastewater treatment (AWT) standards. Per § 403.086, Fla. Stat. (2021) AWT standards require WRF's effluent pollutant concentrations to be less than or equal to 5 mg/L cBOD5, 5 mg/L TSS, 3 mg/L TN, and 1 mg/L TP, when applied. In some instances, the TP concentration limit of the AWT standards may be waived if it can be demonstrated that phosphorus is not the limiting nutrient in the receiving water bodies. It is expected that the NRWRF would qualify for this waiver based on historical knowledge of nitrogen limitation in the surrounding receiving water bodies and because the NRWRF does not directly discharge treated effluent to surface water bodies. Additional evaluation and discussion of this topic is provided in **Section 5.1** of this CER.

SECTION 2 EXISTING CONDITIONS

2.1 BACKGROUND

The NRWRF, FDEP permit No. FLA012617, is owned and operated by Manatee County. A copy of the NRWRF current permit is included in **Appendix A**. A site map is shown in **Figure 2.1**. The plant is currently designed, permitted, and constructed as a 7.5 MGD TMRADF Type I oxidation ditch activated sludge wastewater treatment facility. The current NRWRF includes influent mechanical screening, vortex grit removal, an MLE secondary treatment process with Ovivo Carrousel oxidation ditches to achieve removal of organic pollutants and nitrogen, tertiary filtration, chlorine disinfection, and effluent pumping to onsite reclaimed water (RCW) storage or the countywide public access reuse (PAR) system, Manatee County Master Reuse System (MCMRS), which has a separate FDEP permit No. FLA474029.

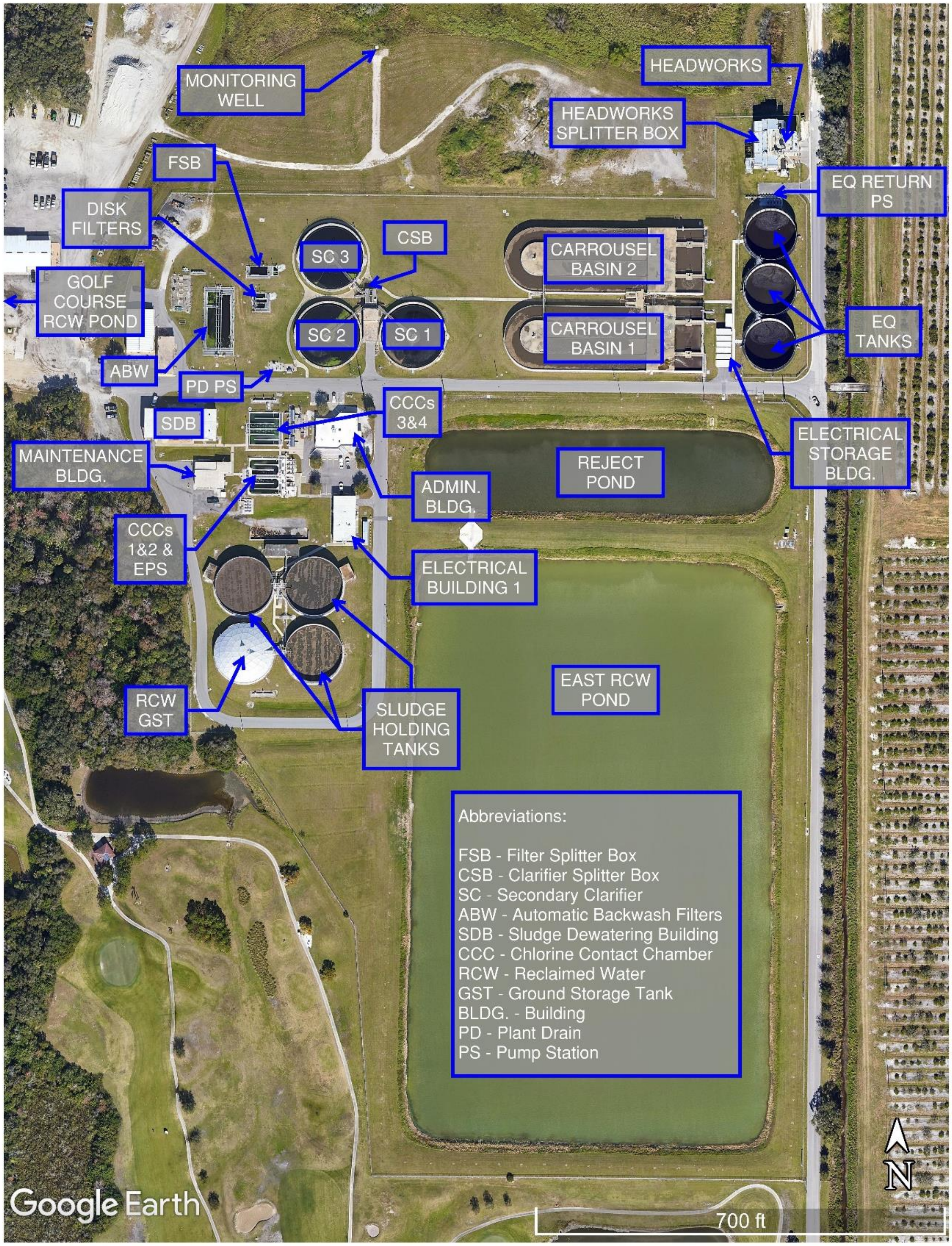


Figure 2.1 Manatee County NRWRF Existing Site

2.2 CONCEPTUAL FLOW PROJECTION UPDATE

In response to County request, an alternate flow comparison of previously completed flow projections with a recent trend of year-over-year flows was included due to the increased rate of development in the NRWRF service area in recent years. In 2021, NRWRF was operating at 5.53 MGD TMRADF which is 74% of the permitted 7.5 MGD TMRADF capacity. The historical flows and flow projections were analyzed to estimate when the NRWRF is projected to exceed the permitted flow.

A summary of the NRWRF's flow projection from the most recent CAR is provided in **Table 2.1** below (from the 2020 CAR by Carollo Engineers, Inc). According to the 2020 CAR the annual average daily flow projections through year 2040 were based on population projection and wastewater flow of 80 gallons per capita per day. The annual maximum three-month average daily flow projection was calculated using the peaking factor of 1.13 based on the historical flow from 2005 through 2014.

Table 2.1 Projected Flows from 2020 CAR

Years	Projected Annual Average Daily Flows (MGD)	Projected Maximum TMADF (MGD)
2019	4.39	4.85
2020	4.59	5.08
2021	4.79	5.3
2022	4.99	5.52
2023	5.19	5.74
2024	5.39	5.96
2025	5.59	6.18
2026	5.79	6.4
2027	5.99	6.63
2028	6.19	6.85
2029	6.39	7.07
2030	6.59	7.29
2031	6.79	7.51
2032	6.99	7.73
2033	7.19	7.95
2034	7.39	8.17
2035	7.59	8.4
2036	7.79	8.62
2037	7.99	8.84
2038	8.19	9.06
2039	8.39	9.28
2040	8.59	9.5

A summary of an updated NRWRF flow projection is provided in **Table 2.2** below, based on the 2022 Wastewater Collection System Master Plan Updates Workshop meeting on May 6th, 2022, conducted by the County and Carollo Engineers, Inc. The projected flow was based on the County's selected Methodology 1, from the Workshop, which utilized a population projection based on the County's existing and planned development. Projected TMRADF values were calculated from the AADF projections using the peaking factor of 1.10 based on the NRWRF's more recent historical peaking factor determined in this CER.

Table 2.2 Projected AADF and TMRADF Flows from Wastewater Collection System Master Plan Updates Workshop

Years	Methodology 1 - County Planned Developments AADF (MGD)	Projected TMRADF (MGD) Based on Methodology 1[1]
2020	4.81	5.29
2025	6.23	6.85
2030	8.20	9.02
2040	12.05	13.26

[1]Projected TMRADF is 110% of the Methodology 1 AADF projected flows based on historical peaking factor

A summary of actual TMADF flow data from 2018 to 2022 is provided in **Table 2.3** below. Note that the actual TMRADF for 2020, 2021, and 2022 is very close to the corresponding TMRADF year projections from the Wastewater Collection System Master Plan Updates Workshop. It was assumed that the County started accepting about 100,000 gpd of wastewater from Piney Point into the collections system in April of 2021, which is included in the raw TMRADF for 2021 and 2022 below. After this flow analysis was completed, the following information was presented. The Piney Point flow was halted on May 12, 2021, and restarted August 18, 2021. However, this flow analysis was not updated for the three-month interruption of Piney Point flow.

Table 2.3 Recent Three-Month Rolling Average Daily Flow

Years	Recent TMRADF Flows w/o Piney Pt (MGD)	Recent TMRADF Flows w/ Piney Pt (MGD)
2018	4.10	4.10
2019	4.64	4.64
2020	5.19	5.19
2021	5.5	5.53
2022	5.32	5.42

[1]See below regarding gpd removed to account for Piney Point

Two linear trendlines are presented in **Figure 2.2**. One is based on the four years of flows without the Piney Point wastewater in 2021 and 2022. It is estimated that an average of 100,000 gpd of Piney Point wastewater was accepted to NRWRF in 2021 for nine of the twelve months and 100,000 gpd for all twelve months in 2022 (see above regarding assumptions). The other linear trendline includes the Piney Point wastewater for 2021 and 2022 as well as projections that the Piney Point flows will increase to 200,000 gpd in 2026. Note that it is impossible to predict whether these trajectories of year-over-year increases in TMRADF will continue into the future as shown on the trendlines. These actual TMRADF values and linear projections are compared with the projections from 2020 CAR and the 2022 Wastewater Collection System Master Plan Updates Workshop in **Figure 2.2.**

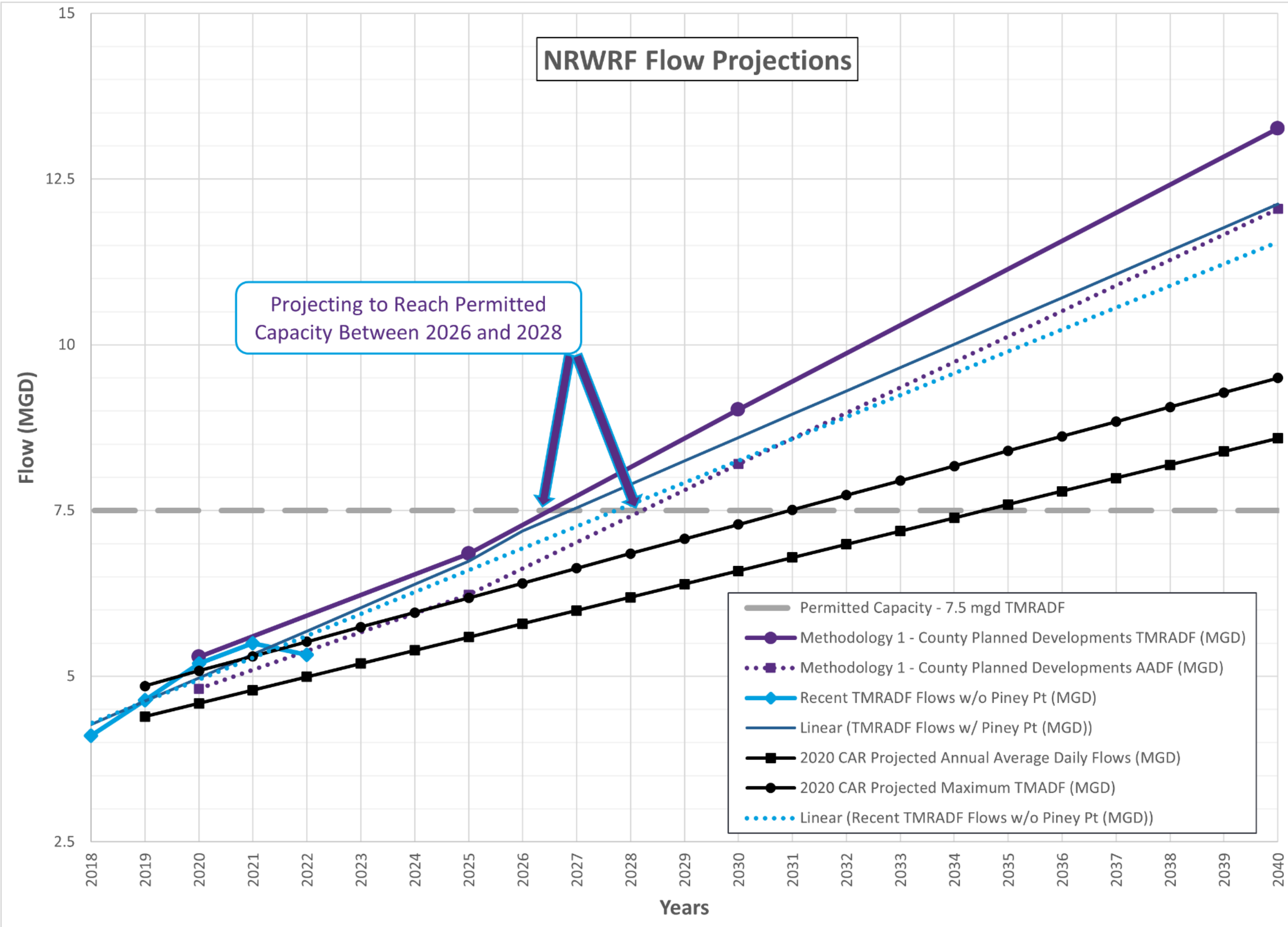


Figure 2.2 NRWRF Conceptual Flow Projection Update

In summary, the 2020 CAR projected that TMRADF would reach the permitted capacity of 7.5 MGD TMRADF in the year 2031. The TMRADF equivalent values from 2022 Wastewater Collection System Master Plan Updates Workshop indicated that the flow was projected to reach the permitted capacity in the year 2026. Using the trajectory of actual TMRADF flows to create linear trendlines, the flow is projected to potentially reach the permitted capacity in 2026 or 2027. It is therefore recommended that the County track the increase in TMRADF every year closely to see if this trend continues, or if the rate of growth decreases or increases. Additionally, in preparation for the potential exceedance of capacity as early as 2026, the County should immediately begin planning and design activities in support of an expansion.

The County may need to make some operational changes and should re-rate the facility to prevent exceeding the design capacity until an expansion can be designed, constructed, and put into operation. The County may have no choice but to treat Piney Point wastewater onsite and redirect leachate hauled to NRWRF to another facility to save this capacity. The NRWRF can treat an additional 0.5 to 1.5 MGD of flow with the existing unit processes. Refer Section 6 Re-Rate to 8 MGD AADF for more information on this. An evaluation and subsequent permit re-rate are recommended. With the current trend of year-over-year increase in flow of 0.5 MGD per year a re-rate could provide a one-to-three-year extension to stay in permit compliance until an expansion is online.

2.3 EXISTING TREATMENT PROCESS DESCRIPTION

At the headworks, wastewater undergoes preliminary treatment. It includes two self-cleaning mechanical screens, a manual bar rack, two vortex degritting units, and two grit classifiers that eliminate debris, coarse materials, and grit before continuing onto the Headworks Splitter Box. It also includes an odor control system.

Currently, raw wastewater from Manatee County's north service area enters the NRWRF headworks via a 48-inch diameter force main. An ultrasonic meter on the 30-inch diameter pipe records the influent flow before it enters the influent channel. Raw wastewater then passes through the mechanical screens - the headworks structure includes three parallel channels, two with a Parkson 6-mm band screen. The remaining, central channel contains one standby manual bar rack. Each mechanical screen has a capacity of 20 MGD, and the manual bar rack has a capacity of 20 MGD according to the 2017 WRF Master Plan. The headworks also includes two Hydro International HeadCell® stacked tray induced vortex grit removal units, each with a capacity of 15.2 MGD with eight (8) 12-ft diameter trays (expandable to twelve trays with a capacity of 22.5 MGD). The grit slurry from each HeadCell® unit is sent to a grit washing/classification unit; a combination of a Hydro International SlurryCup™ for grit washing, and a Grit Snail® clarifier for grit dewatering to meet 95% removal of 50-micron and larger particles. The removed grit is then routed into a dumpster. Effluent from the headworks flows to the Headworks Splitter Box via an effluent weir gate downstream of each HeadCell® grit unit.

The screened and degritted raw wastewater is combined with plant recycle flows in the Headworks Splitter Box including returned activated sludge (RAS) pumped from the underflow of the clarifiers. During daily diurnal higher flows, a portion of the influent wastewater overflows a weir gate in the Headworks Splitter Box to three off-line equalization (EQ) tanks, each with a storage volume of 1 MG. During lower flow, the flow from the EQ tanks is returned to the splitter box via the return pump station containing 5 pumps with a capacity of 1,500 gpm each. Mixed liquor from the Headworks Splitter Box is routed to the secondary MLE treatment process via two 42" pipes. Each anoxic basin has two mechanical mixers. From the anoxic portion of each basin, flow goes through a port which feeds mixed liquor flow to the aerated, oxidation ditch portion of each basin. Each aerobic section has three Ovivo mechanical surface aerators. A portion of the nitrified mixed liquor from the aerobic oxidation ditch portion of each basin is returned back to the anoxic zone via axial-flow internal recycle

(IR) pumps while the remaining flow passes over an adjustable weir gate into an effluent chamber. The mixed liquor is then conveyed to the Clarifier Flow Splitter Box.

From the Clarifier Flow Splitter Box, flow is split and conveyed to the three secondary clarifiers. Clarified effluent discharged from the secondary clarifiers is directed to the Filter Flow Splitter Box. RAS from the underflow of the clarifiers is conveyed back to the RAS influent box at the headworks, and waste activated sludge (WAS) is transferred to the three aerated sludge holding tanks. Scum is removed from the clarifiers and is combined with WAS.

The NRWRF has an existing tertiary filtration system to remove additional suspended solids from the treated and clarified secondary effluent before it flows to the chlorine contact chambers for disinfection. This system comprises four (4) filters with a total combined filtration surface area of 5,462 ft^2, including the following:

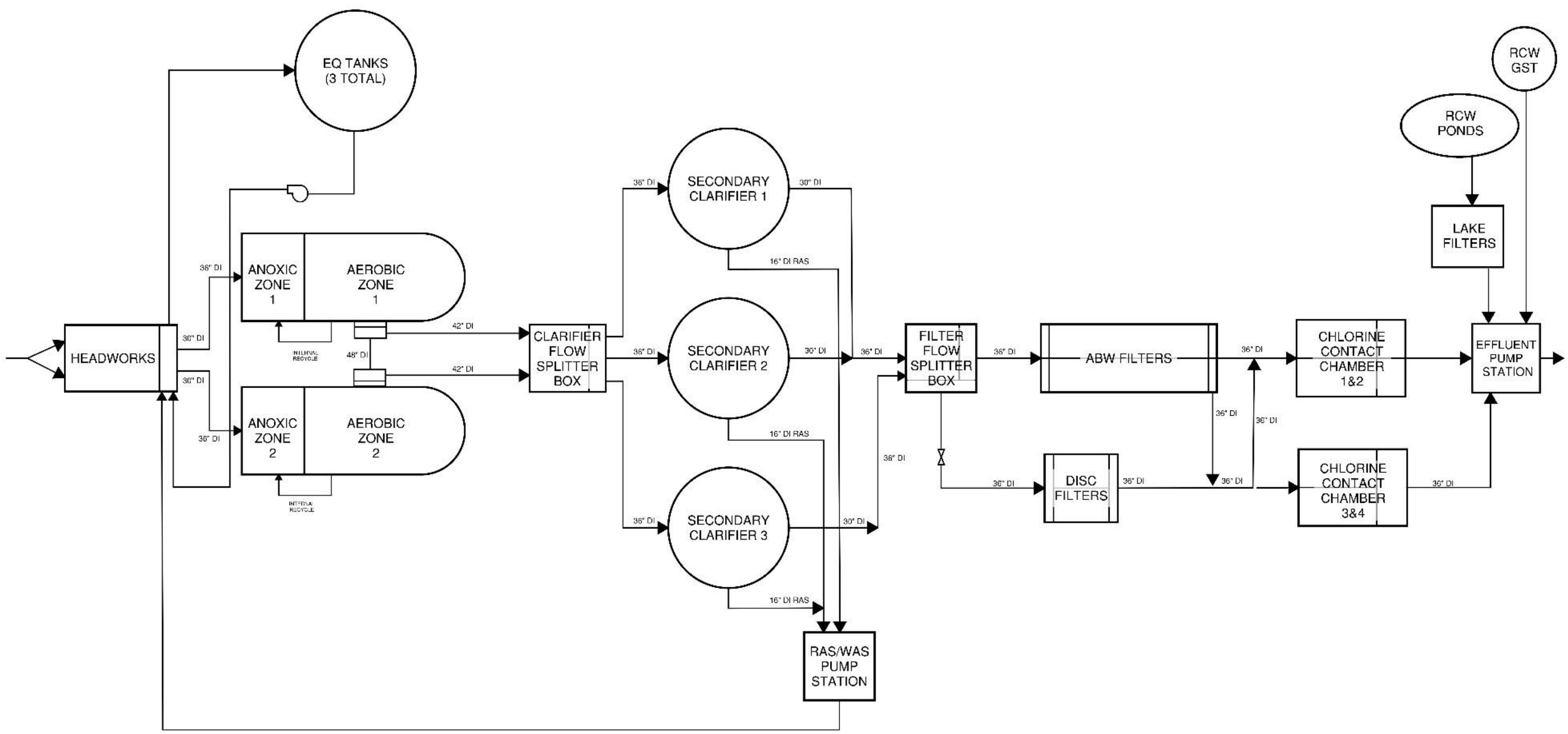
- Two (2) ABW sand and anthracite traveling bridge filters with a filtration surface area of 1,440 ft^2 per unit
- Two (2) cloth disk filters with a filtration surface area of 1,291 ft^2 per unit

Clarified secondary effluent flows by gravity to the Filter Flow Splitter Box influent channel, splits between two effluent weir gates, and flows on to the ABW filters and the disk filters. Note that the current operation of this flow split between ABW and disk filters, based on site visit in August 2022, is by operation of a buried butterfly valve on the disk filters influent line, and the weir gates in the Filter Splitter Box were lowered all the way down. Filter influent flows by gravity through the double layer of 12-inch anthracite and 12-inch sand on top of the support porous plates and the underdrain system in the ABW filters, and through the cloth media in the disk filters. The filtered effluent continues flowing by gravity to the CCCs for chlorine disinfection. Backwash waste from the tertiary filters containing the solids removed by the filters is collected and returned to the plant influent for treatment via the plant drain system.

The NRWRF produces high quality advanced level treated effluent which meets the regulatory requirements for Part III public access reuse (PAR). To meet these requirements, the facility provides high level disinfection. The filtration unit process that precedes the disinfection system provides the additional TSS removal (beyond secondary treatment levels) in accordance with the requirements of Chapter 62-600 F.A.C. The applicable regulatory requirement for high-level disinfection as stated in the facility permit (No. FLA012617) is to maintain a minimum of 1.0 mg/L of total residual chlorine at the end of the CCCs for a minimum contact time of 15 minutes based on peak hourly flow (62-600.440 (5) (b)). Disinfection takes place in four chlorine contact chambers (CCC) with 0.310 MG of total volume. Chlorination with sodium hypochlorite is used for disinfection. The sodium hypochlorite is injected and mixed at the influent end of each CCC with an Evoqua Water Champ chemical induction system. After disinfection, the effluent reclaimed water can be conveyed to the effluent reuse system Manatee County Master Reuse System (MCMRS), or onsite storage. If reuse demand exceeds the NRWRF effluent flow, previously treated effluent from pond storage is pumped back to the lake filters and discharged to the effluent pump station wetwell to meet the demand. A process flow schematic for the liquid stream processes at the NRWRF is depicted below in **Figure 2.3**.

For solids processing, waste activated sludge (WAS) and scum from the secondary clarifiers are sent to one of the three aerated sludge holding tanks prior to dewatering. There are a total of four WAS pumps, and the pump details are provided in **Table 2.4**. Each tank has a volume of 0.999 MG, for a total storage volume of 2.996 MG. Aeration and mixing in the aerated sludge holding tanks is accomplished using coarse bubble diffusers in each tank. There is a total of three 250 hp blowers, each with a capacity of 4,000 scfm for the aerated sludge holding tanks. Aeration and mixing are provided to keep the contents of each tank in suspension and to prevent septic conditions that would degrade the quality of the biosolids and produce foul odors. The aerated sludge holding tanks are decanted to increase the percent solids of sludge prior to dewatering. The supernatant is conveyed to the plant drain system and returned to the headworks. Polymer is injected into the sludge as it enters each of the belt filter presses. The dewatered solids are either transferred to the County's Southeast Water Reclamation Facility (SEWRF) for thermal drying to meet Class AA standards for marketing and distribution or disposed of in a Class I solid waste landfill.

A summary of the NRWRF's existing treatment processes and process capacities is provided in **Table 2.4** below, based on record drawings, the 2017 WRF Master Plan prepared by Carollo Engineers, Inc., the 2020 CAR prepared by Carollo Engineers, Inc., and other sources noted at the bottom of the table.



MANATEE COUNTY NORTH REGIONAL WATER RECLAMATION FACILITY
PROCESS FLOW DIAGRAM
7.5 MGD TMRADF

Figure 2.3 NRWRF Existing Liquid Treatment Process Flow Diagram

Table 2.4 Existing NRWRF Treatment Process Capacity Summary

Process		
Preliminary Treatment		
Headworks Flow Measurement	Number	1
	Type	Ultrasonic meter
	Size	30-inch
Mechanical Band Screens	Number	2
	Type	Mechanically Cleaned
	Capacity, each	20 MGD
	Bar Opening Size	6 mm
	Incline Angle	75-degrees from horizontal
	Channel Width	48 inches
	Channel Depth	60 inches (66 inches at the automatic screen)
Manual Bar Rack	Number	1
	Type	Manually Cleaned
	Capacity	20 MGD[3]
	Channel Width	4 ft
	Channel Depth	5 ft
Grit Removal	Number	2
	Type	Stacked Tray Induced Vortex
	Capacity, each	15.2 MGD (8 out of 12 trays installed)
	Chamber Depth	301 inches
	Diameter	16 ft
Grit Classifiers	Number	2
	Type	Free Vortex
	Capacity, each	Sized for liquid flow of 22.5 MGD
Flow Equalization	Number	3
	Type	Off-line
	Diameter	86.72 ft
	Side Water Depth	19 ft
	Volume	1 MG each
	No. of Return Pumps	5
	Capacity, each	1,500 gpm
Secondary Treatment		
Anoxic Basins	Number of Basins	2
	Length per Zone	48 ft
	Width per Zone	107 ft
	SWD	15 ft
	Volume per Basin	0.58 MG
	Volume, total	1.15 MG
Anoxic Basins Mixers	Number per Basin	2
	Type	Top Entry Mechanical
	Motor Power, each	15 hp

Process		
Aeration Basins (Carrousel Type Oxidation Ditches)	Number	2
	Length	287 ft
	Width	107 ft
	SWD	13.5 ft
	Volume, each	3.10 MG
	Volume, total	6.20 MG
	Aeration Type	Mechanical surface aerators
	Number per Basin	3
	Motor power, each	125 hp (2-speed)
Internal Recycle (IR) Pumps	Number, total	4
	Number per Basin	2
	Type	2-Speed Axial Flow
	Recycle Ratio (high-speed)	323% (@ TMRADF of 3.75 MGD per basin)
	Capacity (high-speed)	8,400 gpm
	Head	10.5 ft
	Motor Power	40/20 hp
Secondary Clarifiers	Number	3
	Type	Center Feed, Peripheral Weir
	Sludge Withdrawal	Segmented Rake (Clarifiers No.1 and No.2) Draft Tube (Clarifier No.3)
	Diameter	110 ft
	SWD	14 ft
	Surface Area, each	9,500 ft^2
	Surface Area, total	28,510 ft^2
	Scum Handling	Scum beach (Clarifiers No.1 and No.2) Ducking skimmers (Clarifier No.3)
RAS Pumps	Number	3
	Type	Centrifugal
	Control	VFD
	Design Capacity, each	2,400 gpm[2]
	Design Firm Capacity	4,800 gpm, 6.91 MGD (92.2 % of TMRADF 7.5 MGD)[2]
	Motor Power, each	25 hp
Tertiary Filters	Number	4
	Type	2 – Automatic Backwash Traveling Bridge
	Media Type and Depth	12 inches (sand) 12 inches (anthracite)
	Surface Area, each	1,440 ft^2
	Surface Area, total	2,880 ft^2
	Filter Loading at Peak Hour Flow	2.0 gpm/ft^2 (ABW Filters)
	Type	2 – Cloth Disk
	Media Type	Pile cloth
	Surface Area, each	1,291 ft^2
	Surface Area, total	2,582 ft^2
	Filter Loading at Peak Hour Flow	4.0 gpm/ft^2 (Disk Filters)[1]

Process		
Disinfection (Sodium Hypochlorite) System	Type	Chlorination (Sodium Hypochlorite)
	Concentration, Sodium Hypochlorite	12.5%
	Number tanks	4[6]
	Capacity, each	2,500 gal[6]
	Number pumps	4
	Type	Metering
	Capacity, each	70 gph
Chlorine Contact Chambers	Number	4
	Length (Nos. 1 & 2)	50 ft
	Width (Nos. 1 & 2)	24 ft
	SWD (Nos. 1 & 2)	8.7 ft
	Volume, each (Nos. 1 & 2)	77,050 gal[5]
	Length (Nos. 3 & 4)	48 ft
	Width (Nos. 3 & 4)	27 ft
	SWD (Nos. 3 & 4)	8.6 ft
	Volume, each (Nos. 3 & 4)	77,710 gal[5]
Biosolids Treatment		
WAS Pumps	Number	4
	Type	Progressive Cavity (1), Centrifugal (3)
	Control	VFD
	Capacity, each	125 gpm[4] (Progressive Cavity), 600 gpm (Centrifugal)
	Motor Power, each	10 hp
Aerated Sludge Holding Tanks	Number	3
	Type	Glass-lined Steel
	Diameter, each	100 ft
	SWD	17 ft
	Volume, each	0.999 MG
	Volume, total	2.996 MG
	Aeration/Mixing System	Medium Bubble[8]
Aerated Sludge Holding Tank Diffusers	Number	3
	Type	Medium Bubble[8]
Aerated Sludge Holding Tank Blowers	Number	3
	Type	Multi-Stage Centrifugal
	Capacity	4,000 scfm[3]
	Discharge Pressure (at high level)	10.8 psig
	Motor Power, each	250 hp
Belt Filter Press Dewatering	Number	3[7]
	Type	Belt Filter Presses
	Width	2 meters
	Design Loading Rate, each	1,200 lb/hr
	Design Capture Efficiency	95%
	Design Cake Solids	18% – 20%

Process		
Dewatering Feed Pumps	Number	4
	Type	Positive Displacement
	Control	VFD
	Capacity, each	125 gpm
	Motor power, each	10 hp
Effluent Pumps	Number	5
	Type	Vertical Turbine
	Control	VFD
	Capacity, each	2,600 gpm
	Motor power, each	150
Reject Pond	Number	1
	Type	Pond
	Area	8 acres
	Permitted Capacity	8 MG
East RCW Storage Pond	Number	1
	Type	Pond
	Area	15 acres
	Permitted Capacity	49 MG
Golf Course Storage Pond	Number	1
	Type	Pond
	Area	112 acres
	Permitted Capacity	417 MG
RCW GST	Number	1
	Type	Storage Tank
	Capacity	0.75 MG

[1]Derated from design 6.5 gpm/sf due to age. The County stated they were not satisfied with turbidity of disk filter effluent at higher flows.
[2]Operators stated that RAS pumps actually have pump less than design capacity.
[3]Capacity listed in the 2017 WRF Master Plan
[4]Estimated from pump curve and assumed head
[5]Calcualted from record drawings surface area and SWD depth calculated with 4.69 MGD flow per CCC (exist. Design PHF of 18.75 divided equally per CCC)
[6]Based on current project to increase NaOCl storage from 6,000 gal to 10,000 gal
[7]BFP operation is currently not 24 hours per day. However, conveyance and infrastructure is in place to load empty trailers at any time of day is in-place for future demands.
[8]See Section 4.1.12 on Biosolids for information on existing diffusers

SECTION 3 DESIGN FLOWS AND LOADING

3.1 HISTORICAL FLOWS

Flow and loading data for calendar years 2018 through 2022 was analyzed to determine design loading and peaking factors for this evaluation. Hourly flow data, daily facility operational data, daily information from DMRs, and weekly influent and effluent lab data were provided. It was assumed that wastewater from Piney Point gypsum stack wastewater holding cell NGS-N started being discharged into the County's collection system beginning April 1, 2021, at 100,000 gpd. This has continued through the date of this CER. See **Section 2.2** regarding a three-month interruption in Piney Point flow that was not considered for this analysis. The Piney Point flow and loading was captured in the County's NRWRF influent data. Note that hauled wastewater to the site, such as landfill leachate, is not recorded with the influent flow meters and not accounted for with these flows.

Flow peaking factors were determined from values calculated from flow data, with an attempt to remove the additional loading from Piney Point and considering the trend of lower peaking factors as flows have increased in the past couple of years. Hourly flow data for the months of August through December of 2019 was not available, and assumptions were made about the peak hourly flow (PHF) trend. A comparison of recent flows to the NRWRF is shown in **Table 3.1** below. Additional rows were added for years 2021 and 2022 with 100,000 gpd removed for Piney Point. Note that the max day flows (MDF) and peak hourly flows did not increase at the same rate as AADF, TMRADF, and MMDF.

Table 3.1 Historical Influent Wastewater Flows from 2018 to 2022

Year	AADF (MGD)	TMRADF (MGD)	MMDF (MGD)	MDF (MGD)	PHF (MGD)
2018	3.76	4.10	4.48	8.22	11.25
2019	4.15	4.64	5.21	8.10	N/A[1]
2020	4.84	5.19	5.67	9.73	13.8
2021[2]	4.90	5.53	5.70	8.35	11.14
2021 w/o PP[3]	4.83	5.50	5.62	8.25	N/A
2022[2]	4.92	5.42	5.87	7.94	11.87
2022 w/o PP[3]	4.82	5.37	5.77	7.84	N/A

[1]See note in paragraph above about missing hourly flow data in 2019
[2]Note values include 100,000 gpd of flow from Piney Point starting in April of 2021
[3]With 100,000 gpd removed from Piney Point

3.2 FLOWS AND LOADING DATA

The sidestream loads from landfill leachate and Piney Point wastewater will be redirected to another facility or end by the time the NRWRF is expanded. The County stated that these loads should not be included in the basis of design for the expansion. The landfill leachate did not impact the data since it is discharged into the plant drain pump station, where flow and concentrations are not measured. For Piney Point, 100,000 gpd was removed from the flow data starting April 1, 2021. See **Section 2.2** regarding a three-month interruption in Piney Point flow that was not considered for this analysis.

Basis of design flow peaking factors compared to the 2017 WRF Master Plan and "10 States Standards" for the NRWRF are summarized in **Table 3.2** below. Note these peaking factors were applied to the AADF not TMRADF.

Table 3.2 Basis of Design Flow Peaking Factors Compared to Other References

PF from AADF [1]	TMRADF	MMADF	MDF	PHF
Basis of Design	1.10	1.20	1.90	2.50
2017 Master Plan	N/A	1.27	1.48	2.75[2]
10 States Standards (for 7.5 MGD)				1.9[3]
10 States Standards (for 12.5 MGD)				1.7[3]

[1]Peaking factors from AADF not TMRADF
[2]Difference between PHF and TMRADF is 2.5
[3]10 States Standards PHF based upon 58 gpcd noted in the 2022 Wastewater Collections System Master Plan Updates

Historical influent wastewater pollutant concentrations are summarized in **Table 3.4** below based on data from 2018 to 2022. Composite samples were analyzed by the Manatee County lab weekly. The number of samples per month creates some uncertainty in the averages and peaking factors derived. The $cBOD_5$ and TSS annual average concentrations reduced as flows have increased. This was influenced by dilution of these pollutants from Piney Point in 2021 and 2022. The trends were considered in the average concentrations used for the basis of design. Pollutant concentrations in the Piney Point wastewater holding cell NGS-N were measured with a separate project in 2021 and again in late 2022. The data is shown below in

Table 3.3. The loading contributions based on these concentrations and flow of 100,000 gpd were subtracted from the calculated loading for the design pollutants for years 2021 and 2022. This appeared to remove too much of the base loading for some of the pollutants as shown in **Table 3.4**. Therefore, a conservative estimate was made on the basis of design concentrations for each of the design pollutants based on historical numbers.

Table 3.3 Piney Point Gypsum Stack Pollutant Concentrations Measured in 2021 and 2022

Pollutant	Units	NGS-N (2021)	NGS-N (2022)	% Difference	Concentrations Used for CER
TSS	mg/L	20	9.8	49%	18
TN	mg/L	310	376	121%	323
Ammonia	mg/L	290	338	117%	300
TKN	mg/L	310	375	121%	323
TP	mg/L	350	233	67%	327

Table 3.4 NRWRF Basis of Design and Historical Influent & Effluent Water Quality Data

Year	$cBOD_5$	TSS	TKN	NH_3-N	TP
2017 Master Plan	250	250	40	N/A	8
2018 (Avg.)	175	253	48	40.6	6.1
2019 (Avg.)	204	241	44.2	40.5	6
2020 (Avg.)	165	165	43.3	41.3	5.4
2021 (Avg.)	159	128	47.2	41.6	7
2021 w/o PP	161	130[1]	44.3	39[2]	3.5[4]
2022 (Avg.)	154	145	53.9	43.8	8.3
2021 w/o PP	158	147[1]	48.2[3]	38.4[2]	1.6[4]
Basis of Design	175	200	46	41	6

[1]Appears to be low, i.e., expected higher dilution
[2]Appears to be a little low compared to prior years
[3]Appears to be a little high compared to prior years
[4]Appears to be a lot lower than expected and prior years

Peaking factors for influent pollutant loads were derived from the five years of lab data and trends. **Table 3.5** summarizes the basis of design influent loading for 7.5 MGD TMRADF. These averages and peaking factors were applied to expansion design flows discussed later in this CER.

Table 3.5 NRWRF Basis of Design Influent Loading for Existing 7.5 MGD TMRADF

Parameter		AADF	PF[2]	TMRADF	PF	Max Mon.	PF	Peak Day	PF	Peak Hour
Flow	MGD	6.82	1.10	7.50	1.20	8.18	1.90	12.95	2.50	17.05
BOD	mg/L	175								
	lb/d	9,951	1.10	10,946	1.4	13,932	1.7	16,917		
TSS	mg/L	200								
	lb/d	11,373	1.10	12,510	1.9	21,608	3.1	35,255		
VSS[1]	mg/L	150								
	lb/d	8,530	1.10	9,383	1.4	11,941	1.7	14,500		
TKN	mg/L	46								
	lb/d	2,616	1.10	2,877	1.2	3,139	1.4	3,662		
NH3	mg/L	41								
	lb/d	2,331	1.10	2,565	1.2	2,798	1.4	3,264		
TP	mg/L	6.2								
	lb/d	353	1.10	388	1.3	458	1.7	599		

[1]Assumed based on typical % of TSS
[2]Peaking Factor

SECTION 4 EVALUATION AND MODELING OF EXPANSIONS

This section describes the proposed capacity improvements to the NRWRF for the expansion to 10 MGD, 12.5 MGD with MLE, and 12.5 MGD with AGS, with 12.5 MGD with AGS being the recommended alternative. The unit processes covered include from the headworks to the effluent pump station and biosolids. The capacity requirements of all unit processes within the expanded NRWRF are based on the flows and loading expected at the future design flow rates, industry standard guidelines such as MetCalf & Eddy Wastewater Engineering, WEF MOP 8, "10 State Standards", and Class I Reliability requirements as defined by the United States Environmental Protection Agency (USEPA) and as carried by FDEP. To meet Class I Reliability, the following conditions apply:

- Flow equalization shall not be considered as a substitute for component backup requirements.
- A backup aeration basin shall not be required; however, at least two equal volume basins shall be provided.
- There shall be a sufficient number of blowers or mechanical aerators to enable the design oxygen transfer to be maintained with the largest capacity unit out of service. At least two units shall be installed.
- The air diffusion system for each aeration basin shall be designed such that the largest section of diffusers can be isolated without measurably impairing the oxygen transfer capability of the system.
- For the clarifiers and filters, there shall be a sufficient number of units of a size, such that with the largest capacity unit out of service, the remaining units shall have a design capacity of at least 75% of the total design flow to that unit operation.
- The chlorine contact chambers shall be of a sufficient number of units of a size, such that with the largest flow capacity unit out of service, the remaining units shall have a design flow capacity of at least 50% of the total design flow to that unit operation.
- A backup pump shall be provided for each set of pumps which perform the same function. The capacity of pumped systems shall be such that with any one pump out of service, the remaining pumps will have capacity to transfer the peak flow. It is permissible for one pump to serve as a backup to more than one set of pumps.

- For components included in the design of the sludge handling and disposal system of Reliability Class I works the following backup requirements apply:
  - Sludge Holding Tanks: Holding tanks are permissible as an alternative to component or system backup capability for components downstream of the tank, provided the following requirements are met. The volume of the holding tank shall be based on the expected time necessary to perform maintenance and repair of the component in question. If a holding tank is used as an alternative to backup capability in a sludge treatment system which is designed for continuous operation, the excess capacity in all components downstream of the holding tanks shall be provided to enable processing the sludge which was retained together with the normal sludge flow.
  - For centrifuges (this also applies to belt filter presses), there shall be a sufficient number of units to enable the design sludge flow to be dewatered with the largest capacity unit out of service. It is permissible for the backup unit to be an uninstalled unit, provided that the installed unit can be easily removed and replaced.

4.1 EXPANSION TO 10 MGD AADF - MLE

4.1.1 FLOW AND LOADS FOR 10 MGD - MLE

The basis of design flows and loads for 10 MGD AADF are shown below in **Table 4.1**. The peaking factors derived from data review discussed in **Section 3.2 Flows and Loading Data** were applied to the future design flow condition.

The 2022 flow projection update and trajectory of recent flows shows that it will take about 6-8 years for AADF flows to increase from 10 MGD to 12.5 MGD. An expansion to 10 MGD AADF will likely require an expansion to 12.5 MGD AADF shortly after. This alternative of expanding to 10 MGD AADF was evaluated based on the agreed upon scope of services. However, expansion to 10 MGD AADF is not a realistic alternative for the County to consider due to the number of years required for design and construction of an expansion.

Table 4.1 NRWRF Basis of Design Influent Loading for Future 10 MGD AADF

Parameter		AADF	PF	Max Mon.	PF	Peak Day	PF	Peak Hour
Flow	MGD	10.00	1.20	12.00	1.90	19.00	2.50	25.00
BOD	mg/L	175						
	lb/d	14,595	1.4	20,433	1.70	24,812		
TSS	mg/L	200						
	lb/d	16,680	1.9	31,692	3.1	51,708		
VSS	mg/L	150						
	lb/d	12,510	1.5	17,514	2.0	23,352		
TKN	mg/L	46						
	lb/d	3,836	1.2	4,604	1.40	5,371		
NH3	mg/L	41						
	lb/d	3,419	1.2	4,103	1.4	4,787		
TP	mg/L	6						
	lb/d	500	1.2	600	1.4	701		

4.1.2 PROCESS EVALUATION OF THE EXPANSION TO 10 MGD - MLE

The following processes identified will require improvements or additional capacity to expand the facility to 10 MGD AADF with the existing MLE process at the current permit limits and target effluent TN of 10 mg/L. If not listed, the existing unit processes have sufficient capacity for the additional flow and loading.

- Headworks improvements and rehabilitation
- Conversion of existing Carrousel basin 125 HP aerators to VFD control with instrumentation and adjustable weir gates
- Upgrade of Secondary Clarifier No. 3 mechanism
- Addition of a fourth secondary clarifier
- Replacement of existing RAS pumps to increase capacity
- Additional parallel RAS line
- Conversation of existing granular media ABW filters to AquaDiamond filters (50’ laterals estimated for 12.5 MGD expansion)
- Upsizing of filter effluent piping
- Additional sodium hypochlorite storage
- Upgrade the effluent pump station capacity
- One gravity belt thickener, thickened sludge pump system, and canopy
- Construction of a new 7 MG Reject Pond using the footprint of the north portion of the east RCW pond

4.1.3 SITE PLAN AND PFD - 10 MGD - MLE

Figure 4.1 shows the proposed additional infrastructure and accessories necessary to expand the NRWRF to meet the future AADF capacity of 10 MGD based on expansion of the existing MLE process. A proposed process flow diagram (PFD) for the expansion of the existing MLE process is also included in **Figure 4.2** below.

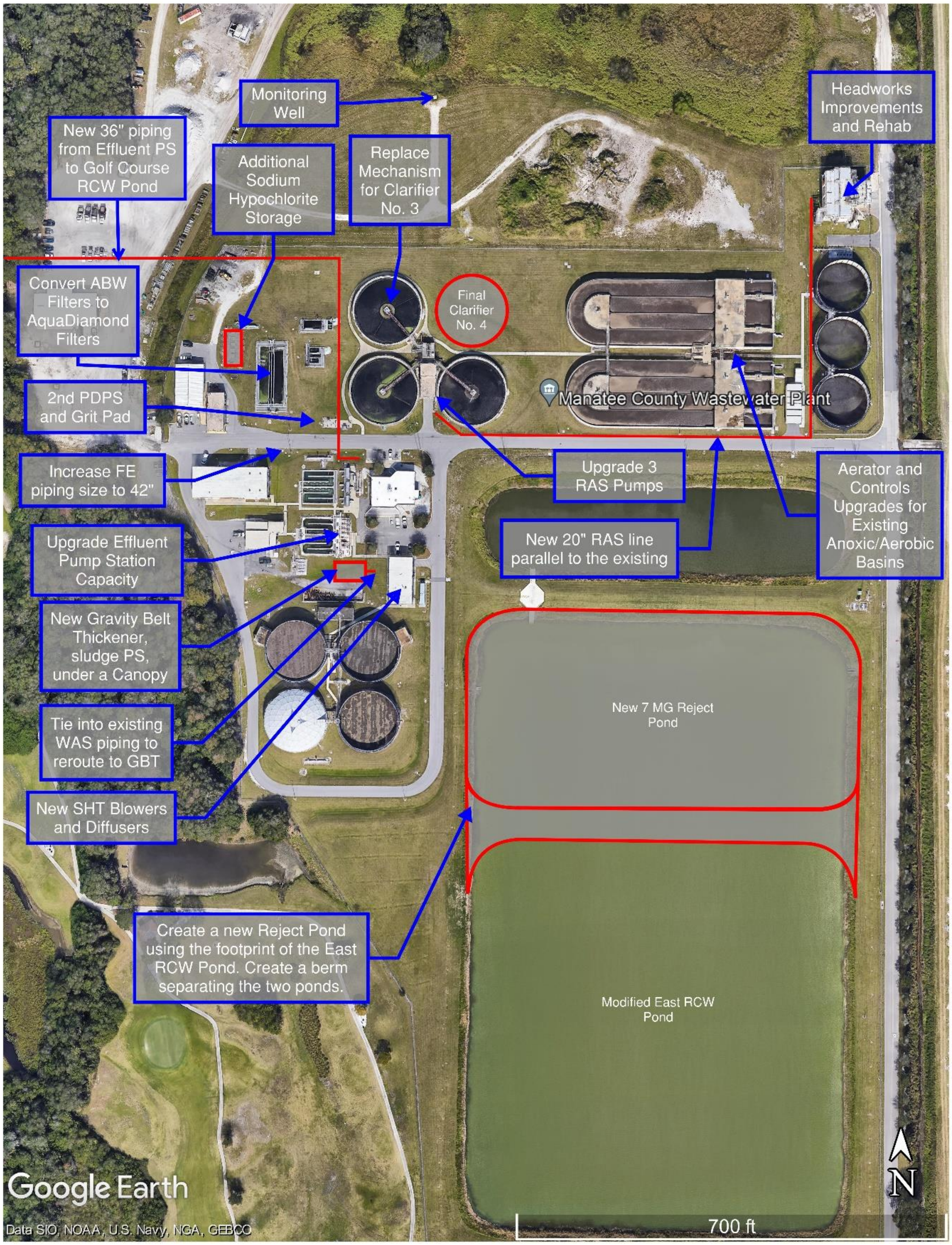
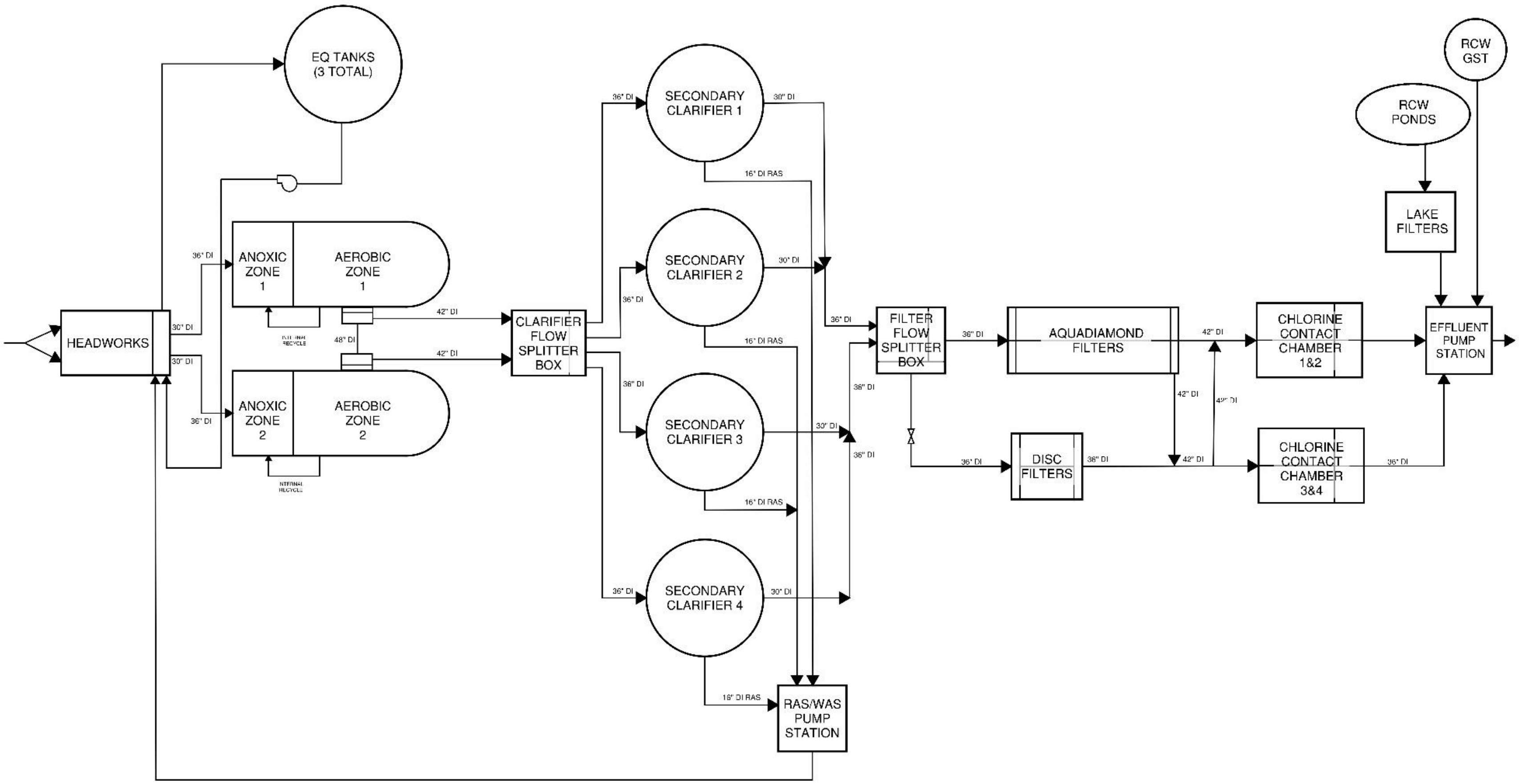


Figure 4.1 Proposed General Arrangement for NRWRF MLE Expansion to 10 MGD AADF



MANATEE COUNTY NORTH REGIONAL WATER RECLAMATION FACILITY
PROCESS FLOW DIAGRAM
EXPANSION TO 10 MGD AADF WITH MLE

Figure 4.2 Proposed Process Flow Diagram for NRWRF MLE Expansion to 10 MGD AADF

4.1.4 IMPACTS OF SITE MODIFICATIONS ON EXISTING PROCESSES – 10 MGD - MLE

Based on the proposed improvements described above, impacts to existing processes, maintenance of plant operations, yard piping, site access/vehicle movement, and stormwater were considered. A summary of the impacts of these improvements is described in the sections below.

4.1.4.1 EXISTING PROCESSES

Expansion of the NRWRF to an AADF capacity of 10 MGD is expected to impact the preliminary, secondary, tertiary, effluent pumping, biosolids treatment processes, reject storage, and RCW storage. These impacts are described later in **Section 4.1**. The operation of the flow equalization facilities will not be affected by this expansion.

4.1.4.2 MAINTENANCE OF PLANT OPERATIONS

Maintenance of plant operations (MOPO) is a critical concern during any major WRF expansion project to ensure that construction activities will not impair the County's ability to adequately operate and maintain the WRF and continue to meet effluent permit limits during construction. Impacts on MOPO for each major recommended improvement for the expansion of the NRWRF to 10 MGD AADF are summarized below:

- Headworks improvements and rehab
    - Extensive bypassing and potentially temporary screening will be required to construct the improvements to the existing headworks.
    - Careful coordination with facility staff must be implemented to maintain continuous flow.
- Retrofit of Anoxic/ Aerobic Basins
    - The anoxic/aerobic basins must be drained one basin at a time to replace aerators, replace weir gates, install other DO control components, and demolish portions of existing walls to construct a new IR gate and concrete channel.
    - These improvements are recommended to be completed after Secondary Clarifier No. 4 is constructed and Secondary Clarifier No. 3 is retrofitted to handle increased MLSS concentrations.

  - The facility will have to run on one Carrousel train at a time during these improvements. This must be done during lower flow and load periods. It may be feasible to have one Carrousel basin out of service for up to two weeks at a time with a temporary aerator added and a low SRT. Aeration is anticipated to be undersized with just three aerators on one basin in service. The lower SRT will keep the MLSS at a reasonable concentration for the secondary clarifiers.
  - Careful coordination with facility staff will be implemented to maintain plant flow and prevent SSO's in the collection system.
- Construction of Secondary Clarifier No. 4
  - There are capped stub outs for connections to the Clarifier and Filter Splitter Boxes in place for the fourth clarifier. No shutdown is anticipated for Clarifier Splitter Box connection. A shutdown of clarifier No. 3 of up to 8 hours may be required to connect a new CE line from new clarifier No. 4 to the manifolded CE line to the Filter Splitter Box shared with clarifier No. 3.
- Replacement of clarifier mechanism at Secondary Clarifier No. 3
  - This is recommended to be completed after Secondary Clarifier No. 4 is constructed and online.
  - Secondary Clarifier No. 3 will be drained to demo the existing draft-tube style mechanism and replaced with a spiral blade mechanism.
  - This must be done during lower flow and load periods. It may be feasible to have clarifier No. 3 out of service for up to a month. The SRT will need to be lowered to keep the solids loading rate on clarifiers Nos. 1 and 2 at a reasonable rate.
  - Careful coordination with facility staff must be implemented to maintain treatment.
- Upgrade RAS pumps and construct additional RAS line
  - Bypassing is expected during the replacement of existing RAS pumps and pump station piping.
  - The additional parallel 20-inch RAS line can be constructed with minimal impacts to RAS and headworks. Short duration shutdowns may be required for tie-ins.
- Construction of an additional Plant Drain Pump Station (PD PS) and Grit Pad
  - The additional PD PS can be constructed with minimal interruptions to the current plant drain system. Brief shutdowns on the plant drain system may be required to tie into the existing PD PS and at the splitter box or EQ tanks.

- Conversion of ABW Filters to AquaDiamond Filters
  - The ABW filters are recommended to be converted to AquaDiamond filters one at a time to maintain sufficient filtration capacity.
- Upsizing of filter effluent piping
  - The existing 36-inch filter effluent piping will be replaced with 42" piping with minimal impacts to the other yard piping. Short duration shutdowns may be required for tie-ins.
  - Careful coordination with facility staff must be implemented to maintain treatment.
- Construction of additional sodium hypochlorite storage
  - Additional sodium hypochlorite storage can be constructed with minimal interruptions to the existing disinfection storage and dosing system. Very brief shutdowns on the chemical pumping system may be required to tie into the pump suction lines.
- Upgrade effluent pump station capacity and new 36-inch RCW line
  - Bypass pumping from the chlorine contact chambers effluent is expected for this upgrade.
  - The additional 36-inch RCW line can be constructed with minimal impacts to effluent pump station. Capacity of discharge into Golf Course RCW pond was not evaluated. If a new discharge structure is needed a coffer dam will be required in the pond. Short duration shutdowns may be required for tie-ins.
  - Careful coordination with facility staff must be implemented to maintain treatment.
- Construction of new sludge holding tank blowers and diffusers
  - The existing sludge holding tanks will be retrofitted with three new diffusers and three new blowers.
  - Each sludge holding tank will be taken down one at a time to replace the diffuser and the blower to minimize impact on the sludge holding tank capacity.
  - Careful coordination with facility staff will be implemented to maintain plant flow.
- Construction of one gravity belt thickener and sludge PS
  - The new gravity belt thickener and sludge PS will be constructed just southeast of the existing chlorine contact chambers.

    - The new gravity belt thickeners will be connected to the existing WAS piping running from the clarifiers to the sludge holding tanks. A 24-hour shutdown of the WAS system may be needed during the connections.
- Replacement of belt filter press polymer system
    - A shutdown of up to 24 hours may be required to make tie-ins for the replacement of the belt filter press polymer system. This can be managed with sludge storage.
- Construction of a new 7 MG Reject Pond
    - East RCW Pond will be dewatered, and a portion of the pond will be sheet piled out to completely drain the northern portion of the pond.
    - During this process, RCW will be diverted to the existing GST or to the Golf Course Storage Lake.
    - Careful coordination with facility staff will be implemented to maintain plant flow.

4.1.4.3 YARD PIPING

The major yard piping modifications proposed for the expansion include the following:

- Extension of 36-inch ML pipelines from existing Clarifier Flow Splitter Box to new Clarifier No. 4
- 16-inch RAS from new Clarifier No. 4 to the RAS/WAS pump station
- 8-inch WAS pipe from new Clarifier No. 4 to the RAS/WAS pump station
- A new parallel 20-inch RAS pipeline from RAS/WAS pump station to the Headworks
- Extension of 30-inch CE from new Clarifier No. 4 to the new 36-inch CE piping then to the existing common 36-inch CE piping
- 8-inch WAS pipeline from new gravity belt thickeners to existing WAS piping to the sludge holding tanks
- 16-inch PD PS force main from the new additional PD PS to the existing splitter box or EQ tanks
- 42-inch FE pipeline to replace existing 36-inch pipeline between AquaDiamond Filters and all CCCs
- 36-inch Effluent pipeline to replace the existing 12-inch pipe from the Effluent Pump Station to Golf Course RCW Pond
- 4-inch pipeline from lake filter backwash to East RCW pond

4.1.4.4 SITE ACCESS/VEHICLE MOVEMENT

Vehicles can access the project area from the north via 69th Street East which is a two-lane asphalt surface roadway in a rural section. Access roads within the NRWRF vary between 20 and 24 feet in width, are constructed of asphalt, and are provided with a turning radius of approximately 35 feet in order to accommodate larger tractor trailer trucks. Minimal impacts to the facility are anticipated from the construction of improvements for the expansion at the NRWRF. Coordination of deliveries and maintenance activities will be required during construction near existing facilities.

4.1.4.5 STORMWATER

The NRWRF site is relatively flat with minimal impervious area. Based on the proposed process improvements, it is expected that the expansion project will result in minimal increase in impervious surface area. The proposed secondary clarifier and upgrades to existing structures for the expansion will be constructed with open tops to allow rainwater in and ensure there will be little to no increase in impervious surface area. As a result, there will be minimal impacts to the existing stormwater system. No additional stormwater improvements are expected as part of these site improvements.

4.1.5 PRELIMINARY TREATMENT SIZING - 10 MGD - MLE

4.1.5.1 HEADWORKS AND EQUALIZATION

Currently, for Class I Reliability the total screening capacity is 40 MGD and the total HeadCell grit units' capacity is 30.4 MGD, with the number of trays installed. Both exceed the expected PHF of 25.0 MGD for the expansion to 10 MGD AADF. However, major improvements and rehabilitation to the existing Headworks structure are needed due to corrosion in the Headworks structure and ragging problems downstream. An evaluation into the Headworks improvements and corrosion mitigation was conducted. Refer to the TM in **Appendix I** for details.

The existing 3 MG of equalization (EQ) storage is estimated to be sufficient for expansion to 12.5 MG AADF. A diurnal pattern developed from 2021 hourly flows was applied to the maximum month flow condition associated with the 12.5 MGD AADF alternative. 2.6 MG of storage is estimated to even out the diurnal pattern for this flow as shown in **Figure 4.3**. The EQ return firm pumping capacity of 6,000 gpm (8.64 MGD) will empty the 3 MG of storage in 8-9 hours. This is sufficient return capacity according to design standards. In the future, the County could add two additional pumps in the two available spots at the existing EQ return PS. However, the cost for EQ system improvements is not included in this CER.

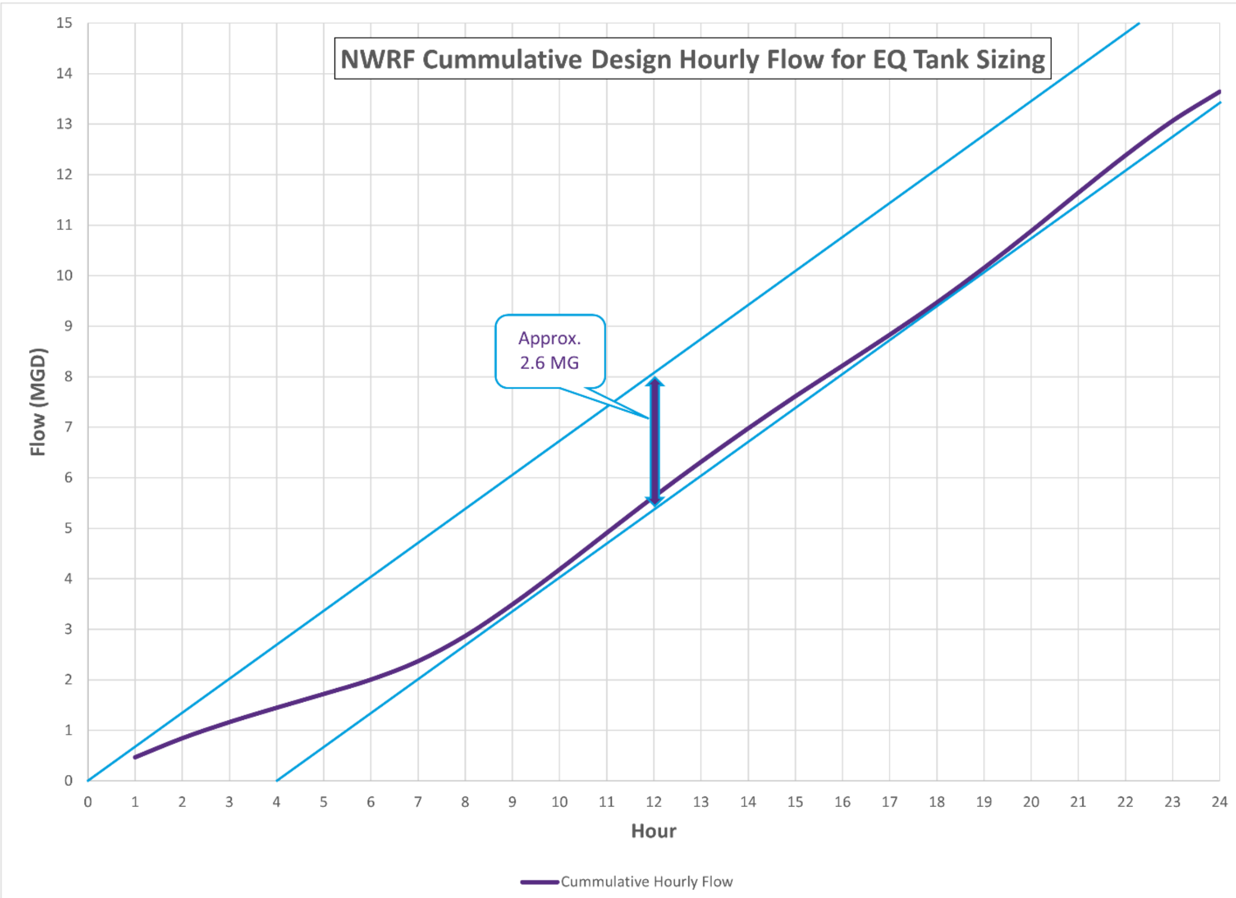


Figure 4.3 Existing EQ Tank Capacity Based on Estimated Diurnal Pattern at Future Max Month Flow

4.1.6 SECONDARY TREATMENT SIZING - 10 MGD - MLE

This alternative is based on expanding the existing MLE secondary treatment process. Expansion by adding new parallel AGS process is not recommended for expansion to 10 MGD AADF. The cost of adding a new parallel AGS system for the additional 2.5 MGD AADF would be significantly more than the addition of a fourth clarifier and increase in RAS capacity. Economy of scale and comparison of additional MLE process volume makes a larger expansion by adding AGS more economically feasible for other alternatives discussed in this CER.

4.1.6.1 SPREADSHEET MODELS

Spreadsheet models were used as an initial estimate to establish capacity of aeration volume and clarifier surface area for the design loading conditions. With the addition of the fourth clarifier the estimated activated sludge capacity was conservatively 10.3 MGD AADF with maximum month loading applied and Class I Reliability of 75% of peak day loading with one clarifier out of service at a Y_{Net}=1 and SVI=200 (see **Section 4.1.6.4**) as shown in **Figure 4.4**. These results are at an aerobic SRT of 7 days with the addition of a fourth clarifier. At these operating conditions and peak day loading the state point for the secondary clarifiers was estimated to be in an underloaded condition. For clarifier state point analysis, an underloaded condition is good, and the operating point is at the intersection of the underflow and overflow lines which is below the gravity flux curve, as shown in **Figure 4.5**.

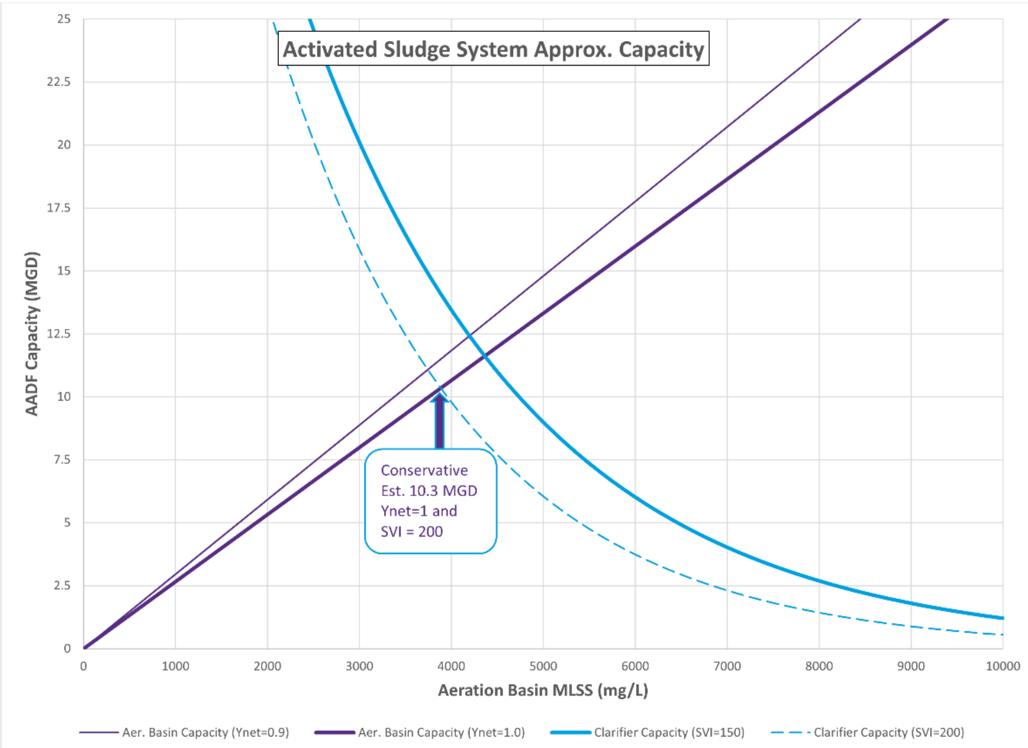


Figure 4.4 Activated Sludge Capacity for 10 MGD AADF (SRT 7 days)

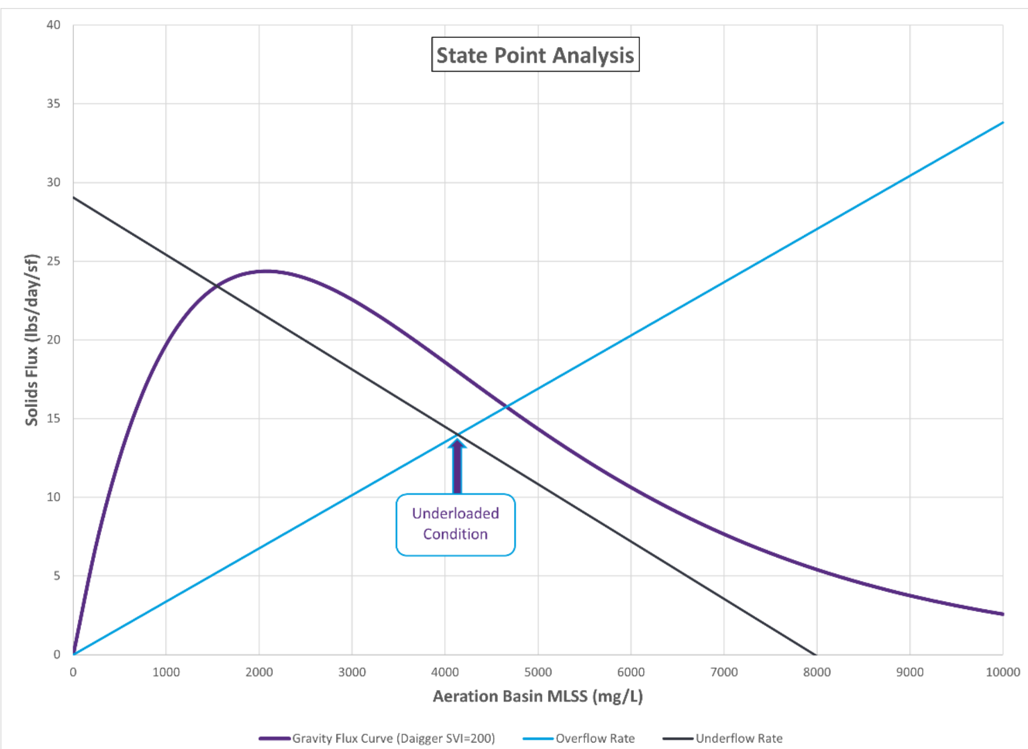


Figure 4.5 State Point Analysis for 10 MGD AADF

The existing six 125 HP aerators (three per basin) must be upgraded to new higher efficiency impellers to have sufficient capacity to meet the estimated increased oxygen demand at the design peak day loading for 10 MDG AADF with Class I Reliability. The horsepower of the aerators does not need to be increased with the higher oxygen transfer noted. See **Table 4.2** below.

Table 4.2 Estimated Total Aeration Capacity for 10 MGD AADF Peak Day Loading

Parameter	Value
Aerator HP (each)	125
Aerator HP (Total)	750
Aerator Oxygen Transfer Efficiency (OTE) (per aerator) (lb O_2/hr/HP)	3.65[1]
Aerator Oxygen Capacity at Standard Conditions (each) (lb O_2/hr)	456.25
Total Aerator Oxygen Capacity at Standard Conditions (lb O_2/d)	65,700
Total Aerator Oxygen Capacity Class I at Standard Conditions (lb O_2/d)	54,750
Estimated Actual Oxygen Requirement (AOR) (lb O_2/d)	33,420
Estimated Standard Oxygen Requirement (SOR) (lb O_2/d)	54,553[2]

[1]Per Ovivo for latest dual impeller aerators
[2]Less than aerator capacity

4.1.6.2 BIOWIN MODELS

Conceptual level BioWin models were set up to confirm initial sizing, evaluate aerator operation, evaluate increased IR rates, and estimate nitrogen removal. No additional sampling was conducted beyond what the County normally conducts to maintain permit compliance. The DO and nitrogen profiles were not calibrated. No supplemental data was acquired for calibration.

The following assumptions were made for conceptual level model setup and should be verified before using for design:

- Influent loading was based on the data available and discussion in **Section 3.2**.
    - Once a week for pollutant concentration measurement is not enough data points for the level of certainly required for detailed design. More sampling should be conducted prior to preliminary design.
- Influent characterization was based on BioWin default values without any facility data. Influent characterization sampling should be conducted prior to preliminary design.
- Carrousel channel velocities were assumed to be 1 ft/sec for all BioWin model setups. Field testing and/or coordination with Ovivo to confirm actual and target ditch velocities at high and low aerator speeds is recommended.

- Additional field testing for the following would be beneficial to improve the accuracy of model performance:
  - Actual DO profile at both aerator speeds
  - Actual nitrogen speciation profile at least one aerator speed
- The number of zones in the model would be adjusted to correlate with the field data mentioned above
- Models were run steady-state at maximum month loading conditions. Peak day aeration demands and clarifier loading were estimated by other means and noted in the previous section.

Models represent one of the two Carrousel trains with a single clarifier of representative surface area for two of the four total (three existing clarifiers plus a fourth for 10 MGD AADF). **Figure 4.6** shows the BioWin flowsheet for model setups. The capacity of the existing axial flow internal recycle (IR) pumps of 12 MGD per train (at high speed) was used for most of the scenarios as noted in **Table 4.3**. An additional scenario was run to predict performance with increased IR rate. The model was run with the existing surface aerators at high speed (125 HP) and based on automatic control to maintain a target DO concentration to demonstrate the benefit of DO control with VFDs on the existing aerators. The latter is representative of a DO control system with VFDs on existing aerators, motorized effluent weir gates on Carrousel basins, and instrumentation in the Carrousel basins. The results of the modeling are listed in **Table 4.3**.

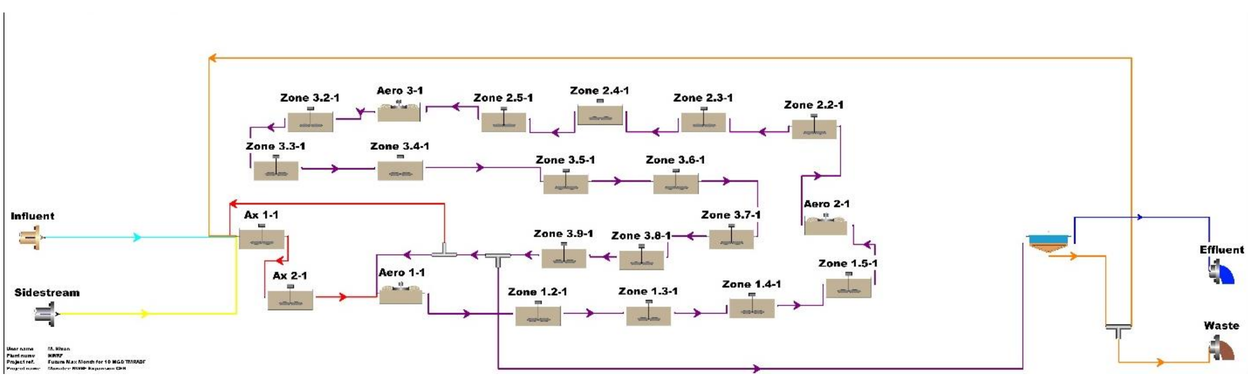


Figure 4.6 BioWin Flowsheet Example from Model Setup

When the model was run with all three aerators on at 125 HP (high speed) simultaneous nitrification-denitrification (SND) was limited in oxidation ditch channels and effluent TN was predicted to be above 10 mg/L. When aerators were adjusted to promote SND, the internal carbon in the wastewater was more effectively used for improved nitrogen removal. SND is dependent on DO throughout the channels in the aerobic oxidation ditch portion of each Carrousel basin. DO drops along the length of the channels as mixed liquor moves away from each aerator, which creates a DO profile. SND starts to occur at a DO around 0.5 mg/L. Implementing the ability to control the DO at the aerators and generate an improved DO profile will increase nitrogen removal without improvements to IR rate, pre-anoxic volume, or addition of external carbon. Effluent TN could be controlled down to 5-6 mg/L without a downstream reaeration basin, assuming sufficient carbon, which would otherwise be needed to increase the DO of MLSS headed to the clarifiers and depress denitrification from occurring in the clarifiers. The model demonstrates this, but due to assumptions noted above the level of certainty is low for predicted results of nitrogen removal performance and actual aerator HP. However, an effluent TN of 10 mg/L or less is expected to be achievable with DO control.

Another scenario to demonstrate the effect of IR rate on denitrification was generated. At 20 MGD per basin, or 4Q (four times the AADF in this case), the effluent NO_3 is predicted to be a little higher than at the current 12 MGD IR rate as shown in **Table 4.3**. One possible reason for this is that the readily biodegradable COD is depleted in the IR stream, i.e., the system is carbon limited. The carbon to nitrogen ratio for the raw wastewater is lower than typical medium strength municipal wastewater, which supports indication that the system is carbon limited. With an MLE system denitrification increases with increased IR rate to a point at which denitrification maxes out or deteriorates with additional increase in IR rate. For a carbon limited system, the ideal IR rate for maximum denitrification is lower than the typical 2 to 4 Q.

The process evaluations on the existing and improved Carrousel basins were discussed with the equipment manufacturer, Ovivo. Process modeling results are consistent with Ovivo's analysis and recommendations. Some of Ovivo's preliminary recommendations are included in **Appendix H**.

Table 4.3 BioWin Modeling Select Results Comparison for 10 MGD AADF – Max Month Condition

Parameter	Aerators - High Speed (125 HP)	Aerators – Adjusted to Promote SND	4Q IR Aerators - High Speed
SRT (days)	7	7	7
IR Rate (MGD)	12	12	20
MLSS (mg/L)	3,681	3,686	3,683
Eff. Ammonia (mg/L)	0.2	0.2	0.2
Eff. NO_3 (mg/L)	12.0	6.3	12.3
Eff. NO_2 (mg/L)	0.1	0.1	0.1
Eff. TN (mg/L)	13.8	8.2	14.2
Eff. TP (mg/L)	3.3	3.2	3.3
Eff. TSS (mg/L)	7.4	7.4	7.4
Eff. BOD_5 (mg/L)	2.3	2.3	2.3
WAS Flow (MGD (% solids))	.434 (0.7%)	.434 (0.7%)	.434 (0.7%)

4.1.6.3 CARROUSEL OPERATIONAL AND PERFORMANCE IMPROVEMENTS

A recommended improvement to increase nitrogen removal and reduce aeration power consumption would be to add a DO control system with VFDs to control the speed of the existing surface aerators. The Ovivo recommended control system also includes ORP probes for the pre-anoxic zones. Additional instrumentation such as nutrient probes may be considered in preliminary design. The existing aerator motors are two-speed. It's estimated that less than 105 HP is needed to meet the peak day loading oxygen demand for the six aerators, and less than 65 HP per aerator is needed for design annual average loading. The ability to ramp aerators up and down to meet the oxygen demand will improve process performance and save on energy cost the majority of the time when the high or low speed does not meet the oxygen requirements. Effluent TN has been below the County's goal most of the time. Due to the actual loading compared to design capacity some of the aerators have been at low speed until sometime in 2022. As loading increased the aerators needed to be at high speed to achieve complete nitrification. Over-aeration is expected with the aerators at high-speed. Over-aeration will minimize SND that occurs in the aerated portion of the Carrousel basins, and the majority of the dentification must occur in the pre-anoxic zones. Limitation of dentification in the pre-anoxic zones is discussed below. The DO control system can be implemented with variable control of the aerators combined with DO probes and motorized effluent gates. Replacement of the existing aerators with higher oxygen transfer efficiency impellers will ensure sufficient capacity for the increase in predicted oxygen demand as previously discussed. The newer Ovivo Excell aerators also have slightly higher oxygen transfer efficiency than the existing aerators. Many of the existing aerators do not have a lower impeller. The lower impeller helps to keep solids in suspension when the aerators speeds are reduced by VFDs. It is recommended that aerator replacements include the lower impellers as part of this DO control system improvement. With DO control SND can been increased as discussed in **Section 4.1.6.2** which is the most efficient way to lower secondary effluent TN with the existing Carrousel basins. It is unlikely that effluent TN of 10 mg/L can be maintained for the expansion without this improvement.

The suggested improvement utilizes the Oculus control system by Ovivo. This utilizes DO probes to control VFDs in the basins. The Oculus control system is a custom engineered control panel that takes in all required signals and with user input such as setpoints and limits can then control the aerator motors via VFDs and control the weir gates based on the data input to the system from the probes. The control panel and motor controls are based on the needs of the project. Additional equipment would include a control panel (containing a PLC and HMI for a user interface), two VFDs to control the aerator motors, and two mixer starters, and I/O capacity to control the gates as well as bring in the instrumentation signals.

Another improvement to the Carrousel basins evaluated was to create internal recycle channels in each basin and use IR gates rather than pumps to return the nitrified mixed liquor to the pre-anoxic zones. This improvement is not recommended due to the findings of the evaluation as follows. IR gates use a fraction of the energy and allow for a larger range of IR rates. The current IR pumping rate for each basin is 12 MGD at the high speed, which would be 2.4 Q (Q = design plant flow per basin = 10 / 2 = 5 MGD). MLE systems generally are designed for 2 to 4 Q of the AADF or MMDF. The IR gates would allow for typical MLE IR rates at or above 4 Q with a reduction in power. This would require modifications to the basins with demolition and concrete reconfiguration. The Ovivo Oculus system installed for DO control would also be able to control the IR gate positions. As discussed in **Section 4.1.6.2**, high level BioWin modeling did not show improvement with increased IR rates beyond the existing high speed pumping capacity. No performance benefit is predicted from implementing this improvement. This improvement could be justified based on O&M benefits and a reduction in power costs with gates compared to the existing pumps. The payback period based on energy saving alone was estimated to be almost 25 years. It was assumed that including O&M costs would at most reduce this by a few years. After discussing the findings in the draft CER with the County it was decided that the IR gates should not be recommended as part of the expansion. With the County's direction to expand NRWRF with AGS it is not fiscally responsible to put additional investment into the Carrousel basins without a reasonable return on investment.

4.1.6.4 RAS AND CLARIFIER CAPACITY AND OPERATIONAL IMPROVEMENTS

The existing RAS capacity will need to be increased to a minimum of 125% of the expanded plant design flow (12.5 MGD RAS capacity for 10 MGD AADF). An evaluation of expanding RAS pumping to 12.5 MGD and 15.63 MGD concluded that the additional cost to increase to 15.63 MGD was less than 10% additional compared to 12.5 MGD. Therefore, it is recommended to increase the RAS pumping capacity to 15.63 MGD. The recommended range of RAS capacity is 50% to 125% of plant design flow. The existing RAS pump station only has space for the existing three pumps. Therefore, these pumps must be replaced along with larger suction and discharge piping and valves. With the triplex pump arrangement and VFDs, covering 5.0 MGD to 15.63 MGD RAS flow will not be an issue. To accommodate the existing RAS flow a second 20" RAS line to the headworks is recommended.

At the August 2022 site visit the facility staff noted that RAS pumping decreased after the startup of the 2019 EQ Tank project. The assumption is that with the RAS line tied into the PD PS discharge line the existing RAS pumps were pushed back on their curves, reducing capacity. The County has a project to construct a new plant drain station and separate the plant drain and RAS discharge lines that are currently manifolded together starting design in 2024. The RAS pumping capacity issue will be resolved with the separate PD PS project, improvements to the RAS pump station, and additional RAS line during preliminary design for expansion.

An upgrade to secondary clarifier No. 3 mechanism is recommended to allow equal operation between the clarifiers in use. Due to the existing clarifier No. 3 sludge withdrawal challenges, WAS is only withdrawn from clarifier No. 3. The recommended replacement clarifier mechanism type is spiral blade.

The fourth clarifier is required for Class I reliability at the additional flow and loading and resulting higher mixed liquor suspended solids concentration in the existing two Carrousel basins for the 10 MGD expansion. The County reported at the August 2022 site visit that sludge volume index (SVI) measurements have been about 200 mL/g for the past couple of years. The clarifier settling flux curves were adjusted to approximate an SVI of 200 mL/g. Design parameters for the four clarifiers are shown below in **Table 4.4**.

Table 4.4 Clarifier Design Parameters with Four Clarifiers at 10 MGD AADF Peak Loading

Parameter	All In Service	Class I Reliability
Qty	4	3
Diameter (ft)	110	110
SWD (ft)	14	14
Surface Area Each (sf)	9,503	9,503
Total Surface Area (sf)	38,013	28,510
Max RAS (times Q)	1.25	1.25
PDF + Max RAS (MGD)	31.5	23.6
Design MLSS (mg/L)	4,000	4,000
SLR (lb/d/sf)	27.6	27.6
HLR (gpd/sf)	657.7	657.7
Underflow Rate (gpd/sf)	328.8	328.8

The recommended upgrade of secondary clarifier No. 3 mechanism to a spiral blade type would involve replacement of the existing mechanism and scum collection system. The RAS/WAS collection sump, drum, or ring will require a retrofit by the clarifier mechanism manufacturer.

4.1.7 TERTIARY TREATMENT SIZING - 10 MGD - MLE

The combination of the existing ABW and disk filters does not have enough capacity for Class I Reliability for the corresponding 75% of PHF for the 10 MGD AADF alternative. It is recommended to convert the two existing ABW filters to AquaDiamond filters to increase the filtration capacity of the ABW filters from 8.3 MGD to 30 MGD (assuming 50' laterals in the 90' available space). With the combined capacity of the existing disk filters of 14.9 MGD, the AquaDiamond conversion of the ABW filters increases the facility's filtration capacity to 44.8 MGD with all filters in service. The Class I Reliability requirement is to treat 75% of the PHF, which is 18.75 MGD. With one of the proposed AquaDiamond filters out of service, the facility filtration capacity will be 29.9 MGD, which exceeds 100% of the PHF for this alternative. **Table 4.5** below shows design parameters for the filters including both ABW to AquaDiamond conversion and the existing disk filters.

Table 4.5 Filter Design Parameters with Four Clarifiers at 10 MGD AADF Peak Loading

Parameter	AquaDiamond Conversion	Disk (Pile Cloth Media)	Total
	AquaDiamond	AquaDisk	
Qty	2	2	4
Surface Area (per filter) (for 50' laterals)	1,600	1,291	2,891
Total Surface Area (8 laterals per filter have 4 sf/ft length)	3,200	2,582	5,782
Max Filtration Rate (gpm/sf)	6.5	4[1]	
Capacity at Max Filtration Rate (MGD)	30.0	14.9	44.8
Class I Reliability Capacity Requirement (75% PHF)			18.75
Capacity at Class I Reliability (MGD)[2]	15.0	14.9	29.9

[1] Derated from manufacturer design rate of 6.5 due to age and operator feedback about turbidity problems at higher flows.
[2] With one AquaDiamond filter out of service

The AquaDiamond conversion would involve replacing the current traveling bridge filter components within the ABW filter structure with cloth AquaDiamond filters and associated equipment. Additionally, a canopy would be included above the filters which is recommended to control algae growth. As discussed in this section, the filter conversion to AquaDiamond will be sufficient to meet the Class I Reliability requirement for this expansion.

4.1.8 DISINFECTION SIZING - 10 MGD - MLE

The existing four chlorine contact chambers have sufficient volume to provide 15 minutes of detention time at a potential PHF of 29.7 MGD with all four in service, which is a higher flow than the design PHF for all alternatives in this CER. The existing contact chambers also have sufficient volume to meet Class I Reliability requirements (50% of the design PHF with the largest out of service) with 22.25 MGD of capacity at 50% of PHF and 44.5 MGD equivalent design PHF capacity. Volumes for the existing contact chambers and calculated detention times are in **Table 4.6**.

Table 4.6 NRWRF Chlorine Contact Chamber Capacity for Expansion to 10 MGD AADF

Parameter	1&2	3&4	Total
Qty	2	2	4
Volume (each, MG)	0.0771	0.0777	0.15476
Total Volume (MG)	0.1541	0.1554	0.30952
SWD (ft)	8.7	8.6	
Detention Time at PHF (min)			17.8
Capacity at 15 min. detention time (MGD)			29.7
Capacity Class I at 15 min. detention time (MGD) (50% of flow w/ largest out)			44.5

The existing sodium hypochlorite pumping capacity has sufficient capacity to meet estimated chlorine demands for the 10 MGD AADF alternative. 174 gph of 12.5% sodium hypochlorite may be required at 25.0 MGD PHF and Cl_2 dose of 20 mg/L. The existing firm pumping capacity is 210 gph. A Cl_2 dose of 20 mg/L is high for design standards. However, the existing chlorine dose at the NRWRF has averaged between 13 and 19 mg/L from 2019 through most of 2022.

The existing sodium hypochlorite storage capacity of 10,000 gallons is not sufficient for the 10 MGD AADF expansion for 14 days of storage at AADF flow (10,000 gal is based on current project not yet constructed). A Cl_2 dose of 15 mg/L was used to estimate the storage needs. At the plant flow and dosing stated above, with an additional 20% for safety factor, an additional 11,000 gallons of sodium hypochlorite storage is needed to provide 14 days of storage at 10 MGD AADF flow. However, this should be analyzed further in preliminary design for the expansion. See below for discussion on historical sodium hypochlorite usage.

Average sodium hypochlorite usage, plant flow, calculated dosing, and other parameters per month are shown in **Table 4.7**. F.A.C. 62.600.440 requires a dosing CT (concentration in mg Cl_2/L x time in minutes) of 120 for facilities which produce public-access reuse reclaimed water from an effluent containing greater than 10,000 fecal coliforms #/100mL before disinfection. At 15 minutes of detention time, the required dosing concentration would only be 8 mg Cl_2/L. The dosing concentration does not consider breakpoint chlorine demand for ammonia and nitrite (NO_2^-). Other facilities in Florida have historical dosing rates of 10-15 mg Cl_2/L. For the purposes of this evaluation historical CL_2 dosing was considered for storage and pumping capacity. The sizing should be evaluated further to avoid potentially oversizing storage needs. It is recommended that a study be conducted, prior to the start of preliminary design for the expansion, to identify causes of high Cl_2 usage and operational challenges with the older contact chambers 1 & 2 noted in the August 2022 site visit.

Table 4.7 NRWRF Historical Chlorine Usage and Calculated Dosing

Month-Year	Avg. NaOCl Usage (gpd)	Avg. Plant Flow (MGD)	gal NaOCl / MGD	Avg. Residual Cl_2 mg/L	Avg. Calc. Dose Cl_2 mg/L	Estimated Cl_2 Demand[1]
Jan-19	577	4.246	135.9		16.3	
Feb-19	866	4.058	213.4		25.6	
Mar-19	886	4.013	220.8		26.5	
Apr-19	565	3.82	147.9		17.7	
May-19	586	3.679	159.3		19.1	
Jun-19	594	3.867	153.6		18.4	
Jul-19	666	4.645	143.4		17.2	
Aug-19	718	5.094	141.0		16.9	
Sep-19	576	4.021	143.2		17.2	
Oct-19	586	4.1	142.9		17.1	
Nov-19	539	4.103	131.4		15.8	
Dec-19	678	4.14	163.8		19.6	
Avg. 2019			156.7		18.8	
Jan-20	503	4.22	119.2		14.3	
Feb-20	800	5.427	147.4		17.7	
Mar-20	616	4.626	133.2		16.0	
Apr-20	606	4.695	129.1		15.5	
May-20	577	4.683	123.2	5.3	14.8	9.5
Jun-20	536	5.301	101.1	5.5	12.1	6.6
Jul-20	537	4.39	122.3	5.0	14.7	9.7
Aug-20	586	5.04	116.3	5.6	13.9	8.3
Sep-20	606	5.357	113.1	6.3	13.6	7.3
Oct-20	459	4.751	96.6	5.8	11.6	5.8
Nov-20	374	5.274	70.9	6.4	8.5	2.1
Dec-20	409	5.059	80.8	6.1	9.7	3.6
Avg 2020			108.5		13.0	
Jan-21	305	5.235	58.3	6.5	7.0	0.5
Feb-21	340	5.452	62.4	6.4	7.5	1.1
Mar-21	337	5.473	61.6	6.1	7.4	1.3
Apr-21	496	5.475	90.6	6.5	10.9	4.4
May-21	445	4.046	110.0	6.0	13.2	7.2
Jun-21	539	4.039	133.4	6.3	16.0	9.7
Jul-21	629	5.063	124.2	6.2	14.9	8.7
Aug-21	681	5.442	125.1	6.8	15.0	8.2
Sep-21	684	4.882	140.1	6.9	16.8	9.9
Oct-21	642	4.433	144.8	6.9	17.4	10.5

Month-Year	Avg. NaOCl Usage (gpd)	Avg. Plant Flow (MGD)	gal NaOCl / MGD	Avg. Residual Cl_2 mg/L	Avg. Calc. Dose Cl_2 mg/L	Estimated Cl_2 Demand[1]
Nov-21	708	4.703	150.5	6.9	18.1	11.2
Dec-21	851	4.534	187.7	7.0	22.5	15.5
Avg 2021			113.0		13.5	
Jan-22	626	4.605	135.9	7.3	16.3	9.0
Feb-22	761	4.597	165.5	6.8	19.8	13.0
Mar-22	641	4.521	141.8	6.9	17.0	10.1
Apr-22	617	4.356	141.6	6.7	17.0	10.3
May-22	575	4.251	135.3	6.5	16.2	9.7
Jun-22	603	4.592	131.3	6.7	15.7	9.0
Jul-22	677	5.24	129.2	6.6	15.5	8.9
Aug-22	703	5.21	134.9	6.7	16.2	9.5
Sep-22	773	5.734	134.8	6.5	16.2	9.7
Oct-22	681	5.072	134.3	6.7	16.1	9.4
Nov-22	742	5.326	139.3	6.5	16.7	10.2
Avg 2022			138.1		16.6	

[1]Cl_2 demand estimated from difference between calculated dose and average residual at the end of the of tanks

4.1.9 EFFLUENT PUMPING - 10 MGD - MLE

The capacity of the effluent pump station must be increased for the new design PHF of 25 MGD. For this scenario it is recommended that all of the existing vertical turbine pumps be replaced with new higher capacity pumps. The proposed improvements include four duty and one standby vertical turbine pumps 4,340 gpm at 208 feet of head each with 325 HP motors. The pump discharge assemblies and header will need to be upsized. Modifications to the concrete around the pump bases are also expected.

4.1.10 MISCELLANEOUS IMPROVEMENTS - 10 MGD - MLE

The capacity of the plant drain system must be increased for the new design PHF of 25 MGD. A second PD PS should be constructed adjacent to the existing PD PS. This second PD PS shall include a cross tie to the existing drain station and new piping to connect to the splitter box or EQ tanks. An additional piping will need to be constructed to separate the existing drain station from the RAS system and to discharge to the EQ tanks. This will aid in optimum process control. Additionally, the new PD PS shall include a sampling station or port which will be a small valve box like enclosure with a riser for sampling the incoming plant drain water.

Other additional improvements include the construction of a grit pad and routing modification for the lake filer backwash. The grit pad shall be constructed in the adjacent area to improve the grit hauling efficiency. The grit pad construction will include installment of a flow measurement device and SCADA programming. The lake filter backwash shall be routed to the East RCW pond since the retreatment of the lake filter backwash is an unnecessary plant load.

4.1.11 REJECT STORAGE - 10 MGD - MLE

The existing reject storage must be expanded and new storage lined to meet the requirements of F.A.C. 62-610.464. The volume requirement from the F.A.C., "volume equal to one day flow at the average daily design flow of the treatment plant or the average daily permitted flow of the reuse system, whichever is less" will be based on the new design AADF since the County's reuse system, MCMRS, is permitted for the entire County. Due to the estimated groundwater elevation and the existing Reject Pond being unlined, the usable volume of the existing pond was estimated to be approximately 5.5 MG at a high water table. This will need to be further evaluated, however, for the purposes of this CER, it was determined that an additional lined 4.5 MG Reject Pond is needed. An evaluation of expanding the total Reject Pond storage to 10 MG and 12.5 MG concluded that the additional cost to increase to 12.5 MG was 13% additional compared to 10 MG. Therefore, it is recommended to increase the total Reject Pond storage to 12.5 MG by constructing a 7 MG Reject Pond on site. A new reject storage will be constructed by adding a berm to separate out northern third portion of the East RCW pond, reducing the capacity of the East RCW pond. F.A.C requirements for reuse storage will still be met for the facility due to the large volume of the Golf Course RCW Pond. The new reject pond must be lined. The bottom of the liner must be above the seasonal high water table. Other associated improvements are motorized valving at the effluent pump station to pump into the reject pond and a new reject pump station to pump out the pond back to the headworks or filter splitter box. The current 36" DIP gravity line between the effluent pump station wetwell and reject pond will be intercepted for the pumped flow arrangement. The existing reject pond drain to the PD PS could be maintained as an alternate method to partially drain the pond, to be determined in further design.

4.1.12 BIOSOLIDS TREATMENT SIZING - 10 MGD - MLE

The biosolids handling processes at the NRWRF must be designed to withstand the maximum month loading conditions to ensure there is sufficient storage and belt filter press (BFP) dewatering capacity to process the WAS produced under sustained maximum loading conditions. In addition, the sludge holding tanks must have sufficient storage volume to accommodate the WAS produced at maximum day loading conditions to accommodate short-term surges in WAS production.

Sludge handling and dewatering operations are sufficient with the additional sludge predicted at the future design flow for the 10 MGD AADF alternative. The sludge storage tank capacity will be reduced to less than seven days with two tanks in service, which is less than current operations. However, this is enough storage time for normal BFP off times and minor repairs. For expansion to 12.5 MGD additional storage is needed, and for that scenario a new thickening stage is recommended. The thickening is recommended to be included in the 10 MGD expansion alternative to be ready for the additional future loading. The recommended solution is to add a gravity belt thickener (GBT) upstream of the sludge holding tanks to decrease the volume of sludge to both unit processes downstream. The Manatee County SEWRF has GBTs in this arrangement. Current operational parameters from SEWRF of GBT effluent percent solids of 2.5–3.0 and hydraulic loading rate to belt filter presses at that percent solids of 100 gpm was used to estimate the required capacity of the proposed GBT, existing sludge holding tanks, and existing BFPs. Sizing parameters for the proposed GBT are listed in **Table 4.8**. The County directed to include only one GBT for this expansion. To save cost and due to the County's experience with the GBTs they are comfortable without an installed spare. Our interpretation is that sludge thickening is not exempt from Class I Reliability requirements. In order to meet Class I Reliability requirements the County would have to increase the number of hours per week for BFP operation when the GBT is out of service. The County made infrastructure improvements to operate the BFPs 24 hours a day, 7 days a week if needed. Additional operator staffing would be required. With the addition of one GBT, no other capacity improvements to the existing sludge holding tanks or BFPs are anticipated as shown in **Table 4.9**. The addition of the GBT would include a polymer system, a canopy over the GBTs and a thickened sludge pump station with progressive cavity pumps, similar to the current setup at the SEWRF. It is recommended that a bypass around the GBT with a motorized valve be installed to prevent overflows at high level and for operational flexibility.

Table 4.8 GBT Design Parameters at 10 MGD AADF Loading

Gravity Belt Thickeners		
Qty	1	
Size (belt width, meters)	2	
Operation Time (Hours per Day)	24	
Operation Time (Days per Week)	7	
Total Hours per Week	168	
Max WAS (times Q)	0.03	
MM WAS (MGD) (gpm)	0.3	208.32
WAS Pump Qty	3+1	
WAS Pump Capacity Each (gpm)	600 (125)[1]	
Total WAS Pump Capacity Class I (gpm) (MGD)	1325	1.91
Design WAS SS (mg/L)	7,500	
WAS (% solids)	0.75%	
GBT HLR (gpm)	300	
GBT Processing Capacity per Week (MG)	3.024	
MM WAS Qty per Week (MG)	2.100	
GBT SLR (lb/hr)	1126.0	design <1,200
GBT Effluent (% solids)	2.5%	
GBT Effluent Flowrate at Max HLR (gpm)	90.0	
GBT Effluent Flowrate at MM WAS (gpm)	62.5	

[1]125 gpm is the estimated capacity of the progressive cavity pump

The existing diffusers in the SHTs are scheduled to be replaced in like-kind as a maintenance project. The diffusers are tube membrane style by EDI, 84P Magnum with polyurethane membranes. EDI refers to these as medium bubble diffusers. According to the manufacturer they have less fouling than fine bubble and prevent solids from getting inside the diffusers in higher solids concentrations such as the sludge holding tanks, and they have improved mixing over fine bubble and improved oxygen transfer over traditional course bubble diffusers. The existing multi-stage centrifugal blowers have required increased maintenance over time and are approaching the end of their useful life. For the expansion it is recommended that the sludge holding tank blowers be replaced with hybrid screw blowers with VFDs and diffusers replaced with duckbill check valve type diffusers.

Table 4.9 Sludge Holding Tanks Design Parameters at 10 MGD AADF Loading

Existing Aerated Sludge Holding Tanks		
Qty	3	
Diameter (ft)	100	
SWD (ft)	17	
Surface Area Each (sf)	7,854	
Total Surface Area (sf)	23,562	
Volume Each (gal)	998,715	
Total Volume (MG)	2.996	
MM GBT Flow (MGD) (gpm)	0.090	62.5
Storage Capacity (days)	33.3	
Storage Capacity (days) (1 tank out of service)	22.2	
Qty of Blowers	3.0	
Blower Capacity Each (SCFM)	4,000	
Total Blower Capacity (SCFM)	12,000	
Air for Mixing (SCFM/ft^2)	0.51	

With the addition of thickening prior to the existing belt filter presses the dewatering capacity will be increased. A new polymer system is required with the higher % solids in the BFP influent. Estimated BFP loading with influent thickened sludge compared to existing capacity is shown in **Table 4.10.** Note that the County has the infrastructure in place to operate the BFPs 24 hours a day, 7 days a week if needed. Additional operator staffing would be required.

Table 4.10 Belt Filter Presses Design Parameters at 10 MGD AADF Loading with Upstream Thickening

Existing Belt Filter Presses		
Qty	3	
Size (belt width, meters)	2	
Operation Time (Hours per Day)	12[1]	
Operation Time (Days per Week)	5[1]	
Total Hours per Week	180	
Total Hours per Week (1 out of service)	120	
Estimated Thickened Sludge in Holding Tanks (% solids)	2.5%	
HLR Each (gpm)	95	Based on influent % solids and SLR
Total HLR (gpm)	285	
Total HLR Class I (gpm)	190	
Processing Capacity per Week (MG)	0.684	
GBT Eff Qty per Week (MG)	0.630	
SLR Each (lb/hr)	1,188.5	Design <1,200
Total SLR Class I (lb/hr)	2,377.1	Design <2,400

[1]The County has infrastructure in place to operate 24/7 if needed

4.1.13 HYDRAULIC EVALUATION - 10 MGD - MLE

The hydraulic profiles of the NRWRF were modeled using Visual Hydraulics hydraulic profile modeling software, Version 5.1, to evaluate the hydraulic capacity of the NRWRF at the future peak hourly flow of 25.00 MGD and for Class I Reliability. The NRWRF hydraulic profile was modeled assuming the proposed secondary clarifier No. 4 required for the MLE expansion to 10 MGD AADF has been installed and is in operation. The hydraulic model flow diagram and the report output from the Visual Hydraulics software is presented in **Appendix B**. The intention of this hydraulic evaluation is to determine if the expanded facility can meet Class I reliability requirements without any major modifications to the existing splitter boxes, channels, and yard piping. As defined by the USEPA and carried by the FDEP, the NRWRF's unit operations shall be designed such that with the largest flow capacity unit out of service, the hydraulic capacity of the remaining units shall be sufficient to handle the peak wastewater flow. In addition, to meet Class I Reliability, flow equalization shall not be considered as a substitute for component backup requirements. Therefore, the hydraulic evaluation considers the full non-equalized peak hourly flow rate of 25.00 MGD through the NRWRF to identify hydraulic deficiencies. Assumptions were made regarding the arrangement and operation of the expansion to the NRWRF's MLE process to meet the 10 MGD AADF design capacity. A list of the assumptions made to complete the hydraulic analysis for the expanded NRWRF is provided below:

- Based on guidance from the County, the maximum RAS flow used under peak hour flow conditions was 125% of the influent flow. This is 12.5 MGD, or 1.04% of the MMADF of 12.00 MGD.
- The maximum IR flow under peak hour flow conditions was 12 MGD per basin, or 220% of the MMADF of 6.00 MGD per basin.
- The Hazen-Williams friction loss coefficient for all pipes was 120
- One new 110-ft diameter secondary clarifier No. 4 is constructed directly to the east of the existing clarifier No. 3, west of the anoxic/aeration basins.
- Piping to new clarifier No. 4 is 36-inches in diameter and piping immediately downstream is 30-inches in diameter.
- Both ABW filters are converted to AquaDiamond filters, each with 1,600 ft^2 of filtration surface area.
- The maximum capacity of the Disk Filters is 14.9 MGD
- The maximum filter flow routed to the Disk Filters is 9.5 MGD (see **Section 4.1.13.1**) and the remainder is routed to the AquaDiamond Filters
- Flow is split equally between CCC trains 1–4
- For Class I reliability if a process train is taken offline the total flow is distributed as equally as possible between the remaining trains of that process

4.1.13.1 HYDRAULIC LIMITATIONS

The hydraulic models of the PHF and Class I Reliability scenarios for this expansion were constructed based on existing record drawings of the NRWRF provided by the County and the assumptions listed above. Any routing of new piping and new pipe length estimates are conceptual. The routing of piping should be investigated further during detailed design. For unit processes, WEF MOP 8 recommends that the typical minimum freeboard under maximum water level conditions be approximately 12-inches, and there should be no submergence of control weirs under peak flow conditions. The 10 State Standards are generally more conservative and provide more specific freeboard guidelines for unit processes. Sections of the NRWRF where the allowable freeboard chosen for the project deviates from recommendations are noted and explained here.

After the model of the current plant configuration was set up in Visual Hydraulics, water surface elevations in the model were checked. This was to ensure that water elevations downstream of weirs were at least 6 inches below the weirs, and that there was at least 1 foot of freeboard in all tanks. The former case is to minimize fluctuations in the upstream water level. Additionally, a downstream water level that is above the weir crest would create a submerged weir situation where the headloss over the weir calculation methods used in the model would no longer be applicable or accurate and could impact the treatment process.

This analysis used the "critical elevation" feature in Visual Hydraulics. Critical elevations are elevations that must be maintained or minimized to ensure that the overall hydraulic behavior of the system is not compromised. This Visual Hydraulics feature allows the user to set a critical elevation for any element of the hydraulic profile. The program will flag the element if that critical elevation is ever reached or exceeded during an analysis. For each weir, the critical elevation of the element directly downstream of the weir was set to be 6 inches lower than the weir elevation. For all remaining tank sections, the critical elevation was set to be 1–2 feet below the top elevation of the outer wall of the tank. The freeboard requirements are summarized in **Table 4.11**.

Table 4.11 Critical Elevations Used in Hydraulic Evaluations

Process Unit	Section	Top of Tank (ft)	Freeboard (ft)	Critical Elevation (ft)
Headworks	Influent Channel	60.50	2	58.50
	Screen Channel	60.50	2	58.50
	Effluent Box upstream of HeadCell Grit Units	60.50	2	58.50
	HeadCell Grit Units	60.50	2	58.50
	Headworks Splitter Box	56.35	2	54.35
	Effluent Box	56.35	2	54.35
Anoxic/Aerobic Basins	Anoxic section	47.42	1	46.42
	Other sections (lowest wall elevation)	43.92	1	42.92
	Effluent box	42.92	1	41.92
Clarifier FSB	All	41.42	1.5	39.92
Clarifier 1	Basin outer wall	39.67	1	38.67
Filter FSB	All	36.33	1	35.33
ABW Filters	All	33.33	1	32.33
Disk Filters	All	35.30	1.5	33.80
CCC 1	All	31.75	1	30.75
CCC 2	All	31.81	1	30.81

Based on initial models of the 10 MGD and 12.5 MGD expansions, a solvable hydraulic issue identified was that head loss to the disk filters caused flow to back up to the Filter FSB weir for the disk filters. Based on the modeling, the water level downstream of the Filter Flow Splitter Box effluent weir to the disk filters was initially significantly smaller than the recommended 0.5 ft. Under these conditions, this weir will operate as a submerged weir, affecting the flow splitting to the filters. Using one of the higher flow scenarios (12.5 MGD), the filter FSB flow split and filter FSB effluent weirs were adjusted to solve this issue. Additionally, the filter FSB effluent weir crests were shortened as much as possible to provide operators with finer control over the flow when weir elevations are changed. The adjustments that resolved the disk filter issue without creating other significant hydraulic issues elsewhere at the filters were routing no more than 9.5 MGD of flow to the disk filters and the remainder to the AquaDiamond filters, and shortening the weir crests from 13 ft to 7 ft. The adjustments made were then applied to all other hydraulic models.

Due to the length of Visual Hydraulics output reports, only the output for the worse case (the Class I Reliability scenario) with recommended adjustments is included in **Appendix B**. Similarly for all subsequent expansions in this CER, only the Visual Hydraulics model output report for the worse case including recommended modifications is included in the Appendices.

There was one major hydraulic bottleneck identified with the modeling.

(1) With increased flow between the filters and the four CCCs the AquaDiamond Filters Effluent Weirs were predicted to be submerged. All of the existing piping is 36-inch. The recommended resolution is to replace it all with 42-inch, with the exception of the short run of 36-inch from Disk Filter effluent to the tee connecting to the AquaDiamond Filters effluent channel. Upsizing to 42-inch pipe allows for increased capacity for the 12.5 MGD AADF alternative. Without this change the CCC effluent weirs would have to be dropped, which would reduce the volume and contact time.

Based on the modeling, five minor hydraulic limitations were identified during the hydraulic analysis, which are summarized as follows. Note that all of these are related to movable weir gates. It is generally recommended to have more freeboard with moveable weir gates to provide operational flexibility. However, even though the actual freeboard in these cases is less than the recommended 18-inches, it is more than 12”, which is acceptable. They were noted as not critical, as explained below:

(1) AquaDiamond Filters Influent Weir 1: The water surface level over the weir is 1.32 ft below the tank wall elevation of 33.33 ft. This does not meet the target freeboard of 1.5 ft, but it is still greater than the minimum required freeboard of 1-ft therefore this is not a critical concern. The same issue was identified in the PHF scenario, with 0.04 ft more freeboard than in the Class I Reliability scenario. The overall 1.36 ft difference between the top of tank elevation and water surface elevation is also large enough that it is not expected to result in significant hydraulic issues.

(2) AquaDiamond Filters Influent Slide Gate 1: The water surface level is 1.19 ft below the tank wall elevation of 33.33 ft. This does not meet the target freeboard of 1.5 ft, but it is still greater than the minimum required freeboard of 1-ft therefore this is not a critical concern. The same issue was identified in the PHF scenario, with 0.08 ft more freeboard than in the Class I reliability scenario. The overall 1.27 ft difference between the top of tank elevation and water surface elevation is also large enough that it is not expected to result in significant hydraulic issues.

(3) Clarifiers FSB Weir Gates 1-3: The water level over the weir gates is expected to be 40.08 ft. This freeboard of 1.34 ft does not meet the target freeboard of 1.5 ft, but it is still greater than the minimum required freeboard of 1-ft therefore this is not a critical concern.

4.1.13.2 RECOMMENDED ACTIONS TO IMPROVE HYDRAULICS AND FLOW SPLITTING

Adjustments to weir gates and minor modifications of weirs are recommended to improve flow control and plant hydraulics at peak flow, see below.

4.1.13.2.1 ADJUST ALL CHLORINE CONTACT TANK EFFLUENT WEIRS TO THE SAME ELEVATION

For the existing plant, the elevations of the effluent Cipolletti weirs of trains Nos. 1, 2, 3 and 4 are 28.75 ft, 28.75 ft, 28.54 ft, and 29.55 ft respectively. Currently the flow distribution between the chlorine contact tanks is adjusted by throttling a buried butterfly valve upstream of the newer chlorine contact tank. All effluent Cipolletti weirs are recommended to be set to the same elevation as trains Nos. 1 and 2, 28.75 ft. This would allow the plant hydraulics to split the flow equally.

4.1.13.2.2 OPTIMIZE FILTER FLOW SPLITTER BOX EFFLUENT WEIR GATES

The County stated that the wide weir gates in the filter splitter box are too large to practically use for adjusting the flow split between the two existing sets of filter basins at the August 2022 site visit, stating that a small adjustment in height makes a large change in flow split. With an expansion, including the need to send more flow to the retrofitted AquaDiamond filters, it is recommended that the County use weir gates to split the flow rather than yard piping valves. An evaluation using the hydraulic models determined that the shortest width weir gates that could be accommodated within the hydraulic profile are 7ft (See section 0). This is still a large weir gate, but it should improve operability if decided to make this change in the design phase.

4.1.13.2.3 ADJUST ANOXIC/AEROBIC BASIN EFFLUENT WEIR GATES ELEVATION

The weir gate elevations were adjusted for 1 ft of freeboard as noted in Visual Hydraulics report.

4.1.13.3 ADDITIONAL OPERATIONAL RECOMMENDATION

4.1.13.3.1 INSTALL ADDITIONAL SPLASH GUARDS NEAR AERATORS

For all aeration tanks the 10 State Standards recommend 18" of freeboard. If a mechanical surface aerator is used (as is the case here), the freeboard requirement is increased to 3 feet to protect against windblown spray and other similar issues. The original facility design included and permitted 1 foot of freeboard. The design standard for this CER is to maintain the 1' as originally designed. Based on the existing tank construction, it is recommended that additional splash guards be installed near the aerator to minimize wind driven spray (similar to the current splash guards on SEWRF basin no. 3).

4.1.14 ENGINEER'S OPCC - 10 MGD - MLE

4.1.14.1 CAPITAL COSTS

To allow for the planning of projected future capital costs associated with the expansion of the NRWRF, **Table 4.12** below presents a summary of the conceptual project costs based on the expansion of the NRWRF to an AADF capacity of 10 MGD using the MLE process. This cost opinion has been prepared meeting the classification as an AACE Class 4 cost estimate. As such, it should be noted that the level of project definition associated with this cost estimate is less than 15%. Per the definition of an AACE Class 4 cost estimate, the expected range of accuracy for this cost estimate on the high end is +20% to +50%, and -15% to -30% on the low end. As a result, the total opinion of probable project cost listed below may vary from $111,339,000 on the low end, to $238,583,000 on the high end. Various factors may combine to result in cost fluctuations within this range including fluctuations in market conditions, changes in project scope, improved project definition, and value engineering.

In estimating construction costs, it is assumed that the new upgrades and equipment are being installed at present-day costs. Further, markups are used to estimate the costs for site improvements, yard piping, electrical improvements, I&C and SCADA, and indirect costs incurred by the contractor(s). The markup factors listed below for direct project costs including sitework and demo, yard piping, electrical, and SCADA/I&C are based on recent project experience, anticipated project scope, current market conditions, and input from local contractors. The markup factors listed below for indirect project costs incurred by the contractor are based on the following:

- Mobilization/Demobilization = 5% per WEF MOP 8
- General Conditions = $150,000 per month per input from local contractors for a project of this general scope and duration
- Contractor Overhead and Profit = 20-25%
- Maintenance of Plant Operations = 4-8% per input from local contractors for a project of this general scope and complexity
- Contractor Bonds/Insurance = 4% per local contractors for projects of this general scope and cost

An estimating contingency is also applied to all facility and disciplines estimates due to the preliminary nature of this evaluation to account for additional costs that will be realized during the detailed stages of design. Project cost escalation between present-day and the estimated date of project bid opening in 2027 is included to estimate the rate of future inflation. Estimated inflation has been included to aid in capital improvement planning, however, this should be re-evaluated annually, and capital improvement budgets adjusted accordingly. Finally, engineering, administrative, and legal costs were estimated based on the direct construction costs at present day costs.

Costs were estimated based on past projects of similar size and scope; and McKim & Creed has no control over the costs of labor, materials, and equipment in the future. This is only an estimate of conceptual construction costs based on materials and equipment costs as of November 2022.

Table 4.12 Cost Opinion for NRWRF Expansion to 10 MGD AADF with MLE

Description	Cost
Mobilization/Demobilization (5%)	**$3,015,000**
Structural/Mechanical	
Headworks Improvements and Rehab	$6,000,000
Aerator Improvements for Ex. Carrousel Basin	$3,800,000
New Clarifier: 110-ft Diameter	$5,100,000
Replace Clarifier Mechanism for #3: 110-ft Diameter	$2,200,000
Replace RAS Pumps and Add Parallel RAS Line	$700,000
AquaDiamond Filters: Two Retrofitted and Add Canopy	$6,750,000
Additional Sodium Hypochlorite Storage	$300,000
Effluent Pump Station Improvements	$2,200,000
Second Plant Drain PS	$1,100,000
Gravity Belt Thickeners (One), Polymer System, Sludge Pumps, and Canopy	$2,200,000
New SHT Blowers and Diffusers	$1,700,000
Structural/Mechanical Subtotal	***$32,050,000***
Other Direct Costs	
Overall Sitework and Demo (10%)	$3,205,000
New Reject Pond (LS)	$4,900,000
Yard Piping (25%)	$8,015,000
Electrical (20%)	$6,410,000
Electrical Building (LS)	$1,600,000
SCADA/I&C (18%)	$5,770,000
Other Direct Costs Subtotal	***$29,900,000***
Indirect Costs	
General Conditions (LS)	$3,600,000
Contractor OH&P (20%)	$12,390,000
Maintenance of Plant Operations (MOPO) (8%)	$4,960,000
Contractor Bonds/Insurance (4%)	$2,480,000
Indirect Costs Subtotal	***$23,430,000***
Construction Subtotal	***$88,395,000***
Estimating Contingency (30%)	***$26,520,000***
Opinion of Probable Construction Cost (2022 dollars)	***$114,915,000***
Inflation, Compounded Annually Until Bid (5% Annually)	$31,750,000
Opinion of Probable Construction Cost (2027 dollars)	***$146,665,000***
Engineering (20%)	$12,390,000
Opinion of Probable Project Cost	**$159,055,000**

4.2 EXPANSION TO 12.5 MGD AADF - MLE

4.2.1 FLOW AND LOADS FOR 12.5 MGD - MLE

The basis of design flows and loads for 12.5 MGD AADF are shown below in **Table 4.13**. The peaking factors derived from data review discussed in **Section 3.2** were applied to the future design flow condition.

As previously noted, the need to expand to 12.5 MGD AADF is imminent. Flow projections show an increase from 10 MGD to 12.5 MGD AADF in six to eight years. Therefore, 10 MGD AADF does not provide long-term capacity.

Table 4.13 NRWRF Basis of Design Influent Loading for Future 12.5 MGD AADF

		AADF	PF	Max Mon.	PF	Peak Day	PF	Peak Hour
Flow	MGD	12.50	1.20	15.00	1.90	23.75	2.50	31.25
BOD	mg/L	175						
	lb/d	18,244	1.4	25,541	1.7	31,014		
TSS	mg/L	200						
	lb/d	20,850	1.9	39,615	3.1	64,635		
VSS	mg/L	150						
	lb/d	15,638	1.4	21,893	1.7	26,584		
TKN	mg/L	46						
	lb/d	4,796	1.2	5,755	1.40	6,714		
NH_3	mg/L	41						
	lb/d	4,274	1.2	5,129	1.4	5,984		
TP	mg/L	6						
	lb/d	626	1.2	751	1.4	876		

4.2.2 PROCESS EVALUATION OF THE EXPANSION TO 12.5 MGD - MLE

The following processes require improvements or additional capacity to expand the facility to 12.5 MGD AADF with expansion of the MLE system. If not noted the existing unit processes have sufficient capacity for the additional flow and loading.

- Headworks improvements and rehabilitation
- Addition of a third Carrousel MLE anoxic/aeration basin with the latest design and equipment
- New electrical building for MLE expansion and VFDs for existing aerators
- Conversion of existing Carrousel basin 125 HP aerators to VFD control with instrumentation and adjustable weir gates
- Upgrade of Secondary Clarifier No. 3 mechanism
- Addition of a fourth secondary clarifier
- Replacement of existing RAS pumps to increase capacity
- Additional parallel RAS line
- Conversion of existing granular media ABW filters to AquaDiamond filters (50' laterals estimated for 12.5 MGD expansion)
- Upsizing of filter effluent piping
- Additional sodium hypochlorite storage
- Conversion of effluent pump station to low service pump station
- New high service pump station
- New 5 MG ground storage tank
- One gravity belt thickener, thickened sludge pump system, and canopy
- New 7MG Reject Pond using a portion of the East RCW pond

4.2.3 SITE PLAN - 12.5 MGD - MLE

4.2.3.1 PROPOSED ADDITIONAL BASINS AND ACCESSORIES

Figure 4.7 shows the proposed additional infrastructure and accessories necessary to expand the NRWRF to meet the future AADF capacity of 12.5 MGD based on expansion of the existing MLE process. A proposed process flow diagram for the expansion of the existing MLE process is also included in **Figure 4.8** below.

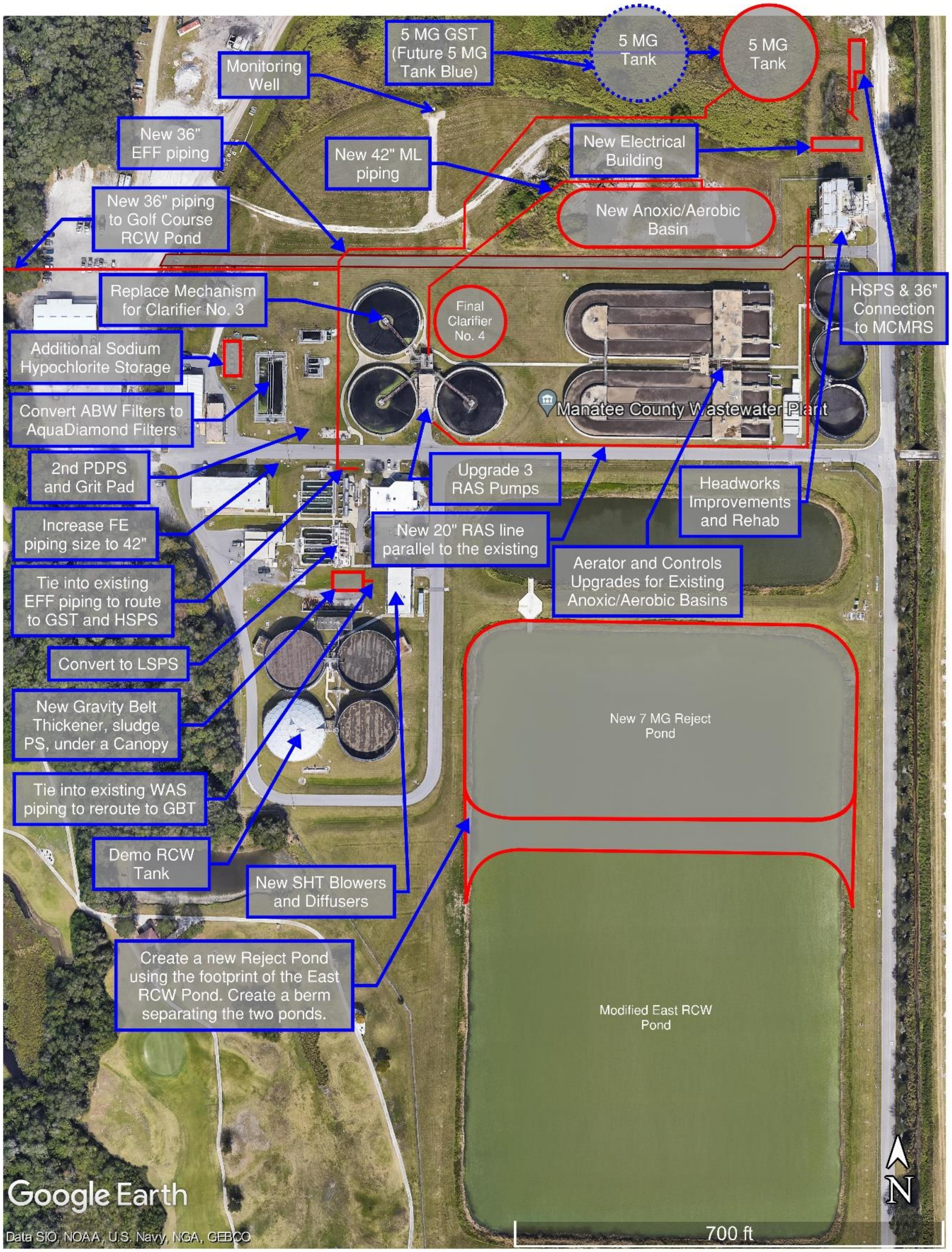
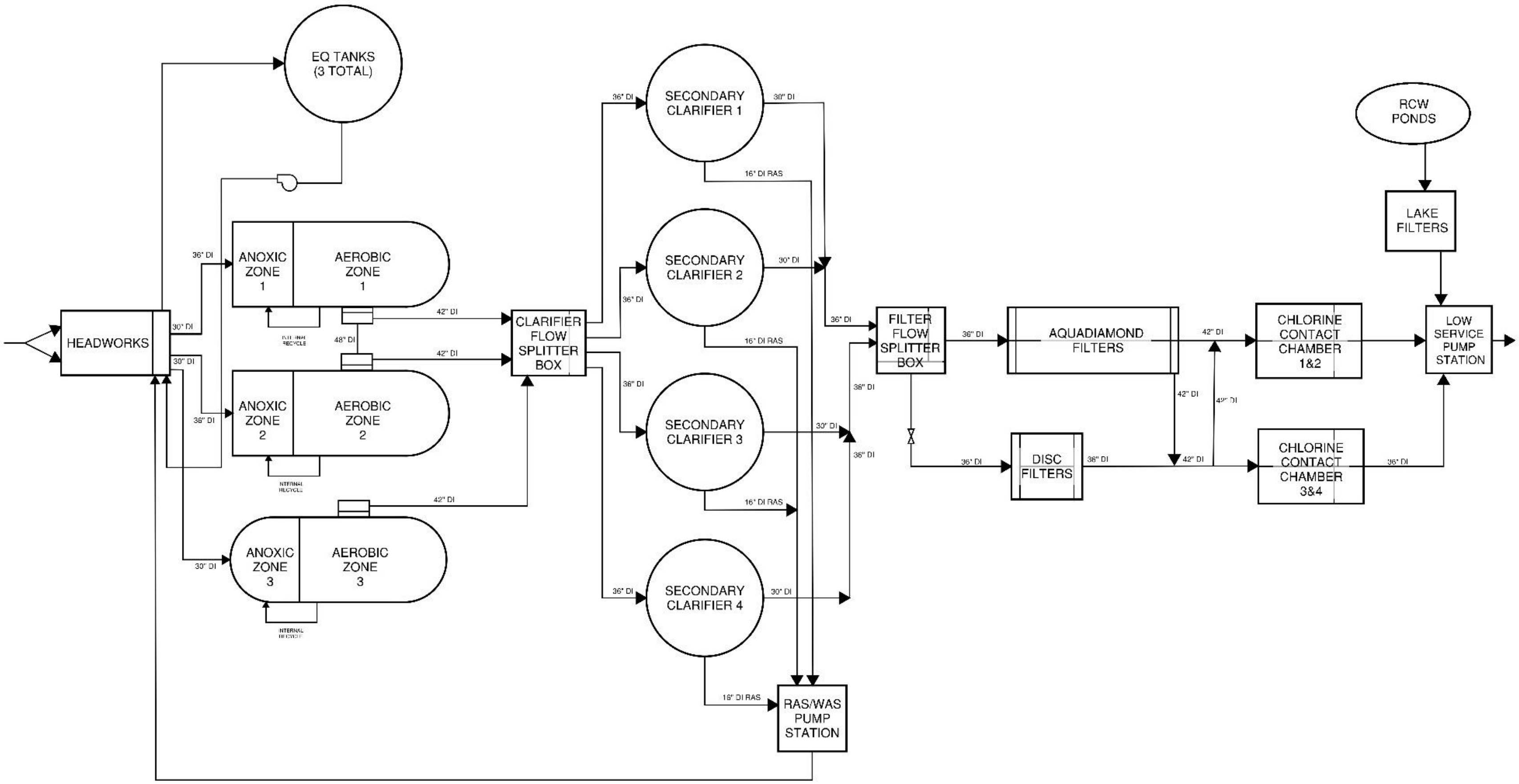


Figure 4.7 Proposed General Arrangement for NRWRF MLE Expansion to 12.5 MGD AADF



MANATEE COUNTY NORTH REGIONAL WATER RECLAMATION FACILITY
PROCESS FLOW DIAGRAM
EXPANSION TO 12.5 MGD AADF WITH MLE

Figure 4.8 Proposed Process Flow Diagram for NRWRF MLE Expansion to 12.5 MGD AADF

4.2.4 IMPACTS OF SITE MODIFICATIONS ON EXISTING PROCESSES - 12.5 MGD - MLE

Based on the proposed improvements described above, impacts to existing processes, maintenance of plant operations, yard piping, site access/vehicle movement, and stormwater were considered. Ongoing improvement projects for the NRWRF were also considered and coordinated with the proposed improvements described above. A summary of the impacts of these improvements is described in the sections below.

4.2.4.1 EXISTING PROCESSES

Expansion of the NRWRF to an AADF capacity of 12.5 MGD is expected to impact the preliminary, secondary, tertiary, effluent pumping, biosolids treatment processes, reject storage, and RCW storage. These impacts are described later in **Section 4.2**. The operation of the flow equalization facilities will not be affected by this expansion.

4.2.4.2 MAINTENANCE OF PLANT OPERATIONS

MOPO is a critical concern during any major WRF expansion project to ensure that construction activities will not impair the County's ability to adequately operate and maintain the WRF and continue to meet effluent permit limits during construction. Impacts on MOPO for each major recommended improvement for the expansion of the NRWRF to 12.5 MGD AADF are summarized below:

- Retrofit of Headworks
    - Extensive bypassing and potentially temporary screening will be required to construct the improvements to the existing headworks.
    - Careful coordination with facility staff must be implemented to maintain continuous flow.
- Construction of New Anoxic/Aerobic Basin
    - It is recommended that the new Carrousel basin be constructed and put into operation before improvements to the existing Carrousel basins are started.
    - Construction of the new anoxic/aeration basins will be located in an open area just north of the existing anoxic/aeration basins.
    - The proposed 30-inch pipeline will be connected from the existing connection at the headworks to the new anoxic basin. Shutdowns are not anticipated for this.

  - The connection of the proposed 42-inch mixed liquor pipeline from the proposed Carrousel basin to the existing Clarifier Flow Splitter Box will require a cofferdam, or other means to dewater a portion of the Clarifier Flow Splitter Box to maintain uninterrupted flow of effluent from other anoxic/aerobic basins to secondary treatment while the splitter box is cored and the new connection is made.
- Retrofit of Anoxic/Aerobic Basins
  - The anoxic/aerobic basins must be drained one basin at a time to replace aerators, replace weir gates, install other DO control components, and demolish portions of existing walls to construct a new IR gate and concrete channel.
  - These improvements are recommended to be completed after Secondary Clarifier No. 4 is constructed and Secondary Clarifier No. 3 is retrofitted to handle increased MLSS concentrations.
  - Careful coordination with facility staff will be implemented to maintain plant flow and prevent SSO's in the collection system. In order to achieve that, construction of the new anoxic/aerobic basins is recommended to be completed before the retrofit of existing anoxic/aeration basins.
- Construction of Secondary Clarifier No. 4
  - There are capped stub outs for connections to the Clarifier and Filter Splitter Boxes in place for the fourth clarifier. No shutdown is anticipated for Clarifier Splitter Box connection. A shutdown of clarifier No. 3 of up to 8 hours may be required to connect a new CE line from new clarifier No. 4 to the manifolded CE line to the Filter Splitter Box shared with clarifier No. 3.
- Replacement of clarifier mechanism at Secondary Clarifier No. 3
  - This is recommended to be completed after Secondary Clarifier No. 4 is constructed and online.
  - Secondary Clarifier No. 3 will be drained to demo the existing draft-tube style mechanism and replaced with a spiral blade mechanism.
  - This must be done during lower flow and load periods. It may be feasible to have clarifier No. 3 out of service for up to a month. The SRT will need to be lowered to keep the solids loading rate on clarifiers Nos. 1 and 2 at a reasonable rate.
  - Careful coordination with facility staff must be implemented to maintain treatment.
- Upgrade of RAS pumps and construction of additional RAS line

  - Bypassing is expected during the replacement of existing RAS pumps and pump station piping.
  - The additional parallel 20-inch RAS line can be constructed with minimal impacts to RAS and headworks. Short duration shutdowns may be required for tie-ins.
- Construction of an additional PD PS and Grit Pad
  - The additional PD PS can be constructed with minimal interruptions to the current plant drain system. Brief shutdowns on the plant drain system may be required to tie into the existing PD PS and at the splitter box or EQ tanks.
- Conversion of ABW Filters to AquaDiamond Filters
  - The ABW filters are recommended to be converted to AquaDiamond filters one at a time to maintain sufficient filtration capacity
- Upsizing of filter effluent piping
  - The existing 36-inch filter effluent piping will be replaced with 42" piping with minimal impacts to the other yard piping. Short duration shutdowns may be required for tie-ins.
  - Careful coordination with facility staff must be implemented to maintain treatment.
- Construction of additional sodium hypochlorite storage
  - Additional sodium hypochlorite storage can be constructed with minimal interruptions to the existing disinfection storage and dosing system. Very brief shutdowns on the chemical pumping system may be required to tie into the pump suction lines.
- Construction of new sludge holding tank blowers and diffusers
  - The existing sludge holding tanks will be retrofitted with three new diffusers and three new blowers.
  - Each sludge holding tank will be taken down one at a time to replace the diffuser and the blower to minimize impact on the sludge holding tank capacity.
  - Careful coordination with facility staff will be implemented to maintain plant flow.
- Construction of gravity belt thickener and sludge PS
  - The new gravity belt thickener and sludge PS will be constructed just southeast of the existing chlorine contact chambers.

- The new gravity belt thickener will be connected to the existing WAS piping running from the clarifiers to the sludge holding tanks. A 24-hour shutdown of the WAS system may be needed during the connections.

- Replacement of BFP polymer system
    - A shutdown of up to 24 hours may be required to make tie-ins for the replacement of the BFP polymer system.
- Construction of 5 MG ground storage tank
    - It is recommended that the new 5 MG ground storage tank be constructed before converting the effluent pump station to low service pump station.
    - Construction of the new 5 MG ground storage tank will be located in an open area southwest of the existing monitoring well.
- Construction of high service pump station and new RCW pipeline
    - It is recommended that the new high service pump station be constructed before converting the effluent pump station to low service pump station.
    - Construction of the new high service pump station will be located in an open area southwest of the existing monitoring well and south of the proposed 5 MG ground storage tank.
    - Construction of the new RCW pipeline from HSPS to the existing RCW distribution system requires minimal shutdown and will have minimal impact on the operation since the RCW distribution system does not run continuously.
- Upgrade effluent pump station to low service pump station
    - Contractors will require extended bypass pumping to replace effluent pumps with low service pumps.
    - Careful coordination with facility staff must be implemented to maintain treatment.
- Construction of a new 7 MG Reject Pond
    - East RCW Pond will be dewatered, and a portion of the pond will be sheeted out to completely drain the northern portion of the pond.
    - During this process, RCW will be diverted to the existing GST or to the Golf Course Storage Lake.
    - Careful coordination with facility staff will be implemented to maintain plant flow.

4.2.4.3 YARD PIPING

The major yard piping modifications proposed for the expansion include the following:

- 30-inch ML pipeline from existing stub-out at headworks to new Anoxic/Aerobic Basin No. 3
- 42-inch ML pipeline from new Anoxic/Aerobic Basin No. 3 to existing Clarifier Flow Splitter Box stub-out
- Extension of 36-inch ML pipelines from existing Clarifier Flow Splitter Box to new Clarifier No. 4
- 16-inch RAS pipeline from new Clarifier No. 4 to the common RAS/WAS pump station
- 8-inch WAS pipe from new Clarifier No. 4 to the RAS/WAS pump station
- A new parallel 20-inch RAS pipeline from RAS/WAS pump station to the Headworks
- Extension of 30-inch CE from new Clarifier No. 4 to the existing common 36-inch CE piping
- 8-inch WAS pipeline from new gravity belt thickeners to existing WAS piping to the sludge holding tanks
- 16-inch PD PS force main from the new additional PD PS to the existing splitter box or EQ tanks
- 42-inch FE pipeline to replace existing 36-inch pipeline between AquaDiamond Filters and all CCCs
- 36-inch RCW pipeline from LSPS to Golf Course RCW pond and smaller branch to 5 MG tank
- 36-inch RCW pipeline from HSPS to the existing RCW distribution system south of the headworks
- 4-inch pipeline from lake filter backwash to East RCW pond

4.2.4.4 SITE ACCESS/VEHICLE MOVEMENT

Vehicles can access the project area from the north via 69th Street East which is a two-lane asphalt surface roadway in a rural section. Access roads within the NRWRF vary between 20 and 24 feet in width, are constructed of asphalt, and are provided with a turning radius of approximately 35 feet in order to accommodate larger tractor trailer trucks. A new asphalt access road is recommended along the south side of the new Carrousel basin No. 3, which could connect to the stub-out near the headworks. Minimal impacts to the facility are anticipated from the construction of improvements for the expansion at the NRWRF. Coordination of deliveries and maintenance activities will be required during construction near existing facilities.

4.2.4.5 STORMWATER

The NRWRF site is relatively flat with minimal impervious area. Based on the proposed process improvements, it is expected that the expansion project will result in minimal increase in impervious surface area. The proposed secondary clarifier and upgrades to existing structures for the expansion will be constructed with open tops to allow rainwater in and ensure there will be little to no increase in impervious surface area other than new road. As a result, there will be minimal impacts to the existing stormwater system. Minor stormwater improvements are expected as part of these site improvements.

4.2.5 PRELIMINARY TREATMENT SIZING - 12.5 MGD – MLE

4.2.5.1 HEADWORKS AND EQUALIZATION

Currently, for Class I Reliability the total screening capacity is 40 MGD and the total HeadCell grit units' capacity is 30.4 MGD, with the number of trays installed. The total Headcell grit units' capacity is below the expected PHF of 31.25 MGD for the expansion to 12.5 MGD AADF. Therefore, additional trays will need to be installed. Assuming the rest of the 4 trays be installed, the final total HeadCell grit units' capacity will be 45 MGD. In addition, major improvements and rehabilitation to the existing Headworks structure are needed due to corrosion in the Headworks structure and ragging problems downstream. An evaluation into the Headworks improvements and corrosion mitigation was conducted. Refer to the TM in **Appendix I** for details.

The existing 3 MG of equalization (EQ) storage is estimated to be sufficient for expansion to 12.5 MG AADF. A diurnal pattern developed from 2021 hourly flows was applied to the maximum month flow condition associated with the 12.5 MGD AADF alternative. 2.75 MG of storage is estimated to even out the diurnal pattern for this flow as shown in **Figure 4.3** in **Section 4.1.5**. The EQ return firm pumping capacity of 6,000 gpm (8.64 MGD) will empty 3 MG in 8-9 hours. This is sufficient return capacity according to design standards. In the future, the County could add two additional pumps in the two available spots at the existing EQ return PS. However, the cost for EQ system improvements is not included in this CER.

4.2.6 SECONDARY TREATMENT SIZING - 12.5 MGD - MLE

4.2.6.1 SPREADSHEET MODELS

Spreadsheet models were used as an initial estimate to establish capacity of aeration volume and clarifier surface area for the design loading conditions. With the addition of the third Carrousel anoxic/aerobic MLE basin and fourth clarifier the estimated activated sludge capacity was conservatively 13.0 MGD AADF with maximum month loading applied and Class I Reliability of 75% of peak day loading with one clarifier out of service at a Y_{Net}=1 and SVI=200 (see **Section 4.1.6.4**) as shown in **Figure 4.9**. These results are at an aerobic SRT of 7 days with the additional unit processes. At these operating conditions and peak day loading the state point for the secondary clarifiers was estimated to be in an underloaded condition. For clarifier state point analysis, an underloaded condition is good where the intersection of underflow and overflow lines is below the gravity flux curve, as shown in **Figure 4.10**.

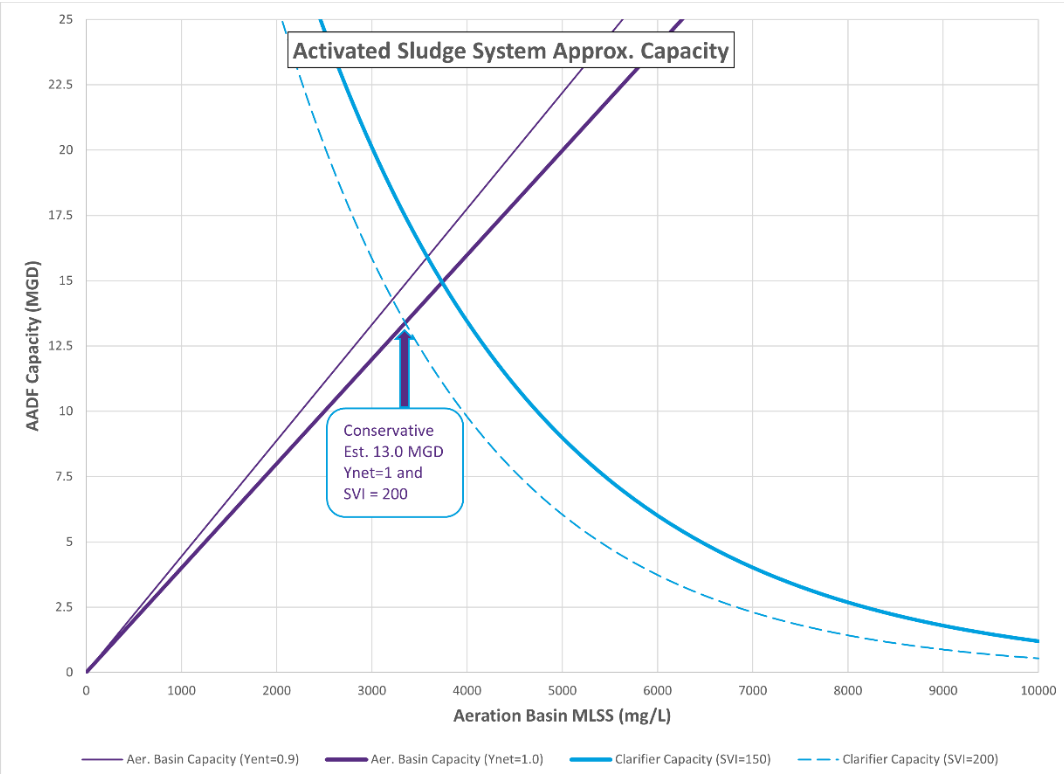


Figure 4.9 Activated Sludge Capacity for 12.5 MGD AADF (SRT 7 days)

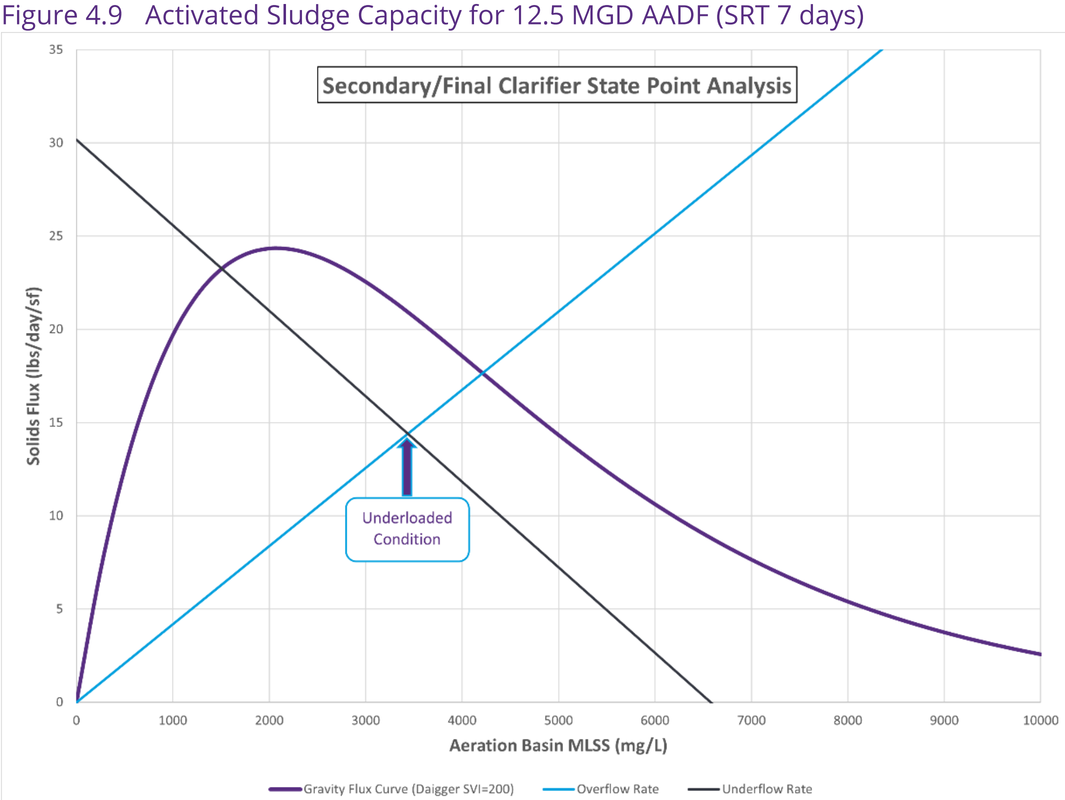


Figure 4.10 State Point Analysis for 12.5 MGD AADF

The existing six 125 HP aerators (three for each of the two existing basins) plus an additional three 125 HP aerators (on the third Carrousel basin) have sufficient capacity to meet the increased oxygen demand at the design peak day loading for 12.5 MDG AADF. See **Table 4.14** below. The total aeration capacity with one 125 HP aerator out of service in each train is more than the total estimated oxygen requirement. All nine aerators should have the same horsepower for reliability and operational flexibility. Aeration is a major operational cost for the facility. During preliminary design, after additional long-term sampling has been conducted and design loadings been updated, it is recommended that benefits of lower HP aerators be analyzed.

Table 4.14 Estimated Total Aeration Capacity for 12.5 MGD AADF Peak Day Loading

Parameter	Value
Aerator HP (each)	125
Aerator HP (total)	1125
Aerator Oxygen Transfer Efficiency (OTE) (per aerator) (lb O_2/hr/HP)	3.65[1]
Aerator Oxygen Capacity at Standard Conditions (each) (lb O_2/hr)	456.25
Total Aerator Oxygen Capacity at Standard Conditions (lb O_2/d)	98,550
Total Aerator Oxygen Capacity Class I at Standard Conditions (lb O_2/d)	87,600
Estimated Actual Oxygen Requirement (AOR) (lb O_2/d)	40,104
Estimated Standard Oxygen Requirement (SOR) (lb O_2/d)	65,464[2]

[1]Per Ovivo for newer design
[2]Less than aerator capacity

4.2.6.2 BIOWIN MODELS

Conceptual level BioWin models were set up to confirm initial sizing, evaluate aerator operation, evaluate increased IR rates, and estimate nitrogen removal. No additional sampling was conducted beyond what the County normally conducts for permit compliance. The DO and nitrogen profiles were not calibrated. No supplemental data was acquired for calibration.

The following assumptions were made for conceptual level model setup and should be verified before using for design:

- Influent loading was based on the data available and discussion in Section 0
- Once a week for pollutant concentration measurement does not provide enough data points for the level on certainly required for a design phase. More sampling should be conducted prior to preliminary design.

- Influent characterization was based on BioWin default values without any facility data. Influent characterization sampling should be conducted prior to preliminary design.
- Carrousel channel velocities were assumed to be 1 feet/sec for all BioWin model setups. Field testing and/or coordination with Ovivo to confirm actual and target ditch velocities at high and low aerator speeds is recommended
- Additional field testing for the following would be beneficial to improve the accuracy of model performance:
    - Actual DO profile at both aerator speeds
    - Actual nitrogen speciation profile at both aerator speeds
- The number of zones in the model would be adjusted to correlate with the field data mentioned above

Models were run steady-state at maximum month loading conditions. Peak day aeration demands and clarifier loading were estimated by other means and noted in the previous section.

Models represent one of the three Carrousel trains with a single clarifier of representative surface area for 1/3 of the total surface area for all four clarifiers. **Figure 4.11** shows the BioWin flowsheet for model setups. The new third Carrousel basin will have an IR gate rather than pumps. However, due to degradation of nitrogen removal at higher IR rates noted in **Section 4.1.6.2** the capacity of the existing axial flow internal recycle (IR) pumps of 12 MGD per train (at high speed) was used for most of the scenarios as noted in **Table 4.15**. An additional scenario was run to predict performance with increased IR rate. The model was run with the existing surface aerators at high speed, 125 HP and at HP between the high and low or target DO to demonstrate the benefit of DO control with VFD on the existing aerators. The latter is representative of a DO control system with VFDs on existing aerators, motorized effluent weir gates on Carrousel basins, and instrumentation in the Carrousel basins. The results of the modeling are listed in **Table 4.15**.

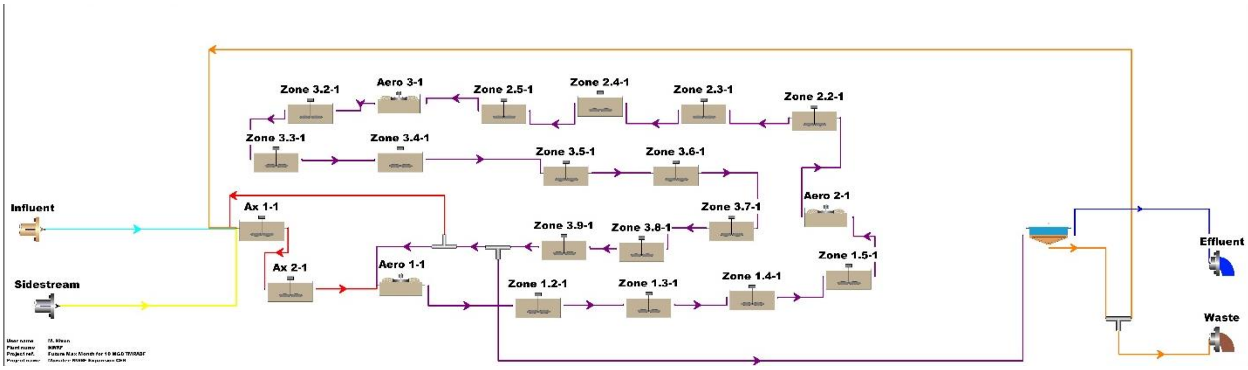


Figure 4.11 BioWin Flowsheet Example from Model Setup

When the model was run with all three aerators on at 125 HP (high speed) simultaneous nitrification-denitrification (SND) was limited in oxidation ditch channels and effluent TN was predicted to be above 10 mg/L. When aerators were adjusted to promote SND the internal carbon in the wastewater was more effectively used for improved nitrogen removal. SND is dependent on DO throughout the channels in the aerobic oxidation ditch portion of each Carrousel basin. DO drops along the length of the channels as mixed liquor moves away from each aerator, which creates a DO profile. SND starts to occur at a DO around 0.5 mg/L. Implementing the ability to control the DO at the aerators and generate an improved DO profile and will increase nitrogen removal without improvements to IR rate, pre-anoxic volume, or addition of external carbon. Effluent TN could be controlled down to 5-6 mg/L without a downstream reaeration basin, which would otherwise be needed to increase the DO of MLSS headed to the clarifiers and depress denitrification from occurring in the clarifiers. The model demonstrates this, but due to limitations noted above the level of certainty is low for predicted results of nitrogen removal performance and actual aerator HP. However, an effluent TN of 10 mg/L or less is expected to be achievable with DO control.

Another scenario to demonstrate the effect of IR rate on denitrification was generated. At 16.7 MGD per basin, or 4Q (four times the AADF in this case), the effluent NO_3 is predicted to be a little higher than at the current 12 MGD IR rate. One possible reason for this is that the readily biodegradable COD is depleted in the IR stream, i.e., the system is carbon limited. The carbon to nitrogen ratio for the raw wastewater is lower than typical medium strength municipal wastewater, which supports indication that the system is carbon limited. With an MLE system denitrification increases with increased IR rate to a point at which denitrification maxes out or deteriorates with additional increase in IR rate. For a carbon limited system that ideal IR rate for maximum denitrification is lower than the typical 2 to 4 Q.

The BioWin report for max month condition for 12.5 MGD AADF with MLE is included in **Appendix G**. The process evaluations on the existing and improved Carrousel basins were discussed with the equipment manufacturer, Ovivo. Process modeling results are consistent with Ovivo's analysis and recommendations.

Table 4.15 BioWin Modeling Select Results Comparison for 12.5 MGD AADF – Max Month Condition

Parameter	Aerators - High Speed (125 HP)	Aerators – Adjusted to Promote SND	4Q IR Aerators - High Speed
SRT (days)	7.0	7.0	7.0
IR Rate (MGD)	12	12	16.67
MLSS (mg/L)	3,126	3,132	3,128
Eff. Ammonia (mg/L)	0.2	0.3	0.2
Eff. NO_3 (mg/L)	14.2	5.3	14.7
Eff. NO_2 (mg/L)	0.1	0.2	0.1
Eff. TN (mg/L)	16.1	7.3	16.5
Eff. TP (mg/L)	3.2	3.2	3.2
Eff. TSS (mg/L)	6.3	6.3	6.3
Eff. BOD_5 (mg/L)	2.1	2.2	2.1
WAS Flow (MGD (% solids))	.65 (0.6%)	.65 (0.6%)	.65 (0.6%)

4.2.6.3 CARROUSEL OPERATIONAL AND PERFORMANCE IMPROVEMENTS

A recommended improvement to increase nitrogen removal and reduce aeration power consumption would be to add a DO control system with VFDs to control the speed of the existing surface aerators. The Ovivo recommended control system also includes ORP probes for the pre-anoxic zones. Additional instrumentation such as nutrient probes may be considered in preliminary design. The existing aerator motors are two-speed. It's estimated that less than 90 HP is needed to meet the peak day loading oxygen demand for the six aerators, and less than 55 HP per aerator is needed for design annual average loading. The ability to ramp aerators up and down to meet the oxygen demand will improve process performance and save on energy cost the majority of the time when the high or low speed does not meet the oxygen requirements. Effluent TN has been below the goal most of the time. Due to the actual loading compared to design capacity some of the aerators have been at low speed until sometime in 2022. As loading increased the aerators needed to be at high speed to achieve complete nitrification. As loading increases the aerators will need to be at high speed to achieve complete nitrification. Since the aerators are estimated to be oversized with actual BOD loading lower than the original design, over-aeration is expected with the aerators at high-speed. Over-aeration will minimize SND that occurs in the aerated portion of the Carrousel basins, and the majority of the dentification must occur in the pre-anoxic zones. Limitation of denitrification in the pre-anoxic zones is discussed below. The DO control system can be implemented with variable speed control of the aerators combined with DO probes and motorized effluent weir gates. The existing aerators have sufficient capacity for the increase in predicted oxygen demand as previously discussed. However, many of the existing aerators do not have a lower impeller. The lower impeller helps to keep solids in suspension when the aerator's speed is reduced by a VFD. It is recommended that all the existing impellers be replaced as part of this DO control system improvement. The newer Ovivo Excell aerators also have slightly higher oxygen transfer efficiency than the existing aerators. With DO control SND can been increased as discussed in **Section 4.1.6.2** which is the most efficient way to lower secondary effluent TN with the existing Carrousel basins. It is uncertain that effluent TN of 10 mg/L can be maintained for the expansion without this improvement.

The suggested improvement utilizes the Oculus control system by Ovivo. This utilizes DO probes in the basins to control VFDs for the aerators. The Oculus control system is a custom engineered control panel that takes in all required signals and with user input such as setpoints and limits can then control the aerator motors via VFDs and control the weir gates based on the data input to the system from the probes. The control panel and motor controls are based on the needs of the project. Additional equipment would include a control panel (containing a PLC and HMI for a user interface), two VFDs to control the aerator motors, and two mixer starters, and I/O capacity to control the gates as well as bring in the instrumentation signals.

Another improvement to the Carrousel basins evaluated was to create internal recycle channels in each basin and use IR gates rather than pumps to return the nitrified mixed liquor to the pre-anoxic zones. This improvement is not recommended due to the findings of the evaluation as follows. IR gates use a fraction of the energy and allow for a larger range of IR rates. The current IR pumping rate for each basin is 12 MGD at the high speed, which would be 2.9 Q (Q = design plant flow per basin = 12.5 / 3 = 4.17 MGD). MLE systems generally are designed for 2 to 4 Q of the AADF or MMDF. The IR gates would allow for typical MLE IR rates at or above 4 Q with a reduction in power. This would require modifications to the basins with demolition and concrete reconfiguration. As discussed in **Section 4.1.6.2**, high level BioWin modeling did not show improvement with increased IR rates beyond the existing high speed pumping capacity. No performance benefit is predicted from implementing this improvement. This improvement could be justified based on O&M benefits and reduction in power costs with gates compared to the existing pumps. The payback period based on energy saving alone was estimated to be almost 25 years. It was assumed that including O&M costs would at most reduce this by a few years. After discussing the draft report with the County it was decided that the IR gates should not be recommended as part of the expansion. With the County's direction to expand NRWRF with AGS it is not fiscally responsible to put additional investment into the Carrousel basins without a reasonable return on investment.

4.2.6.4 RAS AND CLARIFIER CAPACITY AND OPERATIONAL IMPROVEMENTS

The existing RAS capacity will need to be increased to a minimum of 125% of the expanded plant design flow. With the three-pump arrangement and VFDs covering 7.5 MGD to 12.5 MGD RAS flow will not be an issue. The existing RAS pump station only has space for the existing three pumps. Therefore, these pumps must be replaced along with larger suction and discharge piping and valves. To accommodate the existing RAS flow a second 20" RAS line to the headworks is recommended.

At the August 2022 site visit the facility staff noted that RAS pumping decreased after the startup of the 2019 EQ Tank project. The assumption is that with the RAS line tied into the PD PS discharge line the existing RAS pumps were pushed back on their curves, reducing capacity. The County has a project to construct a new plant drain station and separate the plant drain and RAS discharge lines that are currently manifolded together starting design in 2024. The RAS pumping capacity issue will be resolved with the separate PD PS project, improvements to the RAS pump station, and additional RAS line during preliminary design for expansion.

An upgrade to the secondary clarifier No. 3 mechanism is recommended to allow equal operation between the clarifiers in use. Due to the existing clarifier No. 3 sludge withdraw challenges, WAS is only withdrawn from clarifier No. 3. The recommended replacement clarifier mechanism is a spiral blade type.

The fourth clarifier is required for Class I reliability at the additional flow and loading and resulting higher mixed liquor suspended solids concentration in the three Carrousel basins for the 12.5 MGD expansion. The County reported at the August 2022 site visit that sludge volume index (SVI) measurements have been about 200 mL/g for past couple of years. The clarifier settling flux curves were adjusted to approximate an SVI of 200 mL/g. Design parameters for the four clarifiers are shown below in **Table 4.16**.

Table 4.16 Clarifier Design Parameters with Four Clarifiers at 12.5 MGD AADF Peak Loading

Parameter	All In Service	Class I Reliability
Qty	4	3
Diameter	110	110
SWD	14	14
Surface Area Each	9,503	9,503
Total Surface Area	38,013	28,510
Max RAS (times Q)	1.25	1.25
PDF + Max RAS (MGD)	39.4	29.5
Design MLSS (mg/L)	3,150	3,150
SLR (lb/d/sf)	27.2	27.2
HLR (gpd/sf)	822.1	822.1
Underflow Rate (gpd/sf)	411.0[1]	411.0[1]

[1]Exceeds recommended underflow rate of 400 gpd/sf which could result in thinning of sludge. A lower RAS rate will reduce this parameter.

4.2.7 TERTIARY TREATMENT SIZING - 12.5 MGD - MLE

The combination of the existing ABW and disk filters does not have enough capacity for Class I Reliability for the corresponding 75% of PHF for the 12.5 MGD AADF alternative. Recommended filter conversion to AquaDiamond will increase the filter capacity of the two ABW filters from 8.3 MGD to 30 MGD (assuming 50' laterals in the 90' available space). With the existing disk filter combined capacity of 14.9 MGD, the AquaDiamond conversion increases the facility filtration capacity to 44.8 MGD with all filters in service. The Class I Reliability requirement is to treat 75% of the PHF, which is 23.4 MGD. With one of the AquaDiamond filters out of service the facility filtration capacity will be 29.9 MGD, which exceeds 100% of the PHF for this alternative. **Table 4.17** below shows design parameters for the filters.

Table 4.17 Filter Design Parameters with Four Clarifiers at 12.5 MGD AADF Peak Loading

Parameter	AquaDiamond Conversion	Disk (Pile Cloth Media)	Total
	AquaDiamond	AquaDisk	
Qty	2	2	4
Surface Area (per filter) (for 50' laterals)	1,600	1,291	2,891
Total Surface Area (8 laterals per filter have 4 sf/ft length)	3,200	2,582	5,782
Max Filtration Rate (gpm/sf)	6.5	4[1]	
Capacity at Max Filtration Rate (MGD)	30.0	14.9	44.8
Class I Reliability Capacity Requirement (75% PHF)			23.4
Capacity Class I (MGD)[2]	15.0	14.9	29.9

[1] Derated from manufacturer design rate of 6.5 due to age.
[2] With one AquaDiamond filter out of service

4.2.8 DISINFECTION SIZING - 12.5 MGD - MLE

The volumes of existing four chlorine contact chambers are slightly undersized to provide 15 minutes of detention time at a PHF of 31.25 MGD with all four in service. However, the detention time of 14.3 minutes is close enough to the required 15 minutes to not recommend a fifth contact chamber. The applicable F.A.C. requirements state that this is allowed with a higher design total chlorine residual at the end of the chambers than the minimum of 1 mg/L. The historical records show that this is already occurring, and the increase in sodium hypochlorite storage capacity discussed below will satisfy the F.A.C. requirements. The existing contact chambers have sufficient volume to meet Class I Reliability requirements (50% of the design PHF with the largest out of service) with 22.25 MGD of capacity at 50% of PHF and 44.5 MGD equivalent design PHF capacity. Volumes for the existing contact chambers and calculated detention times are in **Table 4.18**.

Table 4.18 NRWRF Chlorine Contact Chamber Capacity for Expansion to 12.5 MGD AADF

Parameter	1&2	3&4	Total
Qty	2	2	4
Volume (each, MG)	0.0771	0.0777	0.15476
Total Volume (MG)	0.1541	0.1554	0.30952
SWD	8.7	8.6	
Detention Time at PHF (min)			14.3[1]
Capacity at 15 min. detention time (MGD)			29.7
Capacity Class I at 15 min. detention time (MGD) (50% of flow w/ largest out)			22.3

[1]A higher total chlorine residual is recommended to satisfy permitting requirements

The existing sodium hypochlorite pumping capacity is slightly less than the recommended capacity to meet estimated chlorine demands for the 12.5 MGD AADF alternative. 217 gph of 12.5% sodium hypochlorite would be required at 31.24 MGD PHF and Cl_2 dose of 20 mg/L. The existing firm pumping capacity is 210 gph. A Cl_2 dose of 20 mg/L is high for design standards. However, the existing chlorine usage at the NRWRF has averaged between 13 and 19 mg/L per year from 2019 through most of 2022. With the existing 210 gph capacity the Cl_2 would be 19.3 mg/L at PHF, and an increase in pumping capacity is not recommended.

The existing sodium hypochlorite storage capacity of 10,000 gallons is not sufficient for the 12.5 MGD AADF expansion for 14 days of storage at AADF flow (10,000 gal is based on current project not yet constructed). A Cl_2 dose of 15 mg/L was used to estimate the storage needs. At the plant flow and dosing stated above with an additional 20% for safety factor an additional 16,500 gallons of sodium hypochlorite storage is needed to provide 14 days of storage at 12.5 MGD AADF flow. However, this should be analyzed further in preliminary design for the expansion. See **Section 4.1.8** for discussion on historical sodium hypochlorite usage. The County is currently in the process of installing the 10,000 gallons of storage and a dosing system in the existing open-air structure to the north of the filters. There is an existing concrete pad between these structures that was used for old lake filters, that have since been removed. With some minor cleanup, this pad can be used and has sufficient space for the additional sodium hypochlorite bulk storage tanks. No structure over the tanks was included in the estimated costs.

4.2.9 EFFLUENT PUMPING - 12.5 MGD - MLE

The capacity of the effluent pump station is not sufficient for the new design PHF of 31.25 MGD. The recommended approach is to convert this pump station to a low service (low pressure) effluent pump station (LSPS) to pump treated effluent to onsite reclaimed water storage. This converted low service pump station will pump to either one of the existing reclaimed water ponds, the new 5 MG reclaimed water ground storage tank, or the reject ponds. The existing RCW GST will be demolished in this expansion. A new 36-inch line from the low service pump station to the Golf Course reclaimed water pond and a smaller branch to the new 5 MG tank is recommended for the increase flow. With the conversion of the effluent pump station, a new high service pump station (HSPS) is recommended to pump stored reclaimed water into the Manatee County Master Reuse System (MCMRS). The new 5 MGD reclaimed water ground storage tank is recommended for diurnal storage and will feed the new high service pump station. The gravity lake filter discharge is currently into the wetwell for the existing effluent pump station. Changing this arrangement will add another pump station, which was not included in this CER. Therefore, the low service pump station will re-pump the filtered reclaimed water to the 5 MG tank for distribution into the MCMRS.

The recommended arrangement of low service and high service pump stations is similar to the County's other two WRFs. The pumping arrangement proposed is:

- **<u>LSPS</u>**:
    - 4 duty / 1 standby
        - 5,425 gpm at 60' head per pump (31.25 MGD with all four pumps pumping)
- **<u>HSPS</u>**:
    - <u>Main pumps</u>:
        - 3 duty / 1 standby
        - 6,945 gpm at 208' head (30 MGD total with three pumps pumping)
    - <u>Jockey pumps</u>:
        - 1 duty / 1 standby
        - 3,475 gpm at 208' head

For layout and cost estimation the arrangement of the high service pump station at the County's SEWRF was used with six vertical turbine pumps in cans and suction line feed from the ground storage tank. The SEWRF high service pump station is shown below in **Figure 4.12**.

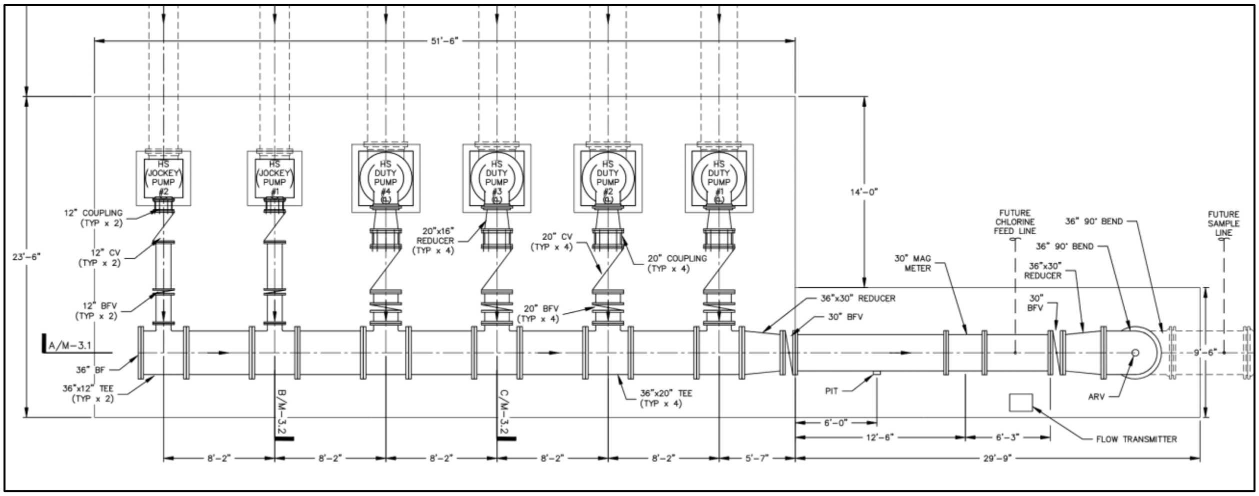


Figure 4.12 Example of High Service Pump Station at SEWRF

4.2.10 MISCELLANEOUS IMPROVEMENTS - 12.5 MGD - MLE

The capacity of the plant drain system must be increased for the new design PHF of 25 MGD. A second PD PS should be constructed adjacent to the existing PD PS. This second PD PS shall include a cross tie to the existing drain station and new piping to connect to the splitter box or EQ tanks. An additional piping will need to be constructed to separate the existing drain station from the RAS system and to discharge to the EQ tanks. This will aid in optimum process control. Additionally, the new PD PS shall include a sampling station or port which will be a small valve box like enclosure with a riser for sampling the incoming plant drain water.

Other additional improvements include the construction of a grit pad and routing modification for the lake filer backwash. The grit pad shall be constructed in the adjacent area to improve the grit hauling efficiency. The grit pad construction will include installment of a flow measurement device and SCADA programming. The lake filter backwash shall be routed to the East RCW pond since the retreatment of the lake filter backwash is an unnecessary plant load.

4.2.11 REJECT STORAGE - 12.5 MGD - MLE

The existing reject storage must be expanded and new storage lined to meet the requirements of F.A.C. 62-610.464. The volume requirement from the F.A.C., "volume equal to one day flow at the average daily design flow of the treatment plant or the average daily permitted flow of the reuse system, whichever is less" will be based on the new design AADF since the County's reuse system, MCMRS, is permitted for the entire County. Due to the estimated groundwater elevation and the existing Reject Pond being unlined, the usable volume of the existing pond was estimated to be approximately 5.5 MG at a high water table. This will need to be further evaluated, however, for the purposes of this CER, it was determined that an additional lined 7.0 MG Reject Pond is needed.

A new reject storage will be constructed by adding a berm to separate out northern third portion of the East RCW pond, reducing the capacity of the East RCW pond. F.A.C requirements for reuse storage will still be met for the facility due to the large volume of the Golf Course RCW Pond. The new reject pond must be lined. The bottom of the linear must be above the seasonal high water table. Other associated improvements are motorized valving at the effluent pump station to pump into the reject pond and a new reject pump station to pump out the pond back to the headworks or filter splitter box. The current 36” DIP gravity line between the effluent pump station wetwell and reject pond will be intercepted for the pumped flow arrangement. The existing reject pond drain to the PD PS could be maintained as an alternate method to partially drain the pond, to be determined in further design.

An alternative to this approach is to fill in the existing reject pond and build concrete ground storage tanks for reject storage. This would be a smaller overall footprint and not impact the East RCW pond. Cost and benefits comparisons for this potential alternative were not included in this CER. An example of this potential alterative is shown below in **Figure 4.13** from a 2010 NRWRF expansion design that was shelved.

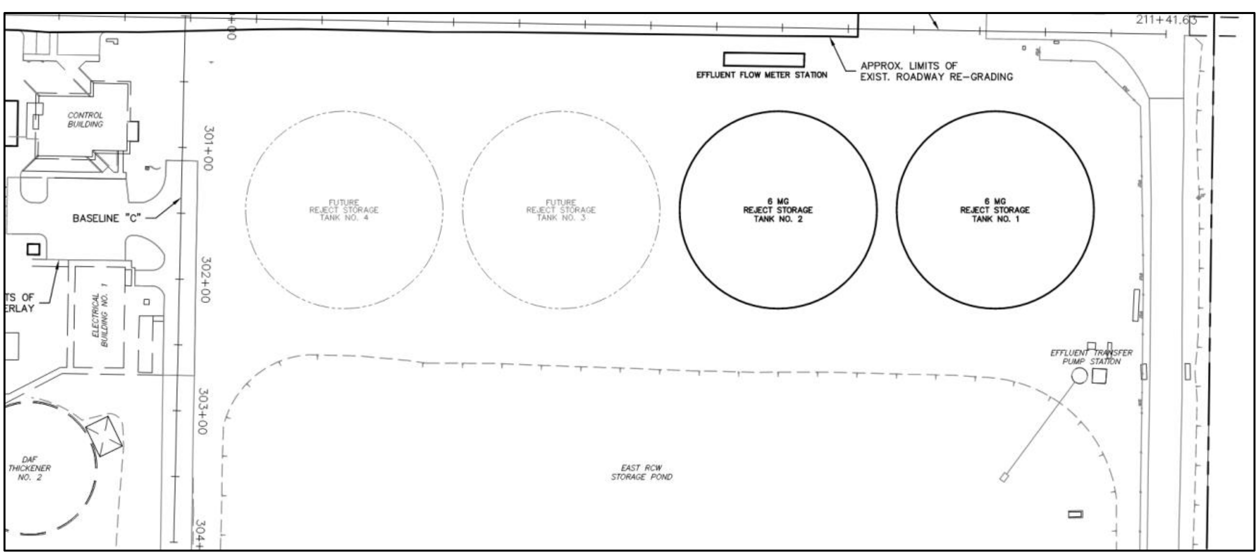


Figure 4.13 Portion of Proposed Site Plan from 2010 NWRF Expansion (That was not constructed)

4.2.12 BIOSOLIDS TREATMENT SIZING - 12.5 MGD - MLE

The biosolids handling processes at the NRWRF must be designed to withstand the maximum month loading conditions to ensure there is sufficient storage and belt filter press (BFP) dewatering capacity to process the WAS produced under sustained maximum loading conditions. In addition, the sludge holding tanks must have sufficient storage volume to accommodate the WAS produced at maximum day loading conditions to accommodate short-term surges in WAS production.

Sludge handling and dewatering operations will be overloaded with the additional sludge predicted at the expanded design flow. Both sludge storage tank capacity and weekly dewatering capacity from the existing belt presses will be undersized. The recommended solution is to add a gravity belt thickener upstream of the sludge holding tanks to decrease the volume of sludge to both unit processes downstream. Manatee County SEWRF has GBTs in this arrangement. Current operational parameters from SEWRF of GBT effluent percent solids of 2.5-3.0 and hydraulic loading rate to belt filter presses at that percent solids of 100 gpm was used to estimate the required capacity of the proposed GBT, existing sludge holding tanks, and existing BFPs. Sizing parameters for the proposed GBT are listed in **Table 4.19**. The County directed to include only one GBT for this expansion. To save cost and due to the County's experience with the GBTs they are comfortable without an installed spare. Our interpretation is that sludge thickening is not exempt from Class I Reliability requirements. In order to meet Class I Reliability requirements the County would have to increase the number of hours per week for BFP operation when the GBT is out of service. The County made infrastructure improvements to operate the BFPs 24 hours a day, 7 days a week if needed. Additional operator staffing would be required. With the addition of one GBT, no other capacity improvements to the existing sludge holding tanks or BFPs are anticipated as shown in **Table 4.20**. The addition of the GBT would include a polymer system, a canopy over the GBTs, and a thickened sludge pump station with progressive cavity pumps, similar to the current setup at the SEWRF. It is recommended that a bypass around the GBT with a motorized valve be installed to prevent overflows at high level and for operational flexibility.

Table 4.19 GBT Design Parameters at 12.5 MGD AADF Loading

Gravity Belt Thickeners		
Qty	1	
Size (belt width, meters)	2	
Operation Time (Hours per Day)	24	
Operation Time (Days per Week)	7	
Total Hours per Week	168	
Max WAS (times Q)	0.03	
MM WAS (MGD) (gpm)	0.375	260.4
WAS Pump Qty	3+1	
WAS Pump Capacity Each (gpm)	600 (125)[1]	
Total WAS Pump Capacity Class I (gpm) (MGD)	1325	1.91
Design WAS SS (mg/L)	7,500	
WAS (% solids)	0.75%	
GBT HLR (gpm)	300	
GBT Processing Capacity per Week (MG)	3.024	
WAS Qty per Week (MG)	2.625	
SLR (lb/hr)	1126.0	design <1,200
GBT Effluent (% solids)	2.5%	
GBT Effluent Flowrate at Max HLR (gpm)	90.0	
GBT Effluent Flowrate at MM WAS (gpm)	78.1	

[1]125 gpm is the estimated capacity of the progressive cavity pump

The existing diffusers in the SHTs are scheduled to be replaced in like-kind as a maintenance project. The diffusers are tube membrane style by EDI, 84P Magnum with polyurethane membranes. EDI refers to these as medium bubble diffusers. According to the manufacturer they have less fouling than fine bubble and prevent solids from getting inside the diffusers in higher solids concentrations such as the sludge holding tanks, and they have improved mixing over fine bubble and improved oxygen transfer over traditional course bubble diffusers. The existing multi-stage centrifugal blowers have required increased maintenance over time and are approaching the end of their useful life. For the expansion it is recommended that the sludge holding tank blowers be replaced with hybrid screw blowers with VFDs and diffusers replaced with duckbill check valve type diffusers

Table 4.20 Sludge Holding Tanks Design Parameters at 10 MGD AADF Loading

Existing Aerated Sludge Holding Tanks		
Qty	3	
Diameter	100	
SWD	17	
Surface Area Each	7,854	
Total Surface Area	23,562	
Volume Each	998,715	
Total Volume	2.996	
Max GBT Flow (MGD) (gpm)	0.113	78.1
Storage Capacity (days)	26.6	
Storage Capacity (days) (1 tank out of service)	17.8	
Qty of Blowers	3.0	
Blower Capacity Each (SCFM)	4,000	
Total Blower Capacity (SCFM)	12,000	
Air for Mixing (SCFM/ft^2)	0.51	

With the addition of thickening prior to the existing belt filter presses the dewatering capacity will be increased. A new polymer system is required with the high % solids the BFP influent. Estimated BFP loading with influent thickened sludge compared to existing capacity is shown in **Table 4.21.** Note that the County has the infrastructure in place to operate the BFPs 24 hours a day, 7 days a week if needed. Additional operator staffing would be required.

Table 4.21 Belt Filter Presses Design Parameters at 10 MGD AADF Loading

Existing Belt Filter Presses		
Qty	3	
Size (belt width, meters)	2	
Operation Time (Hours per Day)	12[1]	
Operation Time (Days per Week)	6[1]	
Total Hours per Week	216	
Total Hours per Week (1 out of service)	144	
Estimated Thickened Sludge in Holding Tanks (% solids)	2.5%	
HLR Each (gpm)	95	Based on influent % solids and SLR
Total HLR (gpm)	285	
Total HLR Class I (gpm)	190	
Processing Capacity per Week (MG)	0.821	
GBT Eff Qty per Week (MG)	0.787	
SLR Each (lb/hr)	1188.5	Design <1,200
Total SLR Class I (lb/hr)	2377.1	

[1]The County has infrastructure in place to operate 24/7 if needed

4.2.13 HYDRAULIC EVALUATION - 12.5 MGD - MLE

The hydraulic profile of the NRWRF was modeled using Visual Hydraulics hydraulic profile modeling software, Version 5.1, to evaluate the hydraulic capacity of the NRWRF at the future peak hourly flow of 31.25 MGD and for Class I Reliability. The NRWRF hydraulic profile was modeled assuming the proposed secondary clarifier No. 4 required for the MLE expansion to 12.5 MGD AADF has been installed and is in operation and the existing ABW filters have been converted to AquaDiamond filters. The hydraulic model flow diagram and the report output from the Visual Hydraulics software is presented in **Appendix C**. The intention of this hydraulic evaluation is to determine if the expanded facility can meet peak flow and Class I reliability requirements without any major modifications to the existing splitter boxes, channels, and yard piping. As defined by the USEPA and carried by the FDEP, the NRWRF's unit operations shall be designed such that with the largest flow capacity unit out of service, the hydraulic capacity of the remaining units shall be sufficient to handle the peak wastewater flow. In addition, to meet Class I Reliability, flow equalization shall not be considered as a substitute for component backup requirements. Therefore, the hydraulic evaluation considers the full non-equalized peak hourly flow rate of 31.25 MGD through the NRWRF to identify hydraulic deficiencies. Assumptions were made regarding the arrangement and operation of the expansion to the NRWRF's MLE process to meet the 12.5 MGD AADF design capacity. A list of the assumptions made to complete the hydraulic analysis for the expanded NRWRF is provided below:

- Based on guidance from the County, the maximum RAS flow used under peak hour flow conditions was 125% of the influent flow. This is 15.625 MGD, or 1.04% of the MMADF of 15.00 MGD.
- The maximum NRCY flow under peak hour flow conditions is 12 MGD per basin, or 240% of the MMADF of 5.00 MGD per basin.
- The Hazen-Williams friction loss coefficient for all DI pipes is 120
- One new anoxic/aeration basin is constructed to the north of No. 2.
- Piping to the new anoxic/aeration basin No. 3 is 30-inches in diameter.
- Piping from the new anoxic/aeration basin No. 3 to the clarifier splitter box is 42-inches in diameter.
- One new 110-ft diameter secondary clarifier No. 4 is constructed directly to the east of the existing clarifier No. 3, west of the anoxic/aeration basins.

- Piping to and new clarifier No. 4 is 36-inches in diameter and piping immediately downstream is 30-inches in diameter.
- Both ABW filters are converted to AquaDiamond filters, each with 1,600 ft^2 of filtration surface area.
- The maximum capacity of the Disk Filters is 14.9 MGD
- At PHF and for Class I reliability the maximum filter flow routed to the Disk Filters is 9.5 MGD (see **Section 4.1.13.1**) and the remainder is routed to the AquaDiamond Filters
- Flow is split equally between CCC trains 1–4
- For Class I reliability if a process train is taken offline the total flow is distributed as equally as possible between the remaining trains of that process

4.2.13.1 HYDRAULIC LIMITATIONS

The hydraulic models of the PHF and Class I Reliability scenarios were constructed based on existing record drawings of the NRWRF provided by the County and the assumptions listed above. Any routing of new piping and new pipe length estimates are conceptual. The routing of piping should be investigated further during detailed design. For unit processes, WEF MOP 8 recommends that the typical minimum freeboard under maximum water level conditions be approximately 12-inches, and there should be no submergence of control weirs under peak flow conditions. The 10 State Standards are generally more conservative and provide more specific freeboard guidelines for unit processes. Sections of the NRWRF where the allowable freeboard chosen for the project deviates from recommendations are noted and explained here.

After the models were set up in Visual Hydraulics, water surface elevations in the model were checked for reasons previously explained in **Section 4.1.13.1**. The freeboard requirements are summarized in **Table 4.11**. Based on the modeling, the Class I Reliability scenario generally resulted in larger deviations from the target critical elevations than the PHF scenario. Therefore, the Class I Reliability model results are described here. Based on the modeling, one major and several minor hydraulic limitations were identified during the hydraulic analysis, which are summarized as follows. Note that most of these are related to movable weir gates. It is generally recommended to have more freeboard with moveable weir gates to provide operational flexibility. However, even though the actual freeboard in these cases is less than the recommended 18-inches, it is more than 12”, which is acceptable. There was one major hydraulic bottleneck identified with the modeling.

(1) With increased flow between the filters and the four CCCs the AquaDiamond Filters Effluent Weirs were predicted to be submerged. All of the existing piping is 36-inch. The recommended resolution is to replace it all with 42-inch, with the exception of the short run of 36-inch from Disk Filter effluent to the tee connecting to the AquaDiamond Filters effluent channel. Without this change the CCC effluent weirs would have to be dropped, which would reduce the volume and contact time. This hydraulic bottleneck is not as bad on the Class I Reliability Visual Hydraulics report. Refer to the 12.5 MGD MLE PHF Visual Hydraulics report in **Appendix J**. The hydraulics downstream of the filter splitter box is the same for all 12.5 MGD alternatives.

The minor hydraulic limitation were noted as not critical, as explained below:

(1) AquaDiamond filters influent weirs: The water surface elevation is expected to be 32.15 ft which is 1.18 ft below the top of tank elevation of 33.33 ft. This does not meet the 1.5 ft freeboard target, however the elevation difference is large enough that it is not expected to result in significant hydraulic issues.

(2) AquaDiamond filters influent slide gates: The water surface elevation is expected to be 32.42 ft which is 0.91 ft below the top of tank elevation of 33.33 ft. This does not meet the 1.5 ft freeboard target, however the elevation difference is large enough that it is not expected to result in significant hydraulic issues.

(3) Clarifiers No.1–4 effluent launders: The water surface elevation is 0.28 ft below the V-notch weirs. This does not meet the target of being at least 0.5 ft below the weir. However, this is based on the existing launder design, and this elevation difference is still large enough that it is not expected to significantly create uncertainty in the calculated head over the weir. If the clarifier v-notch weirs were to become surcharged in a high flow condition it would not impair the settling performance of the clarifiers. It is important to note that the model also predicts the water surface level in the effluent boxes would be 36.04 ft, only 0.04 ft under the clarifier launder invert elevation of 36.08 ft. If this elevation difference were to be smaller, there would be a concern about this causing water in the launders to back up and create a situation where the V-notch weir is submerged.

(4) Clarifier FSB channel and Clarifier FSB weir gates No.1–4: At these points the water surface elevation is expected to be 40.05 ft. This is higher than the target of 1.5ft freeboard below the clarifier FSB top elevation of 41.42 ft. However, the freeboard is 1.37 ft, which is close enough to the target that it is not expected to result in significant hydraulic issues.

(5) Headworks automatic fine screens 1 and 2: The water surface elevation is expected to be 58.66 ft, meaning the freeboard would be 1.84 ft. This is less than the required freeboard of 2 ft, but close enough that it is not expected to result in significant hydraulic issues. This also could be addressed with the new screens.

4.2.13.2 RECOMMENDED ACTIONS TO IMPROVE HYDRAULICS AND FLOW SPLITTING

Adjustments to weir gates and minor modifications of weirs are recommended to improve flow control and plant hydraulics at peak flow, see below.

4.2.13.2.1 ADJUST ALL CHLORINE CONTACT TANK EFFLUENT WEIRS TO THE SAME ELEVATION

For the existing plant, the elevations of the effluent Cipolletti weirs of trains Nos. 1,2,3 and 4 are 28.75 ft, 28.75ft, 28.54 ft, and 29.55 ft respectively. Currently the flow distribution between the chlorine contact tanks is adjusted by throttling a valve upstream of the new chlorine contact tank. All effluent Cipolletti weirs should be set to the same elevation of 28.5 ft. This would allow the plant hydraulics to split the flow equally. The hydraulics of 42-inch lines and CCC weir elevations should be evaluated further in preliminary design to maximize the CCC volume.

4.2.13.2.2 OPTIMIZE FILTER FLOW SPLITTER BOX EFFLUENT WEIR GATES

The County stated that the wide weir gates in the filter splitter box are too large to practically use for adjusting the flow split between the two existing sets of filter basins at the August 2022 site visit, stating that a small adjustment in height makes a large change in flow split. With an expansion, including the need to send more flow to the retrofitted AquaDiamond filters, it is recommended that the County use weir gates to split the flow rather than yard piping valves. An evaluation using the hydraulic models determined that the shortest width weir gates that could be accommodated within the hydraulic profile are 7ft (See section 0). This is still a large weir gate, but it should improve operability if decided to make this change in the design phase.

4.2.13.2.3 ADJUST ANOXIC/AEROBIC BASIN EFFLUENT WEIR GATES ELEVATION

The weir gate elevations were lowered from 42.33 ft to 42.20 ft resulting in a freeboard of 1.09 ft. This meets the 1 ft minimum freeboard requirement. This weir elevation was used in subsequent 12.5 MGD hydraulic models (namely 12.5 MGD MLE with AGS).

4.2.13.3 ADDITIONAL OPERATIONAL RECOMMENDATION

4.2.13.3.1 INSTALL ADDITIONAL SPLASH GUARDS NEAR AERATORS

For all aeration tanks the 10 State Standards recommend 18" of freeboard. If a mechanical surface aerator is used (as is the case here), the freeboard requirement is increased to 3 feet to protect against windblown spray and other similar issues. The original facility design included and permitted 1 foot of freeboard. The design standard for this CER is to maintain the 1' as originally designed. Based on the existing tank construction, it is recommended that additional splash guards be installed near the aerator to minimize wind driven spray (similar to the current splash guards on SEWRF basin no. 3).

4.2.14 ENGINEER'S OPCC - 12.5 MGD - MLE

4.2.14.1 CAPITAL COSTS

To allow for the planning of projected future capital costs associated with the expansion of the NRWRF, **Table 4.22** below presents a summary of the conceptual project costs based on the expansion of the NRWRF to an AADF capacity of 12.5 MGD using the MLE process. This cost opinion has been prepared meeting the classification as an AACE Class 4 cost estimate. As such, it should be noted that the level of project definition associated with this cost estimate is less than 15%. Per the definition of an AACE Class 4 cost estimate, the expected range of accuracy for this cost estimate on the high end is +20% to +50% and -15% to -30% on the low end. As a result, the total opinion of probable project cost listed below may vary from $181,573,000 on the low end, to $389,085,000 on the high end. Various factors may combine to result in cost fluctuations within this range including fluctuations in market conditions, changes in project scope, improved project definition, and value engineering. Headworks corrosion mitigation estimated costs have been included.

In estimating construction costs, it is assumed that the new upgrades and equipment are being installed at present-day costs. Further, markups are used to estimate the costs for site improvements, yard piping, electrical improvements, I&C and SCADA, and indirect costs incurred by the contractor(s). The markup factors listed below for direct project costs including sitework and demo, yard piping, electrical, and SCADA/I&C are based on recent project experience, anticipated project scope, current market conditions, and input from local contractors. The markup factors listed below for indirect project costs incurred by the contractor are based on the following:

- Mobilization/Demobilization = 5% per WEF MOP 8
- General Conditions = $150,000 per month per input from local contractors for a project of this general scope and duration
- Contractor Overhead and Profit = 20-25%
- Maintenance of Plant Operations = 4-8% per input from local contractors for a project of this general scope and complexity
- Contractor Bonds/Insurance = 4% per local contractors for projects of this general scope and cost

An estimating contingency is also applied to all facility and disciplines estimates due to the preliminary nature of this evaluation to account for additional costs that will be realized during the detailed stages of design. Project cost escalation between the present day and the estimated date of project bid opening in 2027 is included to estimate the rate of future inflation. Estimated inflation has been included to aid in capital improvement planning, however, this should be re-evaluated annually and capital improvement budgets adjusted accordingly. Finally, engineering, administrative, and legal costs were estimated based on the direct construction costs at present day costs.

Costs were estimated based on past projects of similar size and scope; and McKim & Creed has no control over the costs of labor, materials, and equipment in the future. This is only an estimate of conceptual construction costs based on materials and equipment costs as of November 2022.

Table 4.22 Cost Opinion for NRWRF Expansion to 12.5 MGD AADF with MLE

Description	Cost
Mobilization/Demobilization (5%)	**$5,015,000**
Structural/Mechanical	
Headworks Improvements and Rehab	$6,000,000
New Carrousel Anoxic/Aerobic Basin	$14,500,000
Aerator Improvements for Ex. Carrousel Basin	$3,800,000
New Clarifier: 110-ft Diameter	$5,100,000
Replace Clarifier Mechanism for No. 3: 110-ft Diameter	$2,200,000
Replace RAS Pumps and Add Parallel RAS Line	$700,000
AquaDiamond Filters: Two Retrofitted and Add Canopy	$6,750,000
Additional Sodium Hypochlorite Storage	$300,000
Low Service PS Conversion, High Service PS, 5 MG Tank	$10,800,000
Second Plant Drain PS	$1,100,000
Gravity Belt Thickener (One), Polymer System, Sludge Pumps, and Canopy	$2,200,000
New SHT Blowers and Diffusers	$1,700,000
Structural/Mechanical Subtotal	***$55,150,000***
Other Direct Costs	
Overall Sitework and Demo (10%)	$5,515,000
New Reject Pond (LS)	$4,900,000
Yard Piping (25%)	$13,790,000
Electrical (20%)	$11,030,000
Electrical Building (LS)	$1,600,000
SCADA/I&C (18%)	$9,930,000
Other Direct Costs Subtotal	***$46,765,000***
Indirect Costs	
General Conditions (LS)	$4,500,000
Contractor OH&P (20%)	$20,385,000
Maintenance of Plant Operations (MOPO) (8%)	$8,155,000
Contractor Bonds/Insurance (4%)	$4,080,000
Indirect Costs Subtotal	***$37,120,000***
Construction Subtotal	***$144,050,000***
Estimating Contingency (30%)	**$43,215,000**
Opinion of Probable Construction Cost (2022 dollars)	***$187,265,000***
Inflation, Compounded Annually Until Bid (5% Annually)	$51,740,000
Opinion of Probable Construction Cost (2027 dollars)	***$239,005,000***
Engineering (20%)	$20,385,000
Opinion of Probable Project Cost	**$259,390,000**

4.2.14.2 O&M COSTS

Operation and maintenance costs for secondary treatment were estimated based on information from the manufacturer, see **Table 4.23**. Labor for maintenance was not included. The purpose of this was for comparison of secondary treatment processes. A 20-year net present value was calculated based on an annual discount rate of 2%. The estimated O&M 20-year net present value for this alternative was $7.9 million dollars.

Table 4.23 MLE O&M Costs for Net Present Value Calculation 12.5 MGD AADF with MLE

Parameter			
Aerator HP at AADF per	55	41.0	kW
Aerator HP at AADF Total for 9	495	369.1	kW
RAS HP	110	82.0	kW
IR HP	105	78.3	kW
Total HP	765.0	529.5	kW
Parameter			
MLE Energy per year		4638031	kWh
Power Cost Rate $/kWh		$ 0.10	
Cost Per Year		$ 463,803	
Parameter			
Estimated Other Annual O&M Costs	$ 780[1]		
Parameter			
Year 20 Other O&M Costs	$ 450,000[1]		

[1]Does not include energy costs listed separately

4.3 EXPANSION TO 12.5 MGD AADF - AGS (RECOMMENDED)

4.3.1 FLOW AND LOADS FOR 12.5 MGD - AGS

The total basis of design flows and loads for the expansion to 12.5 MGD AADF with AGS for the parallel processes were the same as in **Section 4.2.1 Flow and loads for 12.5 MGD** . However, the AGS system would treat 40% of the total loading and the existing MLE system would treat the remaining 60% of the loading.

This is the recommended alternative for expansion.

4.3.2 PROCESS EVALUATION OF THE EXPANSION TO 12.5 MGD - AGS

An alternate approach for expansion to 12.5 MGD AADF at the current permit limits and target effluent TN of 10 mg/L is to add a new 5 MGD secondary treatment system in addition to the existing 7.5 MGD MLE system. The process evaluated was an AquaNereda aerobic granular sludge (AGS) system. AquaNereda by Aqua-Aerobic Systems, Inc. is the exclusive provider of this innovative main liquid stream aerobic granular sludge (AGS) process in the US. The key innovation with this process is that the mixed liquor liquid/solids separation by gravity settling happens in a fraction of the time and at much higher MLSS concentrations compared to conventional active sludge (CAS) secondary clarification. AquaNereda is based on the conventional sequencing batch reactor (SBR) process, with several modifications to select for the growth and maintenance of granulated activated sludge particles. The granular activated sludge that is unique to the AquaNereda process settles much faster than conventional activated sludge flocs, and each granule simultaneously consists of aerobic, anoxic, and anaerobic conditions that enables enhanced nutrient removal. AGS is an intensification process that has reduced volume and footprint requirements due to higher MLSS concentrations compared to CAS processes. Intensification processes are sometimes a necessity to increase facility capacity with limited available land or to meet more stringent effluent requirements. For the NRWRF the main benefit is the reduced required footprint compared to the MLE expansion alternative. This saves on tankage capital costs. Other benefits of implementing AGS alongside the existing MLE process are noted later in **Section 4.3.5**.

The AGS process has proven results in Europe, and, at the time this CER was written in fall of 2022, there is one operational facility in the US, one demonstration facility, and multiple facilities under construction currently. AGS is a suspended growth activated sludge process that does not require media, membranes, or mineral addition. With the exception of the SRB batch process for AGS, the operation of an AquaNereda system is not much different than a traditional CAS system. Aqua-Aerobic Systems, Inc. has offered SBR treatment systems for over 35 years according to the website, and there are numerous SBRs at municipal wastewater treatment facilities in successful operation throughout the US. Three risks with implementing this process at the NRWRF as described herein are: 1. Loss of or inability to maintain granules; 2. Operating two parallel, separate secondary treatment processes; 3. Inherent unforeseen challenges associated with this innovative technology. On the second point, Manatee County's current WRF administration and operations staff stated that they are willing to operate dual processes. The County has chosen to do this with a current project in design for the SEWRF, which includes estimated capital cost savings compared to CAS expansion. Aqua-Aerobic Systems, Inc. has also stated that there are benefits to the existing CAS process when run in parallel with AquaNereda. Regarding the first and third points the AquaNereda process has been in full scale operation for many years at multiple facilities in Europe, and the technology has built-in controls and process pressures to grow and maintain the granules. It is reasonable that risks of unforeseen challenges with this innovative technology could be avoided with enhanced focus on implementation and operation.

The following processes require improvements or additional capacity to expand the facility to 12.5 MGD AADF with expansion of the AGS system with current permit effluent limits and desired effluent TN of 10 mg/L or less. If not noted the existing unit processes have sufficient capacity for the additional flow and loading.

- Headworks improvements and rehabilitation
- Addition of a new 5 MGD AGS treatment system
- New electrical building for AGS expansion and VFDs for existing aerators
- Modifications to the Headworks Splitter Box and Return Streams
- Conversion of existing Carrousel basin 125 HP aerators to VFD control with instrumentation and adjustable weir gates.
- Upgrade of Secondary Clarifier No. 3 mechanism
- Replacement of existing RAS pumps to increase capacity
- Additional parallel RAS line
- Conversion of existing granular media ABW filters to AquaDiamond filters (50' laterals estimated for 12.5 MGD expansion)

- Upsizing of filter effluent piping
- Additional sodium hypochlorite storage
- Conversion of effluent pump station to low service pump station
- New high service pump station
- New 5 MG ground storage tank
- One gravity belt thickener sludge pump system, and canopy
- New 7 MG Reject Pond using a portion of the east RCW pond

RAS and PD PS effluent are currently combined with screened raw sewage (SRS) in a common channel in the Headworks Splitter Box. The SRS feed to the new AGS process must be split off prior to any introduction of RAS from the MLE process. The existing PD PS accepts leachate and other hauled liquid waste into the system that is fed into the RAS line. Note that leachate will be redirected to another Manatee County WRF prior to expansion of NRWRF. Modifications to the RAS, PD PS, and EQ return lines and discharge locations in the Headworks Splitter Box were made with the 2019 North WRF Equalization Tank project. RAS and PD PS effluent lines are manifolded just south of the existing EQ tanks (shown on sheet C-2 SITE PIPING PLAN of 2019 North WRF Equalization Tank record drawings) and the combined mixture is returned to the south side of the Headworks Splitter Box as shown on **Figure 4.14**. The western portion of the Headworks Splitter Box is segmented with isolation gates between each pair of effluent boxes. Each pair of effluent boxes has an EQ return line associated with it. Currently, only the first pair of effluent boxes are in use that are directed to the Carrousel Basins.

The RAS and PD PS effluent lines should be separated and directed individually to the Headworks Splitter Box instead of manifolding at the current location. The RAS also should not discharge into the main channel that would feed all downstream secondary treatment processes included AGS. One option is for the RAS to be redirected where EQ tank return currently discharges in the southernmost section per the original design for the Headworks Splitter Box. The PD PS effluent could enter from its current location at the south side of the Headworks Splitter Box. Included in this expansion is a project to separate the RAS and PD PS discharges. This section of the report should be reviewed for that design to accommodate the future AGS system. The EQ return could continue to be discharged at the other original RAS return locations except for southernmost location. Weir gates for EQ return and AGS feed sections would need to be changed to slide gates with modifications to the concrete isolation walls. The proposed AGS system could then be fed with the next two effluent boxes, and the western channel isolation gate noted in **Figure 4.14** must remain closed to prevent MLE RAS from being introduced in the AGS influent.

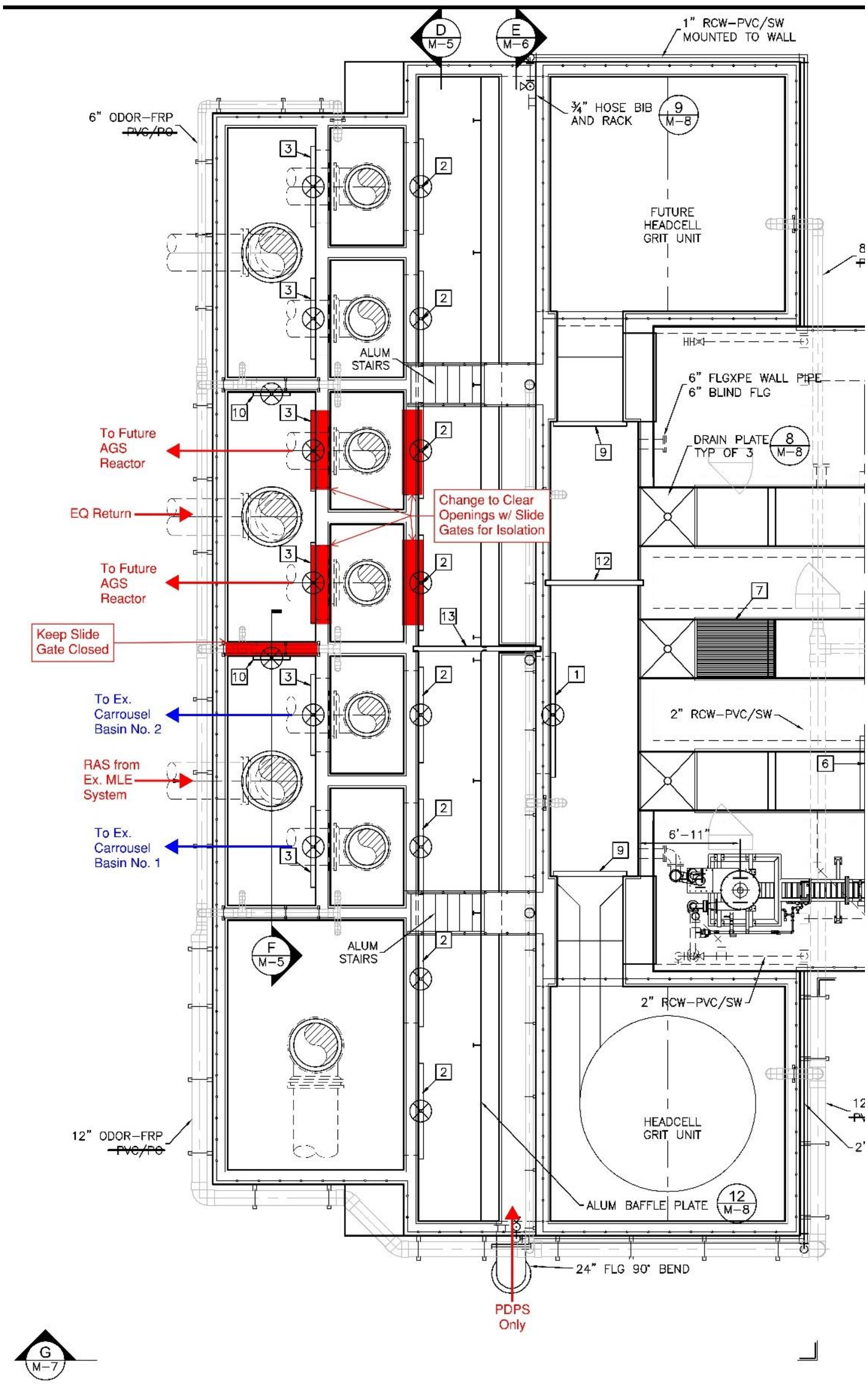


Figure 4.14 Existing Headworks Splitter Box to be Used for AGS Feed*

*From sheet M-2 of Influent Structure at the North Water Reclamation Facility 2010 Record Drawings

Influent to each AGS reactor must be controlled with a valve and flow meter to regulate the influent flow. Therefore, the existing weir gates in the Headworks Splitter Box should be evaluated during preliminary design. The flow into each reactor must be regulated and monitored by the AGS control system according to Aqua-Aerobic Systems, Inc.

4.3.3 SITE PLAN - 12.5 MGD - AGS

4.3.3.1 PROPOSED ADDITIONAL BASINS AND ACCESSORIES

Figure 4.15 shows the proposed additional infrastructure and accessories necessary to expand the NRWRF to meet the future AADF capacity of 12.5 MGD based on expansion of the existing MLE process with a new AGS system. A proposed process flow diagram for the expansion of the existing process with AGS is also included in **Figure 4.16** below.

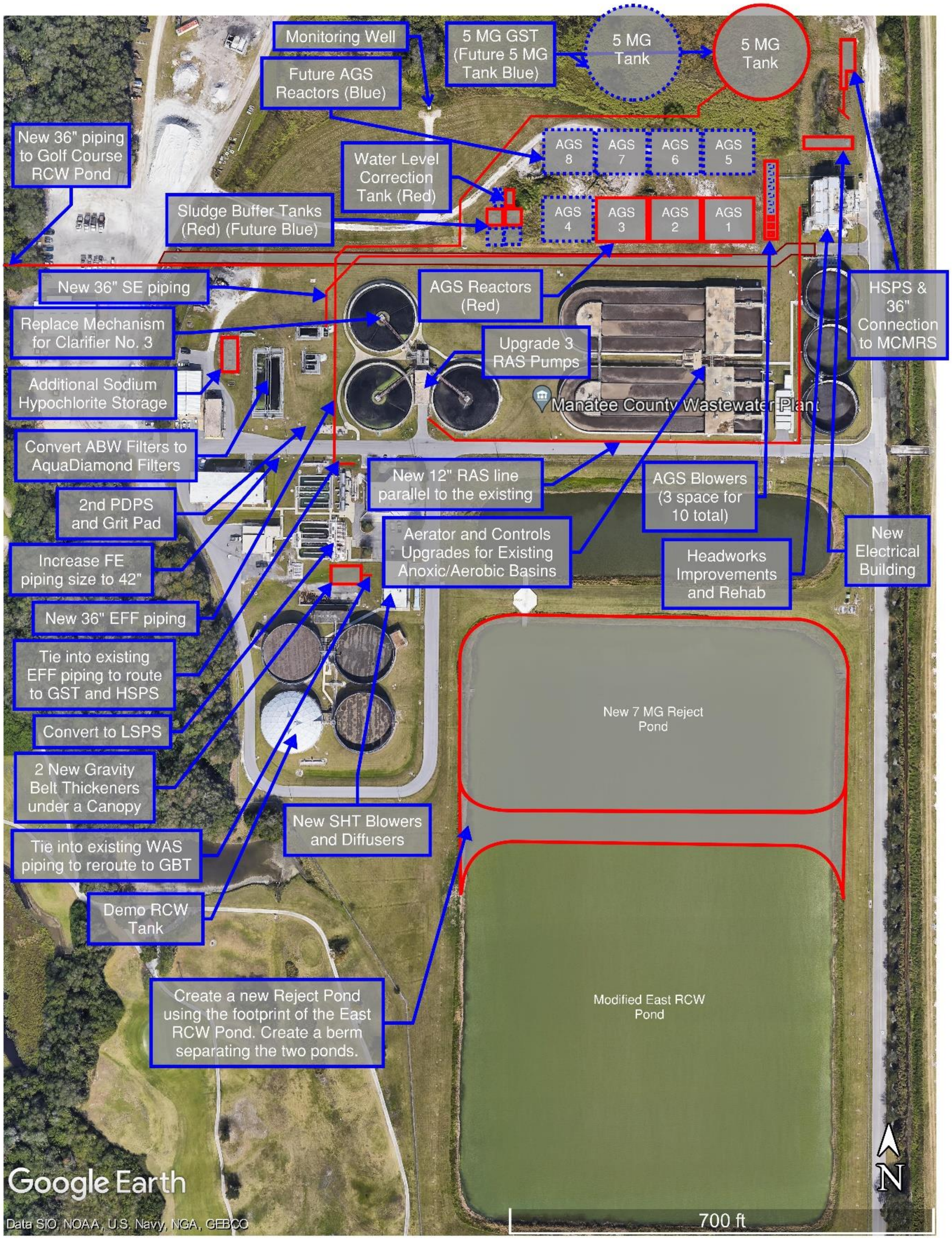
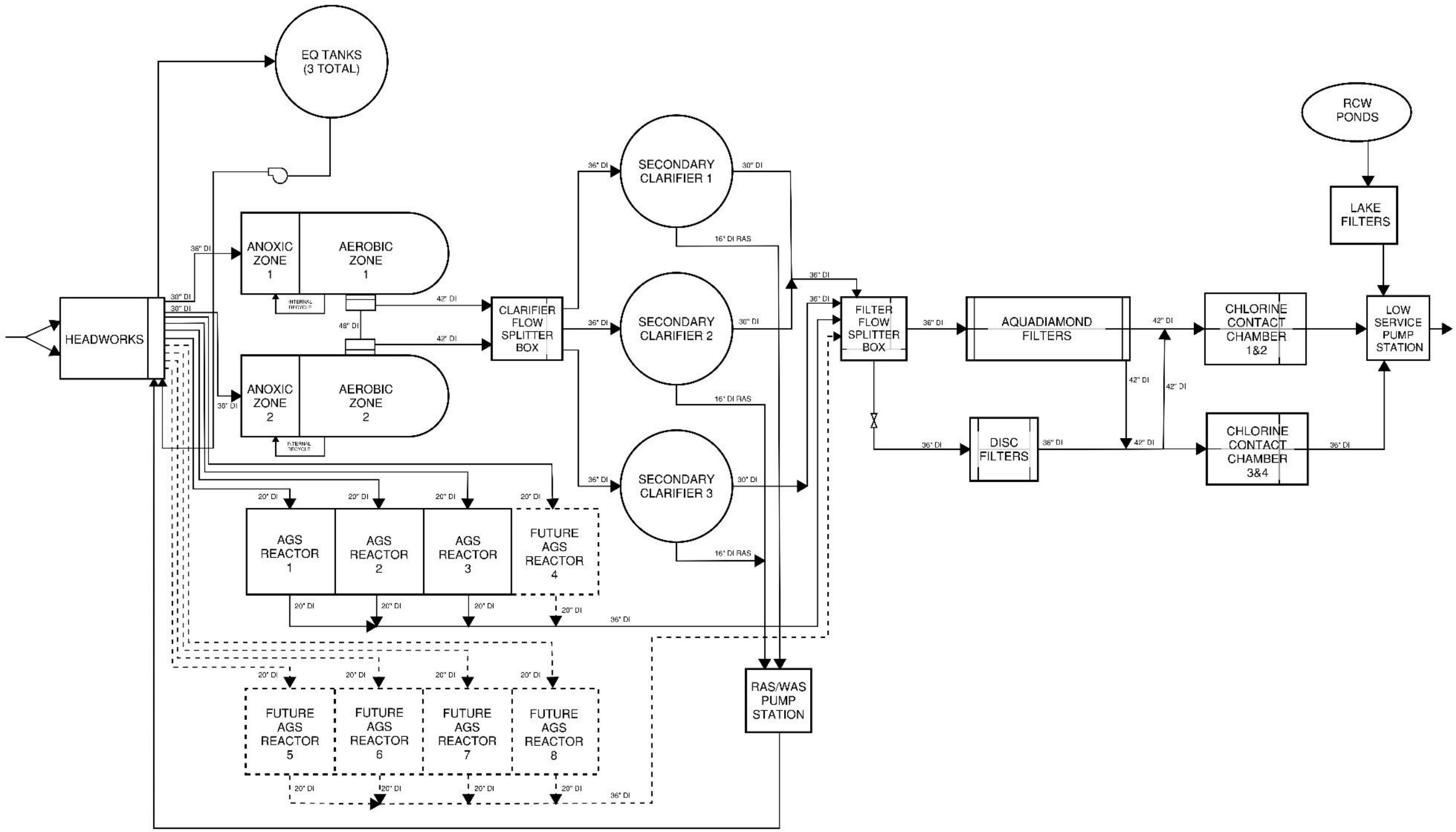


Figure 4.15 Proposed General Arrangement for NRWRF Expansion to 12.5 MGD AADF with AGS



MANATEE COUNTY NORTH REGIONAL WATER RECLAMATION FACILITY
PROCESS FLOW DIAGRAM
EXPANSION TO 12.5 MGD AADF WITH AGS

Figure 4.16 Proposed Process Flow Diagram for NRWRF Expansion to 12.5 MGD AADF with AGS

4.3.4 IMPACTS OF SITE MODIFICATIONS ON EXISTING PROCESSES – 12.5 MGD - AGS

Based on the proposed improvements described above, impacts to existing processes, maintenance of plant operations, yard piping, site access/vehicle movement, and stormwater were considered. Ongoing improvement projects for the NRWRF were also considered and coordinated with the proposed improvements described above. A summary of the impacts of these improvements is described in the sections below.

4.3.4.1 EXISTING PROCESSES

Expansion of the NRWRF to an AADF capacity of 12.5 MGD with a new AGS system is expected to impact the preliminary, secondary, tertiary, effluent pumping, biosolids treatment processes, reject storage, and RCW storage. These impacts are described later in **Section 4.3**. The operation of the flow equalization facilities will not be affected by this expansion.

4.3.4.2 MAINTENANCE OF PLANT OPERATIONS

Maintenance of plant operations (MOPO) is a critical concern during any major WRF expansion project to ensure that construction activities will not impair the County's ability to adequately operate and maintain the WRF and continue to meet effluent permit limits during construction. Impacts on MOPO for each major recommended improvement for the expansion of the NRWRF to 12.5 MGD AADF with AGS are summarized below:

- Retrofit of Headworks
    - Extensive bypassing and potentially temporary screening will be required to construct the improvements to the existing headworks.
    - Careful coordination with facility staff must be implemented to maintain continuous flow.
- Construction of New AGS system
    - It is recommended that the new AGS system be constructed and put into operation before improvements to the existing MLE system commence.
    - Construction of New AGS Reactors
        - Construction of the new AGS reactors will be located in an open area just north of the existing Carrousel Basin No. 2.

        - Construction of the new AGS blowers will be located in an open area east of the proposed location of AGS No. 1
        - The proposed 20-inch pipelines will be connected to the existing connections at the headworks to each of the new AGS reactors. Shutdowns are not anticipated for this.
        - Modifications to the RAS return, plant drain return, and gates at the Headworks Splitter Box are anticipated to require short-term bypassing in multiple phases.
        - Connection of the proposed 36-inch SE pipeline from AGS reactors to the existing Filter Flow Splitter Box will require a cofferdam, or other means to dewater a portion of the Filter Flow Splitter Box to maintain uninterrupted flow of effluent from existing secondary clarifiers to tertiary treatment while splitter box is cored and the new connection is made at the Filter Flow Splitter Box.
    - Construction of Water Level Correction Tank and Sludge Buffer Tank
        - Construction of the new water level correction tank and sludge buffer tank will be located in an open area to the west of the proposed AGS No. 3
        - Connection of the proposed pipeline from water level correction tank to the existing headworks shall be constructed. The routing, sizing, and connection location of the pipe will be determined in preliminary engineering design. Bypassing may be required.
        - Connection of the proposed pipeline from sludge buffer tank to the new gravity belt thickeners shall be constructed. The routing and sizing of the pipe will be determined in preliminary engineering design. No additional shutdowns are anticipated beyond what is listed below for construction of the new thickener system.
- Retrofit of Anoxic/Aerobic Basins
    - The anoxic/aerobic basins must be drained one basin at a time to replace aerators, replace weir gates, install other DO control components, and demolish portions of existing walls to construct a new IR gate and concrete channel.
    - These improvements are recommended to be completed Secondary Clarifier No. 3 is retrofitted to handle increased MLSS concentrations.

    - Careful coordination with facility staff will be implemented to maintain plant flow and prevent SSO's in the collection system. In order to achieve that, construction of AGS system is recommended to be completed before the retrofit of existing anoxic/aerobic basins.
- Replacement of clarifier mechanism at Secondary Clarifier No. 3
    - This is recommended to be completed after the AGS is constructed and online but before Carrousel basin improvements are started.
    - Secondary Clarifier No. 3 will be drained to demo the existing draft-tube style mechanism and replaced with a spiral blade mechanism.
    - This must be done during lower flow and load periods. It may be feasible to have clarifier No. 3 out of service for up to a month. The SRT will need to be lowered to keep the solids loading rate on clarifiers Nos. 1 and 2 at a reasonable rate.
    - Careful coordination with facility staff must be implemented to maintain treatment.
- Upgrade RAS pumps and construct additional RAS line
    - Bypassing is expected during the replacement of existing RAS pumps and pump station piping.
    - The additional parallel 12-inch RAS line can be constructed with minimal impacts to RAS and headworks. Short duration shutdowns may be required for tie-ins.
- Construction of an additional PD PS and Grit Pad
    - The additional PD PS can be constructed with minimal interruptions to the current plant drain system. Brief shutdowns on the plant drain system may be required to tie into the existing PD PS and at the splitter box or EQ tanks.
- Conversion of ABW Filters to AquaDiamond Filters
    - The ABW filters are recommended to be converted to AquaDiamond filters one at a time to maintain sufficient filtration capacity.
- Upsizing of filter effluent piping
    - The existing 36-inch filter effluent piping will be replaced with 42" piping with minimal impacts to the other yard piping. Short duration shutdowns may be required for tie-ins.
    - Careful coordination with facility staff must be implemented to maintain treatment.
- Construction of additional sodium hypochlorite storage

  - The additional sodium hypochlorite storage can be constructed with minimal interruptions to the existing disinfection storage and dosing system. Very brief shutdowns on the chemical pumping system may be required to tie into the pump suction lines.
- Construction of new sludge holding tank blowers and diffusers
  - The existing sludge holding tanks will be retrofitted with three new diffusers and three new blowers.
  - Each sludge holding tank will be taken down one at a time to replace the diffuser and the blower to minimize impact on the sludge holding tank capacity.
  - Careful coordination with facility staff will be implemented to maintain plant flow.
- Construction of two gravity belt thickeners and sludge PS
  - The new gravity belt thickeners and sludge PS will be constructed just southeast of the existing chlorine contact chambers.
  - The new gravity belt thickeners will be connected to the existing WAS piping running from the clarifiers to the sludge holding tanks. A 24-hour shutdown of the WAS system may be needed during the connections.
- Replacement of BFP polymer system
  - A shutdown of up to 24 hours may be required to make tie-ins for the replacement of the BFP polymer system.
- Construction of 5 MG ground storage tank
  - It is recommended that the new 5 MG ground storage tank be constructed before converting the effluent pump station to low service pump station.
  - Construction of the new 5 MG ground storage tank will be located in an open area southwest of the existing monitoring well.
- Construction of high service pump station and new RCW pipeline
  - It is recommended that the new high service pump station be constructed before converting the effluent pump station to low service pump station.
  - Construction of the new high service pump station will be located in an open area southwest of the existing monitoring well and south of the proposed 5 MG ground storage tank.

    - Construction of the new RCW pipeline from HSPS to the existing RCW distribution system requires minimal shutdown and will have minimal impact on the operation since the RCW distribution system does not run continuously.
- Upgrade effluent pump station to low service pump station
    - Contractors will require extended bypass pumping to replace effluent pumps with low service pumps.
    - Careful coordination with facility staff must be implemented to maintain treatment.
- Construction of a new 7 MG Reject Pond
    - East RCW Pond will be dewatered, and a portion of the pond will be sheeted out to completely drain the northern portion of the pond.
    - During this process, RCW will be diverted to the existing GST or to the Golf Course Storage Lake.
    - Careful coordination with facility staff will be implemented to maintain plant flow.

4.3.4.3 YARD PIPING

The major yard piping modifications proposed for the expansion include the following:

- 20-inch SRS pipelines from existing stub-out connections at the headworks to new AGS Reactors No. 1 and No. 2
- 20-inch SE pipelines from AGS Reactor No. 1 and No. 2 to new combined 36-in SE pipeline to existing Filter Flow Splitter Box
- Proposed pipeline from water level correction tank to the existing headworks (the routing and sizing of the pipe will be determined in preliminary engineering design)
- Proposed pipeline from sludge buffer tank to the new gravity belt thickeners (the routing and sizing of the pipe will be determined in preliminary engineering design)
- A new parallel 12-inch RAS pipeline from RAS/WAS pump station to the Headworks
- 8-inch WAS pipeline from new gravity belt thickeners to existing WAS piping to the sludge holding tanks
- 16-inch PD PS force main from the new additional PD PS to the existing splitter box or EQ tanks
- 42-inch FE pipeline to replace existing 36-inch pipeline between AquaDiamond Filters and all CCCs

- 36-inch RCW pipeline from LSPS to Golf Course RCW pond and smaller branch to 5 MG tank
- 36-inch RCW pipeline from HSPS to the existing RCW distribution system south of the headworks
- 4-inch pipeline from lake filter backwash to East RCW pond

4.3.4.4 SITE ACCESS/VEHICLE MOVEMENT

Vehicles can access the project area from the north via 69th Street East which is a two-lane asphalt surface roadway in a rural section. Access roads within the NRWRF vary between 20 and 24 feet in width, are constructed of asphalt, and are provided with a turning radius of approximately 35 feet in order to accommodate larger tractor trailer trucks. The roadways will not be impacted from the construction of proposed secondary clarifier and upgrades to existing structures for the expansion at the NRWRF. A new asphalt access road is recommended along the south side of the AGS system, which could connect to the stub-out near the headworks. Minimal impacts to the facility are anticipated from the construction of improvements for the expansion at the NRWRF. Coordination of deliveries and maintenance activities will be required during construction near existing facilities.

4.3.4.5 STORMWATER

The NRWRF site is relatively flat with minimal impervious area. Based on the proposed process improvements, it is expected that the expansion project will result in minimal increase in impervious surface area. The proposed secondary clarifier and upgrades to existing structures for the expansion will be constructed with open tops to allow rainwater in to ensure there will be little to no increase in impervious surface area other than new road. As a result, there will be minimal impacts to the existing stormwater system. Minor stormwater improvements are expected as part of these site improvements.

4.3.5 PRELIMINARY TREATMENT SIZING - 12.5 MGD – AGS

4.3.5.1 HEADWORKS AND EQUALIZATION

Currently, for Class I Reliability the total screening capacity is 40 MGD and the total HeadCell grit units' capacity is 30.4 MGD, with the number of trays installed. The total Headcell grit units' capacity is below the expected PHF of 31.25 MGD for the expansion to 12.5 MGD AADF. Therefore, additional trays will need to be installed. Assuming the rest of the 4 trays be installed, the final total HeadCell grit units' capacity will be 45 MGD. In addition, major improvements and rehabilitation to the existing Headworks structure are needed due to corrosion in the Headworks structure and ragging problems downstream. An evaluation into the Headworks improvements and corrosion mitigation was conducted. Refer to the TM in **Appendix I** for details.

The existing 3 MG of equalization (EQ) storage is estimated to be sufficient for expansion to 12.5 MG AADF . A diurnal pattern developed from 2021 hourly flows was applied to the maximum month flow condition associated with the 12.5 MGD AADF alternative. 2.75 MG of storage is estimated to even out the diurnal pattern for this flow as shown in **Figure 4.3** in **Section 4.1.5**. The EQ return firm pumping capacity of 6,000 gpm (8.64 MGD) will empty 3 MG in 8-9 hours. This is sufficient return capacity according to design standards. In the future, the County could add two additional pumps in the two available spots at the existing EQ return PS. However, the cost for EQ system improvements is not included in this CER.

Modifications to the RAS, PD PS, and EQ return locations into the Headworks Splitter Box are required with the introduction of the AGS system. Modifications to the Headworks Splitter Box are also required. Refer to **Section 4.3.2** for more information and recommendations.

It is not recommended to pump to the new AGS system directly from the existing EQ system due to the current arrangement of Headworks Splitter Box and off-line EQ system. Flow to the AGS system can be controlled by modulating valves at the reactors with direct connection to the Headworks Splitter Box. The balance of flow will be split to the existing MLE system up to level of the weir to the EQ tanks in the splitter box. With the ability to handle a range of flows with the existing MLE system and EQ system combined, flow to the AGS system can be controlled and limited as recommended by Aqua-Aerobics for AGS system optimization.

4.3.6 SECONDARY TREATMENT SIZING - 12.5 MGD- AGS

New AGS reactors could be constructed to the north of the existing Carrousel basins. Three AGS reactors are proposed in common wall, cast-in-place concrete tanks with an estimated 3.3 MG total AGS reactor volume, based on Aqua-Aerobics Preliminary Design Report in **Appendix F**. 21’ SWD AGS reactors are standard for AquaNereda systems, and this evaluation was based on the standard tank depth. To avoid an AGS feed pump station the AGS reactors would need to be partially buried approximately 5-7’ such that the feed water level for the tanks is compatible with existing plant hydraulics. It is estimated that additional ballast required to prevent flotation for empty reactors is minimal with most of the volume of the tanks above grade. This will require shoring and dewatering during construction compared to above grade tanks. However, the depth of the foundation is not unique for utility construction on the west coast of Florida. A water level correction tank was recommended in the AquaNereda preliminary design report. The water level correction tank allows an AGS reactor to drop the water level from the fill/draw stage at the effluent weir elevation to the react stage water level about ten inches lower. New positive displacement (PD) blowers under a canopy structure should be located adjacent to the AGS reactors and potential future AGS reactors. Sludge buffer tanks are required for the AGS system with proposed location shown in **Figure 4.15**. The sludge buffers tank allows for a more consistent waste sludge to be pumped to biosolids handling. A new SE line would convey effluent from each AGS reactor and connect to the existing Filter Splitter Box. An estimated diameter of 36-inch was used for this CER, but this should be further evaluated during design.

Proposals for sizing, predicted performance, and equipment pricing were requested from Aqua-Aerobics Systems Inc. for the 5 MGD of additional capacity as well as other alternatives discussed in other sections of this CER. The process evaluation of the AGS process was based on the proposals provided.

The AquaNereda proposal for 5 MGD AADF (note that preliminary design reports note the maximum month flow of 6 MGD, which is 40% of the 15 MGD for the plant, as the AADF) included the following and in **Table 4.24**, **Table 4.25**, and **Table 4.26** below:

- One Water Level Correction Tank
- Three AGS Reactor Tanks
- Two Sludge Buffer Tanks
- Three 200 HP PD Blowers (2 duty / 1 standby)
- AquaNereda process equipment, instrumentation, controls, valves, pumps, etc.

Table 4.24 AGS Water Level Correction Tank Information for 5 MGD AADF

Water Level Correction Tank	
Quantity	1
Type	Square CIP Concrete
Volume (MG)	0.040
Width (ft)	26
Length (ft)	14.1
SWD (ft)	14.4
Equipment	Pumps, level sensors, etc.

Table 4.25 AGS Reactor Tank Information for 5 MGD AADF

AGS Reactors	
Quantity	3
Type	Rectangular CIP Concrete
Volume (MG)	1.09
Width (ft)	78.5
Length (ft)	88.5
PWL (ft)	21.0
DWL (ft)	21.8
Freeboard (ft) (from PWL)	2.5
Aeration	Fine Bubble Diffusers
Equipment	Influent valves and distribution assemblies
	Effluent weir assemblies
	Sludge Decant and WLC assemblies
	Aeration system distribution and assemblies
	PD blowers
	Level, process parameter, and other instrumentation/sensors
	PLC w/ OIT (indoors)

Table 4.26 AGS Sludge Buffer Tank Information for 5 MGD AADF

Sludge Buffer Tank	
Quantity	2
Type	Rectangular CIP Concrete
Volume (MG)	0.079
Width (ft)	26
Length (ft)	26.3
SWD (ft)	15.4
Equipment	Pumps, control valves, level sensors, etc.

The preliminary process design report the AGS system in **Appendix F** has the following minor inconsistencies compared design information in this CER. However, none of these had a significant impact on the design or cost of the AGS system proposed. Since the design reports were preliminary they were not revised to address minor inconsistencies. The influent and effluent lines to and from each reactor were assumed to be 20-inch for this CER vs. 30-inch in AGS reports. This will need to be evaluated in subsequent design. The design minimum process water temperature for the project is 20°C vs. 15°C in AGS reports.

One additional benefit to adding the AGS process in parallel with the existing CAS MLE Carousel system according to Aqua-Aerobics is settling for the existing clarifiers is expected to improve due to AGS return streams to the headworks.

4.3.6.1 RAS CAPACITY AND OPERATIONAL IMPROVEMENTS

The County requested that the RAS pumping capacity for the secondary treatment system be increased to a minimum of 125% of the existing plant design flow. With the three-pump arrangement and VFDs covering 7.5 MGD to 9.4 MGD RAS flow will not be an issue. The existing RAS pump station only has space for the existing three pumps. Therefore, these pumps must be replaced along with larger suction and discharge piping and valves. To accommodate the existing RAS flow a second 12” RAS line to the headworks is recommended.

At the August 2022 site visit the facility staff noted that RAS pumping decreased after the startup of the 2019 EQ Tank project. The assumption is that with the RAS line tied into the PD PS discharge line the existing RAS pumps were pushed back on their curves, reducing capacity. The County has a project to construct a new plant drain station and separate the plant drain and RAS discharge lines that are currently manifolded together starting design in 2024. The RAS pumping capacity issue will be resolved with the separate PD PS project, improvements to the RAS pump station, and additional RAS line during preliminary design for expansion.

4.3.7 TERTIARY TREATMENT SIZING - 12.5 MGD - AGS

Filtration capacity needs to be increased for the additional design flow. Conversion of the existing ABW filters to AquaDiamond is proposed with the same flows and sizing discussed in **Section 4.2.7 Tertiary Treatment Sizing - 12.5 MGD** .

4.3.8 DISINFECTION SIZING - 12.5 MGD - AGS

The volumes of existing four chlorine contact chambers are slightly undersized to provide 15 minutes of detention time at a PHF of 31.25 MGD with all four in service. However, the detention time of 14.3 minutes is close enough to the required 15 minutes to not recommend a fifth contact chamber. The applicable F.A.C. requirements state that this is allowed with a higher design total chlorine residual at the end of the chambers than the minimum of 1 mg/L. Refer to **Section 4.2.8 Disinfection Sizing - 12.5 MGD - MLE** for more details.

The existing sodium hypochlorite storage capacity needs to be increased for the additional design flow. Refer to Sections 4.1.8 and 4.2.8 Disinfection Sizing - 12.5 MGD - MLE for more details.

4.3.9 EFFLUENT PUMPING - 12.5 MGD - AGS

The capacity of the effluent pump station is not sufficient for the new design PHF of 31.25 MGD. The recommended approach is to convert this pump station to a low service effluent pump station, add a high service pump station, and add a 5 MG ground storage tank. The existing RCW GST will be demolished in this expansion. This arrangement will be similar to the other two County WRFs. Refer to **Section 4.2.9 Effluent Pumping - 12.5 MGD - MLE** for more details.

4.3.10 MISCELLANEOUS IMPROVEMENTS - 12.5 MGD - AGS

The capacity of the plant drain system must be increased for the new design PHF of 25 MGD. A second PD PS should be constructed adjacent to the existing PD PS. Other additional improvements include the construction of a grit pad and routing modification for the lake filer backwash. See **Section 4.2.10 Miscellaneous Improvements** for more details.

4.3.11 REJECT STORAGE - 12.5 MGD AADF - AGS

The existing reject pond storage must be increased for one day flow at the average daily design flow. See **Section 4.2.11 Reject Storage - 12.5 MGD - MLE** for more details.

4.3.12 BIOSOLIDS TREATMENT SIZING - 12.5 MGD - AGS

Solids handling capacity needs to be increased for the additional design WAS flow. Two GBTs are proposed for this alternative. A single GBT would be hydraulically overloaded if wasting from both the MLE and AGS system occur simultaneously. A 2-meter GBT has a HLR of 300 gpm. The sludge pumps for the proposed AGS system have a constant speed capacity of 220 gpm. The combination of wasting from both systems would exceed 300 gpm. The daily total WAS flows and combined concentrations were assumed to be similar to **Section 4.2.12**. Further discussions with Aqua-Aerobics about design WAS flowrates and concentrations are recommended in preliminary design to validate these conceptual rates and verify sizing. In addition, the existing three sludge holding tanks will be retrofitted with new diffusers and the blowers will be replaced in this expansion. Sludge tank holding times and BFP usage would be similar to **Section 4.2.12.** With the addition of thickening prior to the existing belt filter presses the dewatering capacity will be increased. A new polymer system is required with the high % solids the BFP influent. Note that the County has the infrastructure in place to operate the BFPs 24 hours a day, 7 days a week if needed. Additional operator staffing would be required.

4.3.13 HYDRAULIC EVALUATION - 12.5 MGD - AGS

The hydraulic profiles of the NRWRF were modeled using Visual Hydraulics hydraulic profile modeling software, Version 5.1, to evaluate the hydraulic capacity of the NRWRF at the future peak hourly flow of 31.25 MGD and for Class I Reliability. The NRWRF hydraulic profile was modeled assuming the proposed three AGS reactors required for the AGS expansion to 12.5 MGD AADF have been installed and are in operation and the existing ABW filters have been converted to AquaDiamond filters. The hydraulic model flow diagram and the report output from the Visual Hydraulics software is presented in **Appendix D**. The intention of this hydraulic evaluation is to determine if the expanded facility can meet peak flow conditions and Class I reliability requirements without any major modifications to the existing splitter boxes, channels, and yard piping. As defined by the USEPA and carried by the FDEP, the NRWRF's unit operations shall be designed such that with the largest flow capacity unit out of service, the hydraulic capacity of the remaining units shall be sufficient to handle the peak wastewater flow. In addition, to meet Class I Reliability, flow equalization shall not be considered as a substitute for component backup requirements. Therefore, the hydraulic evaluation considers the full non-equalized peak hourly flow rate of 31.25 MGD through the NRWRF to identify hydraulic deficiencies. Assumptions were made regarding the arrangement and operation of the expansion using AGS to meet the 12.5 MGD AADF design capacity. A list of the assumptions made to complete the hydraulic analysis for the expanded NRWRF is provided below:

- Based on guidance from the County, the maximum RAS flow used under peak hour flow conditions was 125% of the MLE portion of the influent flow, 7.5 MGD AADF. This is 9.375 MGD, or 1.04% of the MLE portion of the MMADF of 9.00 MGD.

- The maximum NRCY flow under peak hour flow conditions is 12 MGD per existing anoxic/aerobic basin, or 267% of the MMADF of 4.50 MGD.
- The two existing Anoxic/Aerobic basins are used along with three new AGS reactors
- Under normal conditions, 60% of influent flow is routed to the existing anoxic/aerobic basins and 40% of influent flow is routed to the two new AGS reactors
- At PHF and for Class I reliability, only AGS reactor 3 is actively filling and draining at the AGS design maximum daily flow of 9.5 MGD. This is a worst-case scenario compared to 40% of the PHF (12.5 MGD) split between two AGS reactors.
- The headloss through internal piping in each AGS reactor (1.2 ft) was obtained from Aqua-Aerobic Systems. This is approximated in the "special loss" function of the Visual Hydraulics software. The headloss due to each AGS effluent weir is included as a separate weir element in the Visual Hydraulics model.
- Both ABW filters are converted to AquaDiamond filters, each with 1,600 ft^2 of filtration surface area.
- The maximum capacity of the Disk Filters is 14.9 MGD
- At PHF and for Class I reliability The maximum filter flow routed to the Disk Filters is 9.5 MGD (see **Section 4.1.13.1**) and the remainder is routed to the AquaDiamond Filters
- Flow is split equally between CCC trains 1–4
- For Class I reliability if a process train is taken offline the total flow is distributed as equally as possible between the remaining trains of that process
- For the Class I reliability scenario, if the process units are the same size but their influent of effluent pipe lengths are different, the offline unit(s) are those associated with shorter lengths of influent and/or effluent piping

4.3.13.1 HYDRAULIC LIMITATIONS

The hydraulic models of the PHF and Class I Reliability scenarios for this expansion were constructed based on existing record drawings of the NRWRF provided by the County and the assumptions listed above. The pipe routing and pipe length estimates to and from the AGS reactors are conceptual. The arrangement of the AGS reactors, phasing of AGS reactor installation, routing of piping to and from the AGS reactors, and available space for the reactors and piping should be investigated further during detailed design. For unit processes, WEF MOP 8 recommends that the typical minimum freeboard under maximum water level conditions be approximately 12-inches, and there should be no submergence of control weirs under peak flow conditions. The 10 State Standards are generally more conservative and provide more specific freeboard guidelines for unit processes. Sections of the NRWRF where the allowable freeboard chosen for the project deviates from recommendations are noted and explained here.

After the models were set up in Visual Hydraulics, water surface elevations in the model were checked for reasons previously explained in **Section 4.1.13.1**. The freeboard requirements are summarized in **Table 4.11**. Based on the modeling, the Class I Reliability scenario resulted in more deviations from the target critical elevations than the PHF scenario. Therefore, the Class I Reliability model results are described here. The PHF Visual Hydraulics output is presented in **Appendix D**. The hydraulic limitations identified are summarized as follows. Note that most of these are related to movable weir gates. It is generally recommended to have more freeboard with moveable weir gates to provide operational flexibility. However, even though the actual freeboard in these cases is less than the recommended 18-inches, it is more than 12”, which is acceptable.

There was one major hydraulic bottleneck identified with the modeling.

(1) With increased flow between the filters and the four CCCs the AquaDiamond Filters Effluent Weirs were predicted to be submerged. All of the existing piping is 36-inch. The recommended resolution is to replace it all with 42-inch, with the exception of the short run of 36-inch from Disk Filter effluent to the tee connecting to the AquaDiamond Filters effluent channel. Without this change the CCC effluent weirs would have to be dropped, which would reduce the volume and contact time. This hydraulic bottleneck is not as bad on the Class I Reliability Visual Hydraulics report. Refer to the 12.5 MGD MLE PHF Visual Hydraulics report in **Appendix J**. The hydraulics downstream of the filter splitter box is the same for all 12.5 MGD alternatives.

The minor hydraulic limitation were noted as not critical, as explained below:

(1) AquaDiamond filters influent weir: The water surface elevation is expected to be 32.15 ft, which is 1.18 ft below the top of tank elevation of 33.33 ft. This is 0.09 ft less of freeboard at this point than expected with the expansion to 12.5 MGD AGS at PHF. This does not meet the 1.5 ft freeboard requirement, but the elevation difference is large enough that it is not expected to cause significant hydraulic issues.

(2) AquaDiamond filters influent slide gate: The water surface elevation is expected to be 32.42 ft, which is 0.91 ft below the top of tank elevation of 33.33 ft. This is 0.19 ft less of freeboard at this

point than expected with the expansion to 12.5 MGD AGS at PHF. This does not meet the 1.5 ft freeboard requirement, but the elevation difference is large enough that it is not expected to cause significant hydraulic issues.

(3) Clarifiers 1 and 2 Effluent Launders: The maximum water surface elevation in the launders is expected to be 37.76 ft, which is 0.41 ft below the V-notch weirs elevation of 38.17 ft. This is smaller than the 0.5-ft target but is large enough that it is not expected to cause significant issues. However, this is based on the existing launder design, and this elevation difference is still large enough that it is not expected to significantly create uncertainty in the calculated head over the weir. If the clarifier v-notch weirs were to become surcharged in a high flow condition it would not impair the settling performance of the clarifiers. This was not an issue in the PHF only scenario.

(4) Clarifier FSB weir gate: The water surface elevation above the weir gate is expected to be 40.05 ft, which is 1.37 ft below the top of the tank elevation of 41.42 ft. This does not meet the freeboard target of 1.5 ft. However, this is expected to be large enough to not cause significant hydraulic issues. The same issue was identified for the PHF scenario, with a water surface elevation resulting in 0.2 ft more freeboard. The overall 1.44 ft difference between the top of tank elevation and water surface elevation is also large enough that it is not expected to result in significant hydraulic issues.

(5) Headworks Automatic Fine Screens: The water surface elevation upstream of both fine screens is expected to be 58.66 ft and the freeboard would be 1.84 ft. This is less than the required freeboard of 2 ft, but close enough that it is not expected to result in significant hydraulic issues. The same issue and water surface elevation were identified for the expansion to 12.5 MGD MLE at PHF. This also could be addressed with the new screens.

4.3.13.2 RECOMMENDED ACTIONS TO IMPROVE HYDRAULICS AND FLOW SPLITTING

Adjustments to weir gates and minor modifications of weirs are recommended to improve flow control and plant hydraulics at peak flow. The recommended general modifications that are similar to previous scenarios are described below.

4.3.13.2.1 ADJUST ALL CHLORINE CONTACT TANK EFFLUENT WEIRS TO THE SAME ELEVATION

For the existing plant, the elevations of the effluent Cipolletti weirs of trains Nos. 1,2,3 and 4 are 28.75 ft, 28.75ft, 28.54 ft, and 29.55 ft respectively. Currently the flow distribution between the chlorine contact tanks is adjusted by throttling a valve upstream of the new chlorine contact tank. All effluent

Cipolletti weirs should be set to the same elevation of 28.5 ft. This would allow the plant hydraulics to split the flow equally. The hydraulics of 42-inch lines and CCC weir elevations should be evaluated further in preliminary design to maximize the CCC volume.

4.3.13.2.2 OPTIMIZE FILTER FLOW SPLITTER BOX EFFLUENT WEIR GATES

The County stated that the wide weir gates in the filter splitter box are too large to practically use for adjusting the flow split between the two existing sets of filter basins at the August 2022 site visit, stating that a small adjustment in height makes a large change in flow split. With an expansion, including the need to send more flow to the retrofitted AquaDiamond filters, it is recommended that the County use weir gates to split the flow rather than yard piping valves. An evaluation using the hydraulic models determined that the shortest width weir gates that could be accommodated within the hydraulic profile are 7ft (See section 0). This is still a large weir gate, but it should improve operability if decided to make this change in the design phase.

4.3.13.2.3 ADJUST ANOXIC/AEROBIC BASIN EFFLUENT WEIR GATES ELEVATION

The weir gate elevations were adjusted for 1 ft of freeboard as noted in Visual Hydraulics report.

4.3.13.3 ADDITIONAL OPERATIONAL RECOMMENDATION

4.3.13.3.1 INSTALL ADDITIONAL SPLASH GUARDS NEAR AERATORS

For all aeration tanks the 10 State Standards recommend 18" of freeboard. If a mechanical surface aerator is used (as is the case here), the freeboard requirement is increased to 3 feet to protect against windblown spray and other similar issues. The original facility design included and permitted 1 foot of freeboard. The design standard for this CER is to maintain the 1' as originally designed. Based on the existing tank construction, it is recommended that additional splash guards be installed near the aerator to minimize wind driven spray (similar to the current splash guards on SEWRF basin no. 3).

4.3.14 ENGINEER'S OPCC - 12.5 MGD AADF - AGS

4.3.14.1 CAPITAL COSTS

To allow for the planning of projected future capital costs associated with the expansion of the NRWRF, **Table 4.27** present a summary of the conceptual project costs based on the expansion and conversion of the NRWRF to an AADF capacity of 12.5 MGD with AGS. This cost opinion has been prepared meeting the classification as an AACE Class 4 cost estimate. As such, it should be noted that the level of project definition associated with this cost estimate is less than 15%. Per the definition of an AACE Class 4 cost estimate, the expected range of accuracy for this cost estimate on the high end is +20% to +50% and -15% to -30% on the low end. As a result, the total opinion of probable project cost listed below may vary from $185,516,000 on the low end, to $397,535,000 on the high end. Various factors may combine to result in cost fluctuations within this range including fluctuations in market conditions, changes in project scope, improved project definition, and value engineering. Headworks corrosion mitigation estimated costs have been included.

In estimating construction costs, it is assumed that the new upgrades and equipment are being installed at present day costs. Further, markups are used to estimate the costs for site improvements, yard piping, electrical improvements, I&C and SCADA, and indirect costs incurred by the contractor(s). The markup factors listed below for direct project costs including sitework and demo, yard piping, electrical, and SCADA/I&C are based on recent project experience, anticipated project scope, current market conditions, and input from local contractors. The markup factors listed below for indirect project costs incurred by the contractor are based on the following:

- Mobilization/Demobilization = 5% per WEF MOP 8
- General Conditions = $150,000 per month per input from local contractors for a project of this general scope and duration
- Contractor Overhead and Profit = 20-25%
- Maintenance of Plant Operations = 4-8% per input from local contractors for a project of this general scope and complexity
- Contractor Bonds/Insurance = 4% per local contractors for projects of this general scope and cost

An estimating contingency is also applied to all facility and disciplines estimates due to the preliminary nature of this evaluation to account for additional costs that will be realized during the detailed stages of design. Project cost escalation between present day and the estimated date of project bid opening in 2027 is included to estimate the rate of future inflation. Estimated inflation has been included to aid in capital improvement planning, however, this should be re-evaluated annually and capital improvement budgets adjusted accordingly. Finally, engineering, administrative, and legal costs were estimated based on the direct construction costs at present day costs.

Costs were estimated based on past projects of similar size and scope; and McKim & Creed has no control over the costs of labor, materials, and equipment in the future. This is only an estimate of conceptual construction costs based on materials and equipment costs as of November 2022.

Table 4.27 Cost Opinion for NRWRF Expansion to 12.5 MGD AADF with AGS

Description	Cost
Mobilization/Demobilization (5%)	**$5,125,000**
Structural/Mechanical	
Headworks Improvements and Rehab	$6,000,000
Headworks Splitter Box and RAS Connection Modifications	$200,000
AquaNereda System for 5.0 MGD	$20,513,000
Aerator Improvements for Ex. Carrousel Basin	$3,800,000
Replace Clarifier Mechanism for #3: 110-ft Diameter	$2,200,000
Replace RAS Pumps and Add Parallel RAS Line	$600,000
AquaDiamond Filters: Two Retrofitted and Add Canopy	$6,750,000
Additional Sodium Hypochlorite Storage	$300,000
Low Service PS Conversion, High Service PS, 5 MG Tank	$10,800,000
Second Plant Drain PS	$1,100,000
Gravity Belt Thickeners (Two), Polymer System, Sludge Pumps, and Canopy	$2,500,000
New SHT Blowers and Diffusers	$1,700,000
Structural/Mechanical Subtotal	***$56,463,000***
Other Direct Costs	
Overall Sitework and Demo (10%)	$5,650,000
New Reject Pond (LS)	$4,900,000
Yard Piping (25%)	$14,120,000
Electrical (20%)	$11,295,000
Electrical Building (LS)	$1,600,000
SCADA/I&C (18%)	$10,165,000
Other Direct Costs Subtotal	***$47,730,000***
Indirect Costs	
General Conditions (LS)	$4,500,000
Contractor OH&P (20%)	$20,840,000
Maintenance of Plant Operations (MOPO) (8%)	$8,340,000
Contractor Bonds/Insurance (4%)	$4,170,000
Indirect Costs Subtotal	***$37,850,000***
Construction Subtotal	***$147,168,000***
Estimating Contingency (30%)	***$44,155,000***
Opinion of Probable Construction Cost (2022 dollars)	***$191,323,000***
Inflation, Compounded Annually Until Bid (5% Annually)	$52,860,000
Opinion of Probable Construction Cost (2027 dollars)	***$244,183,000***
Engineering (20%)	$20,840,000
Opinion of Probable Project Cost	**$265,023,000**

4.3.14.2 O&M COSTS

Operation and maintenance costs for secondary treatment were estimated based on information from the manufacturer, see **Table 4.28** and **Table 4.29**. Labor for maintenance was not included. The purpose of this was for comparison of secondary treatment processes. A 20-year net present value was calculated based on an annual discount rate of 2%.

The estimated O&M 20-year net present value for this alternative was $6.9 million dollars, which was $1 million dollars less than the MLE expansion alternative. The biggest difference in operational costs was for aeration.

Table 4.28 MLE Portion O&M Costs for Net Present Value Calculation 12.5 MGD AADF

Parameter			
Aerator HP at AADF per	55	41.0	kW
Aerator HP at AADF Total for 6	330	246.1	kW
RAS HP	71.5	53.3	kW
IR HP	70	52.2	kW
Total HP	526.5	351.6	kW
Parameter			
MLE Energy per year		3080045	kWh
Power Cost Rate $/kWh		$ 0.10	
Cost Per Year		$ 308,004	
Parameter			
Estimated Other Annual O&M Costs[1]	$ 500		
Parameter			
Year 20 Other O&M Costs[1]	$ 300,000		

[1]Does not include energy costs listed separately

Table 4.29 AGS Portion O&M Costs for Net Present Value Calculation 12.5 MGD AADF

Parameter	
AGS Energy per day (kWh)	2,533
Parameter	
AGS Energy per year (kWh)	924,545
Power Cost Rate $/kWh	$ 0.10
Cost	$ 92,455
Parameter	
Estimated Other Annual O&M Costs	$ 1,764
Parameter	
Every 2 Years O&M Costs	$ 7,575
Every 3 Years O&M Costs	$ 26
Every 5 Years O&M Costs	$ 5,270
Every 7 Years O&M Costs	$ 15,840

SECTION 5 ALTERNATIVE TO MEET AWT REQUIREMENTS FOR EXPANSION TO 12.5 MGD AADF

5.1 OVERVIEW OF AWT REQUIREMENTS

As an alternative to the expansion with current limits and County goal of 10 mg/L effluent TN, Manatee County has also requested the evaluation of the expansion to a AADF capacity of 12.5 MGD that can produce treated effluent meeting Florida Advanced Wastewater Treatment water quality requirements. As noted in **Section 1.1**, the AWT standards described in § 403.086, Fla. Stat. (2021) require effluent pollutant concentrations to be less than or equal to 5 mg/L cBOD5, 5 mg/L TSS, 3 mg/L TN, and 1 mg/L TP.

Note that § 403.086, Fla. Stat. (2021) includes provisions to waive the compliance requirements for phosphorus where it can be demonstrated that phosphorus is not a limiting nutrient in the receiving water bodies. While the NRWRF does not discharge effluent to any surface water bodies, it may be inferred that the compliance requirements for phosphorus would be based on indirect discharge of reclaimed water to the surrounding water bodies such as the Manatee River, Terra Ceia Bay, and Tampa Bay. It has been demonstrated that nitrogen is the limiting nutrient in Tampa Bay and other saltwater bodies on the coast of Florida. In addition, nearby WRF's such as the City of Tampa's Howard F. Current AWTP have been granted waivers for compliance with the AWT effluent phosphorus requirements. Therefore, it is expected that the compliance requirements for effluent phosphorus would be waived for the expansion of the NRWRF using processes capable of meeting AWT requirements if needed. As a result, the following evaluation of the NRWRF expansion alternative to meet AWT requirements is based on meeting effluent limits of 5 mg/L cBOD5, 5 mg/L TSS, and 3 mg/L TN, excluding the requirements for TP. However, the County preferred treatment process can meet the effluent TP of 1 mg/L or less if needed.

5.2 PREFERRED PROCESS TO MEET AWT REQUIREMENTS

Under this alternative, the NRWRF must be converted to a new secondary treatment process since the existing MLE process is not capable of meeting effluent TN concentrations of 3 mg/L or less. The County's preferred process is aerobic granular sludge (AGS). The County is currently planning an expansion at the SEWRF by adding AGS as a parallel secondary treatment system. Converting to AGS is also consistent with other recent County WRF evaluations.

5.3 FLOW AND LOADS FOR 12.5 MGD - AWT - AGS

The total basis of design flows and loads for the expansion to 12.5 MGD AADF to meet AWT requirements with AGS were the same as in **Section 4.2.1 Flow and loads for 12.5 MGD** , and the new AGS secondary treatment system would treat 100% of the flow.

5.4 PROCESS EVALUATION OF THE EXPANSION TO 12.5 MGD - AWT - AGS

The County's preferred AWT process evaluated was an AquaNereda aerobic granular sludge (AGS) system. AquaNereda by Aqua-Aerobic Systems, Inc. is the exclusive provider of this innovative main liquid stream aerobic granular sludge (AGS) process in the US. The key innovation with this process is that the mixed liquor liquid/solids separation by gravity settling happens in a fraction of the time and at much higher MLSS concentrations compared to conventional active sludge (CAS) secondary clarification. AquaNereda is based on the conventional sequencing batch reactor (SBR) process, with several modifications to select for the growth and maintenance of granulated activated sludge particles. The granular activated sludge that is unique to the AquaNereda process settles much faster than conventional activated sludge flocs, and each granule simultaneously consists of aerobic, anoxic, and anaerobic conditions that enables enhanced nutrient removal. AGS is an intensification process that has reduced volume and footprint requirements due to higher MLSS concentrations compared to CAS processes. Intensification processes are sometimes a necessity to increase facility capacity with limited available land or to meet more stringent effluent requirements.

The AGS process has proven results in Europe, and, at the time this CER was written in fall of 2022, there is one operational facility in the US, one demonstration facility, and multiple facilities under construction currently. AGS is a suspended growth activated sludge process that does not require media, membranes, or mineral addition. With the exception of the SRB batch process for AGS, the operation of an AquaNereda system is not much different than a traditional CAS system. Aqua-Aerobic

Systems, Inc. has offered SBR treatment systems for over 35 years according to the website, and there are numerous SBRs at municipal wastewater treatment facilities in successful operation throughout the US. Three risks with implementing this process at the NRWRF as described herein are: 1. Loss of or inability to maintain granules; 2. Operating two parallel, separate secondary treatment processes; 3. Inherent unforeseen challenges associated with this innovative technology. On the second point, Manatee County's current WRF administration and operations staff stated that they are willing to operate dual processes, which is anticipated for some duration even with a complete conversion. The County has chosen to do this with a current project in design for the SEWRF, which includes estimated capital cost savings compared to CAS expansion. Aqua-Aerobic Systems, Inc. has also stated that there are benefits to the existing CAS process when run in parallel with AquaNereda. Regarding the first and third points the AquaNereda process has been in full scale operation for many years at multiple facilities in Europe, and the technology has built-in controls and process pressures to grow and maintain the granules. It is reasonable that risks of unforeseen challenges with this innovative technology could be avoided with enhanced focus on implementation and operation.

The following processes require improvements or additional capacity to expand the facility to 12.5 MGD AADF with expansion of the AGS system with AWT limits including TN of 3 mg/L or less. If not noted the existing unit processes have sufficient capacity for the additional flow and loading.

Conversion of the secondary treatment process to a new 12.5 MGD AGS treatment system. Note that processes and equipment noted below are based on the AquaNereda preliminary design report included in **Appendix F**. It is anticipated that the NRWRF will have already been partially converted to AGS and just the balance of tankage and equipment would be needed for the AWT conversion in that case.

- Headworks improvements and rehabilitation
- Addition of a new 12.5 MGD AGS treatment system
- New electrical building for AGS expansion
- Modifications to the Headworks Splitter Box and Return Streams
- Decommissioning of the existing MLE Carrousel basins, secondary clarifiers, and associated components
- Conversation of existing granular media ABW filters to AquaDiamond filters (50' laterals estimated for 12.5 MGD expansion)
- Upsizing of filter effluent piping

- Additional sodium hypochlorite storage
- Conversion of effluent pump station to low service pump station
- New high service pump station
- New 5 MG ground storage tank
- Two gravity belt thickeners (one duty / one standby), sludge pump system, and canopy
- Replacement of BFP polymer system
- New 7 MG Reject Pond using a portion of the east RCW pond

For the first phase of the conversion the SRS feed to the new AGS process must be split off prior to any introduction of RAS from the MLE process (phasing is discussed in **Section 5.8**). RAS and combined PD PS effluent is returned to the common channel where it is combined with SRS in the westernmost channel. Modifications to return lines, discharge locations, and operation of Headworks Splitter Box are needed as described in **Section 4.3.2**. For a complete conversion to AGS the southernmost section of the west channel in Headworks Splitter Box would require similar modifications recommended for AGS feed.

Influent to each AGS reactor must be controlled with a valve and flow meter to regulate the influent flow. Therefore, the existing weir gates in the Headworks Splitter Box should be evaluated during preliminary design. The flow into each reactor must be regulated and monitored by the AGS control system according to Aqua-Aerobic Systems, Inc.

5.5 SITE PLAN – 12.5 MGD – AWT - AGS

5.5.1 PROPOSED ADDITIONAL BASINS AND ACCESSORIES

Figure 5.1 shows the proposed additional infrastructure and accessories necessary to expand the NRWRF to meet the future AADF AWT capacity of 12.5 MGD based the replacement of the existing MLE process with a new AGS system. A proposed process flow diagram for the expansion of the expansion of the existing process with AGS is also included in **Figure 5.2** below.

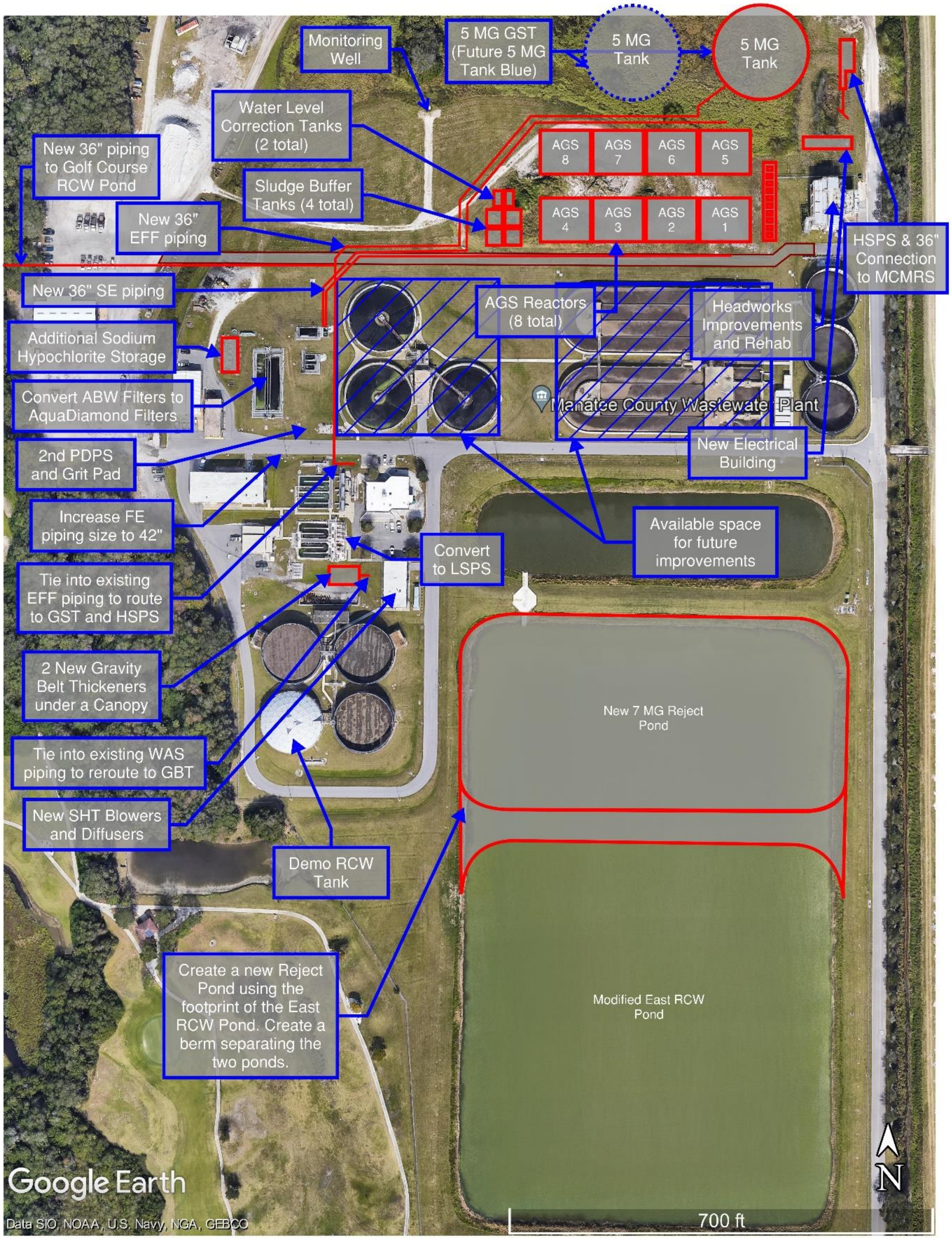


Figure 5.1 Proposed General Arrangement for NRWRF MLE Expansion to 12.5 MGD AADF AWT

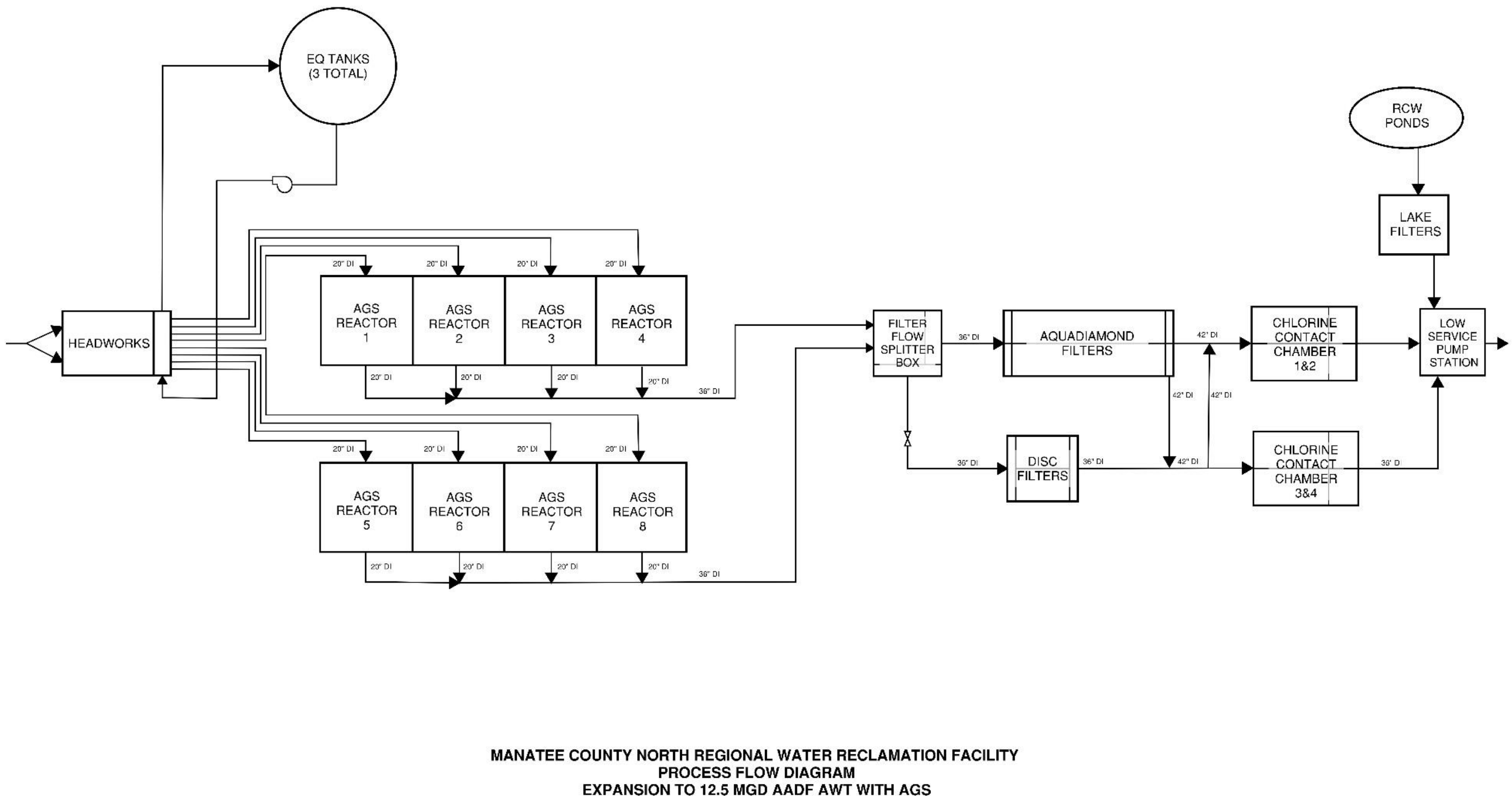


Figure 5.2 Proposed Process Flow Diagram for NRWRF MLE Expansion to 12.5 MGD AADF AWT

5.6 IMPACTS OF SITE MODIFICATIONS ON EXISTING PROCESSES – 12.5 MGD – AWT - AGS

Based on the proposed improvements described above, impacts to existing processes, maintenance of plant operations, yard piping, site access/vehicle movement, and stormwater were considered. Ongoing improvement projects for the NRWRF were also considered and coordinated with the proposed improvements described above. A summary of the impacts of these improvements is described in the sections below.

5.6.1 EXISTING PROCESSES

Expansion of the NRWRF to an AADF AWT capacity of 12.5 MGD AADF AWT with a new AGS system is expected to replace the existing secondary treatment process and impact the preliminary, tertiary, effluent pumping, biosolids treatment processes, reject storage, and RCW storage. These impacts are described later in **Section 5**. The operation of the flow equalization facilities will not be affected by this expansion.

5.6.2 MAINTENANCE OF PLANT OPERATIONS

Maintenance of plant operations (MOPO) is a critical concern during any major WRF expansion project to ensure that construction activities will not impair the County's ability to adequately operate and maintain the WRF, and continue to meet effluent permit limits during construction. Impacts on MOPO for each major recommended improvement for the expansion of the NRWRF to 12.5 MGD AADF AWT are summarized below:

- Retrofit of Headworks
    - Extensive bypassing and potentially temporary screening will be required to construct the improvements to the existing headworks.
    - Careful coordination with facility staff must be implemented to maintain continuous flow.
- Construction of New AGS system
    - The new AGS system will be constructed and put into operation before decommissioning the existing MLE system.
    - Construction of New AGS Reactors

        - Construction of the new AGS reactors No. 1 through No. 8 will be located in an open area just north of the existing Carrousel Basin No. 2.
        - Construction of the new AGS blowers will be located in an open area east of the proposed location of AGS No. 1
        - The proposed 20-inch pipelines will be connected to the existing connections at the headworks to each of the new AGS reactors.
        - Modifications to the Headworks Splitter Box for RAS return, plant drain return, and gates at the Headworks Splitter Box is anticipated to require short-term bypassing in multiple phases.
        - Connection of the two proposed 36-inch SE pipelines from AGS reactors to the existing Filter Flow Splitter Box will require a cofferdam, or other means to dewater a portion of the Filter Flow Splitter Box to maintain uninterrupted flow of effluent from existing secondary clarifiers to tertiary treatment while splitter box is cored and the new connection is made at the Filter Flow Splitter Box.
    - Construction of Water Level Correction Tanks and Sludge Buffer Tanks
        - Construction of the new water level correction tanks and sludge buffer tanks will be located in an open area west of the proposed AGS No. 4
        - Connection of the proposed pipeline from water level correction tanks to the existing headworks shall be constructed. The routing and sizing of the pipe will be determined in preliminary engineering design.
        - Connection of the proposed pipeline from sludge buffer tanks to the new gravity belt thickeners shall be constructed. The routing and sizing of the pipe will be determined in preliminary engineering design.
- Decommissioning of existing MLE Carrousel basins, Clarifier Splitter Box, secondary clarifiers, RAS/WAS pump station, and associated yard piping
    - All anoxic/aerobic basins and secondary clarifiers will be drained and decommissioned.
    - The current footprint of the existing secondary treatment system will be available for future improvements.
- Construction of an additional PD PS and Grit Pad

  - The additional PD PS can be constructed with minimal interruptions to the current plant drain system. Brief shutdowns on the plant drain system may be required to tie into the existing PD PS and at the splitter box or EQ tanks.
- Conversion of ABW Filters to AquaDiamond Filters
  - The ABW filters are recommended to be converted to AquaDiamond filters one at a time to maintain sufficient filtration capacity.
- Upsizing of filter effluent piping
  - The existing 36-inch filter effluent piping will be replaced with 42" piping with minimal impacts to the other yard piping. Short duration shutdowns may be required for tie-ins.
  - Careful coordination with facility staff must be implemented to maintain treatment.
- Construction of additional sodium hypochlorite storage
  - The additional sodium hypochlorite storage can be constructed with minimal interruptions to the existing disinfection storage and dosing system. Very brief shutdowns on the chemical pumping system may be required to tie into the pump suction lines.
- Construction of new sludge holding tank blowers and diffusers
  - The existing sludge holding tanks will be retrofitted with three new diffusers and three new blowers.
  - Each sludge holding tank will be taken down one at a time to replace the diffuser and the blower to minimize impact on the sludge holding tank capacity.
  - Careful coordination with facility staff will be implemented to maintain plant flow.
- Construction of two gravity belt thickeners and sludge PS
  - The new gravity belt thickeners and sludge PS will be constructed just southeast of the existing chlorine contact chambers.
  - The new gravity belt thickeners will be connected to the existing WAS piping running from the clarifiers to the sludge holding tanks. A 24-hour shutdown of the WAS system may be needed during the connections.
- Replacement of BFP polymer system
  - A shutdown of up to 24 hours may be required to make tie-ins for the replacement of the BFP polymer system.
- Construction of 5 MG ground storage tank

   - It is recommended that the new 5 MG ground storage tank be constructed before converting the effluent pump station to low service pump station.
   - Construction of the new 5 MG ground storage tank will be located in an open area southwest of the existing monitoring well.
- Construction of high service pump station and new RCW pipeline
   - It is recommended that the new high service pump station be constructed before converting the effluent pump station to low service pump station.
   - Construction of the new high service pump station will be located in an open area southwest of the existing monitoring well and south of the proposed 5 MG ground storage tank.
   - Construction of the new RCW pipeline from HSPS to the existing RCW distribution system requires minimal shutdown and will have minimal impact on the operation since the RCW distribution system does not run continuously.
- Upgrade effluent pump station to low service pump station
   - Contractors will require extended bypass pumping to replace effluent pumps with low service pumps.
   - Careful coordination with facility staff must be implemented to maintain treatment.
- Construction of a new 7 MG Reject Pond
   - East RCW Pond will be dewatered, and a portion of the pond will be sheeted out to completely drain the northern portion of the pond.
   - During this process, RCW will be diverted to the existing GST or to the Golf Course Storage Lake.
   - Careful coordination with facility staff will be implemented to maintain plant flow.

5.6.3 YARD PIPING

The major yard piping modifications proposed for the expansion include the following:

- 20-inch ML pipelines from existing stub-out connections at the headworks to new AGS Reactors No. 1 through 8
- 20-inch SE pipelines from AGS Reactors No. 1 through 4 to new combined 36-in SE pipeline to existing Filter Flow Splitter Box 24-inch. 20-inch SE pipelines from AGS Reactor Nos. 5 through 8 to new combined 36-in SE pipeline to existing Filter Flow Splitter Box.

- Proposed pipeline from water level correction tank to the existing headworks (the routing and sizing of the pipe will be determined in preliminary engineering design)
- Proposed pipeline from sludge buffer tanks to the new gravity belt thickeners (the routing and sizing of the pipe will be determined in preliminary engineering design)
- 8-inch WAS pipeline from new gravity belt thickeners to existing WAS piping to the sludge holding tanks
- 16-inch PD PS force main from the new additional PD PS to the existing splitter box or EQ tanks
- 42-inch FE pipeline to replace existing 36-inch pipeline between AquaDiamond Filters and all CCCs
- 36-inch RCW pipeline from LSPS to Golf Course RCW pond and smaller branch to 5 MG tank
- 36-inch RCW pipeline from HSPS to the existing RCW distribution system south of the headworks
- 4-inch pipeline from lake filter backwash to East RCW pond

5.6.4 SITE ACCESS/VEHICLE MOVEMENT

Vehicles can access the project area from the north via 69th Street East which is a two-lane asphalt surface roadway in a rural section. Access roads within the NRWRF vary between 20 and 24 feet in width, are constructed of asphalt, and are provided with a turning radius of approximately 35 feet in order to accommodate larger tractor trailer trucks. A new asphalt access road is recommended along the south side of the AGS system, which could connect to the stub-out near the headworks. Minimal impacts to the facility are anticipated from the construction of improvements for the expansion at the NRWRF. Coordination of deliveries and maintenance activities will be required during construction near existing facilities.

5.6.5 STORMWATER

The NRWRF site is relatively flat with minimal impervious area. Based on the proposed process improvements, it is expected that the expansion project will result in minimal increase in impervious surface area. The proposed secondary clarifier and upgrades to existing structures for the expansion will be constructed with open tops to allow rainwater in to ensure there will be little to no increase in impervious surface area other than new road. As a result, there will be minimal impacts to the existing stormwater system. Minor stormwater improvements are expected as part of these site improvements.

5.7 PRELIMINARY TREATMENT – 12.5 MGD – AWT - AGS

5.7.1 HEADWORKS AND EQUALIZATION

Currently, for Class I Reliability the total screening capacity is 40 MGD and the total HeadCell grit units' capacity is 30.4 MGD, with the number of trays installed. The total Headcell grit units' capacity is below the expected PHF of 31.25 MGD for the expansion to 12.5 MGD AADF. Therefore, additional trays will need to be installed. Assuming the rest of the 4 trays be installed, the final total HeadCell grit units' capacity will be 45 MGD. In addition, major improvements and rehabilitation to the existing Headworks structure are needed due to corrosion in the Headworks structure and ragging problems downstream. An evaluation into the Headworks improvements and corrosion mitigation was conducted. Refer to the TM in **Appendix I** for details.

The AGS system does not require equalization (EQ) with the number of AGS reactors included in this alternative. However, the existing 3 MG of equalization (EQ) storage can be used to even out the daily diurnal pattern as it is currently used for the existing MLE system. The existing EQ system is estimated to be sufficient for expansion to 12.5 MG AADF. A diurnal pattern developed from 2021 hourly flows was applied to the maximum month flow condition associated with the 12.5 MGD AADF alternative. 2.75 MG of storage is estimated to even out the diurnal pattern for this flow as shown in **Figure 4.3** in **Section 4.1.5**. The EQ return firm pumping capacity of 6,000 gpm (8.64 MGD) will empty 3 MG in 8-9 hours. This is sufficient return capacity according to design standards. In the future, the County could add two additional pumps in the two available spots at the existing EQ return PS. However, the cost for EQ system improvements is not included in this CER.

It is not recommended to pump to the new AGS system directly from the existing EQ system due to the current arrangement of Headworks Splitter Box and off-line EQ system. Flow to the AGS system can be controlled by modulating valves at the reactors with direct connection to the Headworks Splitter Box. The balance of flow will overflow to the EQ tanks via an existing weir in the splitter box. With the ability to handle a range of flows with the existing EQ system combined, flow to the AGS system can be controlled and limited as recommended by Aqua-Aerobics for AGS system optimization.

5.8 SECONDARY TREATMENT ASSESSMENT - 12.5 MGD - AWT - AGS

Figure 5.1 shows a proposed layout for the secondary process conversion to AGS. The layout is based on adding the first phase AGS reactors in the same location as discussed in **Section 4.3 Expansion to 12.5 MGD AADF - AGS** and then adding the phase 2 AGS reactors in close proximity to each other and blower structure. The existing areas for the Carrousel basins and secondary clarifiers would no longer be needed and left over for future use.

The conversion is shown in two phases. NRWRF could operate after the first phase has been completed (expansion with current limits) with dual, parallel secondary treatment processes for many years into the future. Phase one adds 5 MGD AADF of treatment capacity. Phase two completes the conversion to AGS with the rest of the MLE system decommissioned. The phasing was identified since expansion of capacity at current limits is required in the near future, and if AWT limits are required down the road the AWT conversion would likely be implemented after the expansion. With the available space at the NRWRF property new AGS processes can be constructed and commissioned while the existing processes are in operation. With the exception of short-duration shutdowns for piping tie-ins, electrical tie-ins, longer duration bypassing and MOPO is not anticipated for the secondary treatment process conversion. Extension MOPO is required for other areas noted above in **Section 5.6**.

It's recommended that the AGS reactors be partially buried to be compatible with existing plant hydraulics without an intermediate pump station as noted in **Section 4.3.5**. The layout and estimated capital costs are based on **Figure 5.1**. 21' SWD AGS reactors are standard for AquaNereda systems. This evaluation was based on the standard tank depth. To avoid an AGS feed pump station the AGS reactors would need to be partially buried approximately 5-7' such that the feed water level for the tanks is compatible with existing plant hydraulics. It is estimated that additional ballast required to prevent flotation for empty reactors is minimal with most of the volume of the tanks above grade. This will require shoring and dewatering during construction compared to above grade tanks. However, the depth of the foundation is not uncommon for the area. New PD blowers under a canopy structure should be located adjacent to the AGS reactors and potential future AGS reactors. Four sludge buffer tanks are required for the full buildout AGS system. Sludge buffer tanks allow for a more consistent waste sludge to be pumped to biosolids handling. Two new common SE lines are required to convey effluent from the AGS reactors to the Filter Splitter Box.

The AquaNereda proposal for 12.5 MGD meeting AWT limits included the following and in **Table 5.1**, **Table 5.2**, and **Table 5.3** below:

- Two Water Level Correction Tanks
- Eight AGS Reactor Tanks
- Four Sludge Buffer Tanks
- Ten 200 HP PD Blowers (8 duty / 2 standby)
- AquaNereda process equipment, instrumentation, controls, valves, pumps, etc.

Table 5.1 AGS Water Level Correction Tank Information for 12.5 MGD AADF AWT

Water Level Correction Tank	
Quantity	2
Type	Square CIP Concrete
Volume (MG)	0.040
Width (ft)	26
Length (ft)	14.1
SWD (ft)	14.4
Equipment	Pumps, level sensors, etc.

Table 5.2 AGS Reactor Tank Information for 12.5 MGD AADF AWT

AGS Reactors	
Quantity	8
Type	Square CIP Concrete
Volume (MG)	1.09
Width (ft)	78.5
Length (ft)	88.5
PWL (ft)	21
DWL (ft)	21.8
Freeboard (ft) (from PWL)	2.5
Aeration	Fine Bubble Diffusers
Equipment	Influent valves and distribution assemblies
	Effluent weir assemblies
	Sludge Decant and WLC assemblies
	Aeration system distribution and assemblies
	PD blowers
	Level, process parameter, and other instrumentation/sensors
	PLC w/ OIT (indoors)

Table 5.3 AGS Sludge Buffer Tank Information for 12.5 MGD AADF AWT

Sludge Buffer Tank	
Quantity	4
Type	Rectangular CIP Concrete
Volume (MG)	0.079
Width (ft)	26
Length (ft)	26.3
SWD (ft)	15.4
Equipment	Pumps, control valves, level sensors, etc.

The preliminary process design report the AGS system in **Appendix F** has the following minor inconsistencies compared design information in this CER. However, none of these had a significant impact on the design or cost of the AGS system proposed. Since the design reports were preliminary they were not revised to address minor inconsistencies. The influent and effluent lines to and from each reactor were assumed to be 20-inch for this CER vs. 30-inch in AGS reports. This will need to be evaluated in subsequent design. The design minimum process water temperature for the project is 20°C vs. 15°C in in AGS reports.

5.9 TERTIARY TREATMENT – 12.5 MGD – AWT - AGS

Filtration capacity needs to be increased for the additional design flow. Conversion of the existing ABW filters to AquaDiamond is proposed with the same flows and sizing discussed in **Section 4.2.7 Tertiary Treatment Sizing - 12.5 MGD** .

5.10 DISINFECTION SIZING – 12.5 MGD – AWT - AGS

The volumes of existing four chlorine contact chambers are slightly undersized to provide 15 minutes of detention time at a PHF of 31.25 MGD with all four in service. However, the detention time of 14.3 minutes is close enough to the required 15 minutes to not recommend a fifth contact chamber. The applicable F.A.C. requirements state that this is allowed with a higher design total chlorine residual at the end of the chambers than the minimum of 1 mg/L. Refer to **Section 4.2.8 Disinfection Sizing - 12.5 MGD - MLE** for more details.

The existing sodium hypochlorite storage capacity needs to be increased for the additional design flow. Refer to **Sections 4.1.8 and 4.2.8 Disinfection Sizing - 12.5 MGD - MLE** for more details.

5.11 EFFLUENT PUMPING – 12.5 MGD – AWT - AGS

The capacity of the effluent pump station is not sufficient for the new design PHF of 31.25 MGD. The recommended approach is to convert this pump station to a low service effluent pump station, add a high service pump station, and add a 5 MG ground storage tank. The existing RCW GST will be demolished in this expansion. This arrangement will be similar to the other two County WRFs. Refer to **Section 4.2.9 Effluent Pumping - 12.5 MGD - MLE** for more details.

5.12 MISCELLANEOUS IMPROVEMENTS – 12.5 MGD – AWT - AGS

The capacity of the plant drain system must be increased for the new design PHF of 25 MGD. A second PD PS should be constructed adjacent to the existing PD PS. Other additional improvements include the construction of a grit pad and routing modification for the lake filer backwash. See **Section 4.2.10 Miscellaneous Improvements** for more details.

5.13 REJECT STORAGE – 12.5 MGD – AWT - AGS

The existing reject pond storage must be increased for one day flow at the average daily design flow. See **Section 4.2.11 Reject Storage - 12.5 MGD - MLE** for more details.

5.14 BIOSOLIDS HANDLING – 12.5 MGD – AWT - AGS

Solids handling capacity needs to be increased for the additional design WAS flow. Two GBTs are proposed for this alternative. The net yield listed in the AquaNereda preliminary design report, 1.07 lb WAS / lb BOD5 inf., is comparable to the MLE process. However, the sludge pumps for the proposed AGS system have a constant speed capacity of 440 gpm at WAS TSS concentration of 8,000 mg/L. The same size and quantity of the two 2-meter GBTs, with a combined HLR of 600 gpm, proposed in **Section 4.3.12** are proposed for this alternative. Further discussions with Aqua-Aerobics about design WAS flowrates and concentrations are recommended in preliminary design to validate these conceptual rates and verify sizing. In addition, the existing three sludge holding tanks will be retrofitted with new diffusers and the blowers will be replaced in this expansion as described in **Section 4.2.12**. A new polymer system is required with the high % solids the BFP influent. Note that the County has the infrastructure in place to operate the BFPs 24 hours a day, 7 days a week if needed. Additional operator staffing would be required.

5.15 HYDRAULIC CONSIDERATIONS – 12.5 MGD – AWT - AGS

The hydraulic profile of the NRWRF was modeled using Visual Hydraulics hydraulic profile modeling software, Version 5.1, to evaluate the hydraulic capacity of the NRWRF at the future peak hourly flow of 31.25 MGD and for Class I Reliability. The NRWRF hydraulic profile was modeled assuming the proposed eight AGS reactors required for the AGS expansion to 12.5 MGD AADF AWT have been installed and are in operation and the existing ABW filters have been converted to AquaDiamond filters. The hydraulic model flow diagram and the report output from the Visual Hydraulics software is presented in **Appendix E**. The intention of this hydraulic evaluation is to determine if the expanded facility can meet peak flow conditions and Class I reliability requirements without any major modifications to the existing splitter boxes, channels, and yard piping. As defined by the USEPA and carried by the FDEP, the NRWRF's unit operations shall be designed such that with the largest flow capacity unit out of service, the hydraulic capacity of the remaining units shall be sufficient to handle the peak wastewater flow. In addition, to meet Class I Reliability, flow equalization shall not be considered as a substitute for component backup requirements. Therefore, the hydraulic evaluation considers the full non-equalized peak hourly flow rate of 31.25 MGD through the NRWRF to identify hydraulic deficiencies. Assumptions were made regarding the arrangement and operation of the expansion using AGS to meet the 12.5 MGD AADF design capacity. A list of the assumptions made to complete the hydraulic analysis for the expanded NRWRF is provided below:

- The Hazen-Williams friction loss coefficient for all DI pipes is 120
- The two existing Anoxic/Aerobic basins are out of service
- Eight AGS reactors are operational
- At PHF AGS reactors 4, 7, and 8 fill and drain simultaneously
- The headloss through internal piping in each AGS reactor (1.2 ft) was obtained from Aqua-Aerobic Systems. This is approximated in the "special loss" function of the Visual Hydraulics software. The headloss due to each AGS effluent weir is included as a separate weir element in the Visual Hydraulics model.
- Both ABW filters are converted to AquaDiamond filters, each with 1,600 ft^2 of filtration surface area.
- The maximum capacity of the Disk Filters is 14.9 MGD
- At PHF and for Class I reliability, the maximum filter flow routed to the Disk Filters is 9.5 MGD (see **Section 4.1.13.1**) and the remainder is routed to the AquaDiamond Filters

- Flow is split equally between CCC trains 1–4
- For Class I reliability if a process train is taken offline the total flow is distributed as equally as possible between the remaining trains of that process
- For the Class I reliability scenario, if the process units are the same size but their influent or effluent pipe lengths are different, the offline unit(s) are those associated with shorter lengths of influent and/or effluent piping

5.15.1 HYDRAULIC LIMITATIONS

The hydraulic models of the PHF and Class I Reliability scenarios for this expansion were constructed based on existing record drawings of the NRWRF provided by the County and the assumptions listed above. The pipe routing and pipe length estimates to and from the AGS reactors are conceptual. The arrangement of the AGS reactors, phasing of AGS reactor installation, routing of piping to and from the AGS reactors, and available space for the reactors and piping should be investigated further during detailed design. For unit processes, WEF MOP 8 recommends that the typical minimum freeboard under maximum water level conditions be approximately 12-inches, and there should be no submergence of control weirs under peak flow conditions. The 10 State Standards are generally more conservative and provide more specific freeboard guidelines for unit processes. Sections of the NRWRF where the allowable freeboard chosen for the project deviates from recommendations are noted and explained here.

After the models were set up in Visual Hydraulics, water surface elevations in the model were checked for reasons previously explained in **Section 4.1.13.1**. The freeboard requirements are summarized in **Table 4.11**. Overall neither the PHF only nor the Class I reliability scenario presented new significant hydraulic issues compared to other expansions. Based on the modeling, the PHF scenario generally resulted in larger deviations from the target critical elevations than the Class I reliability scenario. Therefore, the PHF model results are described here. The five minor hydraulic limitations identified are summarized as follows. Note that most of these are related to movable weir gates. It is generally recommended to have more freeboard with moveable weir gates to provide operational flexibility. However, even though the actual freeboard in these cases is less than the recommended 18-inches, it is more than 12”, which is acceptable. There was one major hydraulic bottleneck identified with the modeling.

(1) With increased flow between the filters and the four CCCs the AquaDiamond Filters Effluent Weirs were predicted to be submerged. All of the existing piping is 36-inch. The recommended resolution is to replace it all with 42-inch, with the exception of the short run of 36-inch from Disk Filter effluent to the tee connecting to the AquaDiamond Filters effluent channel. Without this change the CCC effluent weirs would have to be dropped, which would reduce the volume and contact time.

The minor hydraulic limitation were noted as not critical, as explained below:

(1) AquaDiamond filters influent weirs: The water surface elevation is expected to be 32.06 ft, which is 1.27 ft below the top of tank elevation of 33.33 ft. This is 0.09 ft more freeboard than expected at PHF. This does not meet the 1.5 ft freeboard requirement but in both scenarios the elevation difference is large enough that it is not expected to result in significant hydraulic issues.

(2) AquaDiamond filters influent slide gates: The water surface elevation is expected to be 32.23 ft, which is 1.1 ft below the top of tank elevation of 33.33 ft. This is 0.19 ft more freeboard than expected at PHF. This does not meet the 1.5 ft freeboard requirement but in both cases the elevation difference is large enough that it is not expected to result in significant hydraulic issues.

(3) Headworks Automatic Fine Screens: The water surface elevation upstream of both fine screens is expected to be 58.66 ft, meaning the freeboard would be 1.84 ft. This is less than the required freeboard of 2 ft, but close enough that it is not expected to result in significant hydraulic issues. The same issue and water surface elevation were identified for this expansion in the Class I reliability scenario. This also could be addressed with the new screens.

5.15.2 RECOMMENDED ACTIONS TO RESOLVE HYDRAULIC LIMITATIONS

As noted above, minor hydraulic limitations were identified by the PHF and Class I reliability models of the hydraulic profile for the NRWRF expansion to 12.5 MGD AADF with AWT and AGS. Therefore, no new modifications are suggested compared to other expansion scenarios. The general modifications to the NRWRF noted for previous scenarios are also recommended below.

5.15.2.1 ADJUST ALL CHLORINE CONTACT TANK EFFLUENT WEIRS TO THE SAME ELEVATION

For the existing plant, the elevations of the effluent Cipolletti weirs of trains Nos. 1,2,3 and 4 are 28.75 ft, 28.75ft, 28.54 ft, and 29.55 ft respectively. Currently the flow distribution between the chlorine contact tanks is adjusted by throttling a valve upstream of the new chlorine contact tank All effluent

Cipolletti weirs should be set to the same elevation of 28.5 ft. This would allow the plant hydraulics to split the flow equally. The hydraulics of 42-inch lines and CCC weir elevations should be evaluated further in preliminary design to maximize the CCC volume.

5.15.3 ADDITIONAL OPERATIONAL RECOMMENDATION

5.15.3.1 INSTALL ADDITIONAL SPLASH GUARDS NEAR AERATORS

For all aeration tanks the 10 State Standards recommend 18" of freeboard. If a mechanical surface aerator is used (as is the case here), the freeboard requirement is increased to 3 feet to protect against windblown spray and other similar issues. The original facility design included and permitted for 1 foot of freeboard. The design standard for this CER is to maintain the 1' as originally designed. Based on the existing tank construction, it is recommended that additional splash guards be installed near the aerator to minimize wind driven spray (similar to the current splash guards on SEWRF basin no. 3).

5.16 ENGINEER'S OPCC – 12.5 MGD – AWT - AGS

5.16.1 CAPITAL COSTS

The opinion of probable construction and project costs for the expansion to 12.5 MGD AADF using the AquaNereda AGS process to meet AWT requirements is presented in **Table 5.4** below. This cost opinion was developed following the same methodology used for the MLE expansion alternative cost opinion. This is an estimate of conceptual project costs is based on materials and equipment costs as of November 2022. An estimate of inflation has been included to aid in planning, however this should be re-evaluated annually. This cost estimated has been prepared meeting the classification as an AACE Class 4 cost estimate with an expected range of accuracy of +20% to +50% on the high end, and -15% to -30% on the low end. This range of accuracy equates to an estimated range of total project costs of $269,653,000 to $577,827,000. Various factors may combine to result in cost fluctuations within this range including fluctuations in market conditions, changes in project scope, improved project definition, and value engineering. Headworks corrosion mitigation estimated costs have been included.

In estimating construction costs, it is assumed that the new upgrades and equipment are being installed at present day costs. Further, markups are used to estimate the costs for site improvements, yard piping, electrical improvements, I&C and SCADA, and indirect costs incurred by the contractor(s).

The markup factors listed below for direct project costs including sitework and demo, yard piping, electrical, and SCADA/I&C are based on recent project experience, anticipated project scope, current market conditions, and input from local contractors. The markup factors listed below for indirect project costs incurred by the contractor are based on the following:

- Mobilization/Demobilization = 5% per WEF MOP 8
- General Conditions = $150,000 per month per input from local contractors for a project of this general scope and duration
- Contractor Overhead and Profit = 20-25%
- Maintenance of Plant Operations = 4-8% per input from local contractors for a project of this general scope and complexity
- Contractor Bonds/Insurance = 4% per local contractors for projects of this general scope and cost

An estimating contingency is also applied to all facility and disciplines estimates due to the preliminary nature of this evaluation to account for additional costs that will be realized during the detailed stages of design. Project cost escalation between present day and the estimated date of project bid opening in 2027 is included to estimate the rate of future inflation. Estimated inflation has been included to aid in capital improvement planning, however, this should be re-evaluated annually and capital improvement budgets adjusted accordingly. Finally, engineering, administrative, and legal costs were estimated based on the direct construction costs at present day costs.

Costs were estimated based on past projects of similar size and scope; and McKim & Creed has no control over the costs of labor, materials, and equipment in the future. This is only an estimate of conceptual construction costs based on materials and equipment costs as of November 2022.

Table 5.4 Cost Opinion for NRWRF Expansion to 12.5 MGD AADF with AWT

Description	Cost
Mobilization/Demobilization (5%)	**$7,555,000**
Structural/Mechanical	
Headworks Improvements and Rehab	$6,000,000
Headworks Splitter Box and RAS Connection Modifications	$500,000
AquaNereda System for 12.5 MGD	$52,908,000
New Electrical Building	$1,600,000
Headworks Splitter Box Modifications	$400,000
AquaDiamond Filters: Two Retrofitted and Add Canopy	$6,750,000
Additional Sodium Hypochlorite Storage	$300,000
Low Service PS Conversion, High Service PS, 5 MG Tank	$10,800,000
Second Plant Drain PS	$1,100,000
Gravity Belt Thickeners (Two), Polymer System, Sludge Pumps, and Canopy	$2,500,000
New SHT Blowers and Diffusers	$1,700,000
Structural/Mechanical Subtotal	***$84,558,000***
Other Direct Costs	
Overall Sitework and Demo (10%)	$8,460,000
New Reject Pond (LS)	$4,900,000
Yard Piping (25%)	$21,140,000
Electrical (20%)	$16,915,000
Electrical Building (LS)	$1,600,000
SCADA/I&C (18%)	$15,225,000
Other Direct Costs Subtotal	***$68,240,000***
Indirect Costs	
General Conditions (LS)	$4,500,000
Contractor OH&P (20%)	$30,560,000
Maintenance of Plant Operations (MOPO) (8%)	$12,225,000
Contractor Bonds/Insurance (4%)	$6,115,000
Indirect Costs Subtotal	***$53,400,000***
Construction Subtotal	***$213,753,000***
Estimating Contingency (30%)	***$64,130,000***
Opinion of Probable Construction Cost (2022 dollars)	***$277,883,000***
Inflation, Compounded Annually Until Bid (5% Annually)	$76,775,000
Opinion of Probable Construction Cost (2027 dollars)	***$354,658,000***
Engineering (20%)	$30,560,000
Opinion of Probable Project Cost	**$385,218,000**

SECTION 6 RE-RATE TO 8 MGD AADF

A re-rate of the facility to 8.0 MGD AADF is recommended prior to the current permit expiration in early 2026. 8 MGD AADF is equivalent to 8.8 MGD TMRADF. Based on the flows and loading discussed in **Section 3** it is believed that NRWRF can be re-rated without any improvements. This will allow additional time needed to design and construct the expansion to 12.5 MGD AADF.

Table 6.1 NRWRF Influent Loading for 8 MGD AADF

Parameter		AADF	PF	Max Mon.	PF	Peak Day	PF	Peak Hour
Flow	MGD	8.00	1.20	9.60	1.9	15.200	2.50	20.00
BOD	mg/L	175						
	lb/d	11,676	1.4	16,346	1.70	19,849		
TSS	mg/L	200						
	lb/d	13,344	1.9	25,354	3.1	41,366		
VSS	mg/L	150						
	lb/d	10,008	1.4	14,011	1.7	17,014		
TKN	mg/L	46						
	lb/d	3,069	1.2	3,683	1.40	4,297		
NH3	mg/L	41						
	lb/d	2,736	1.2	3,283	1.4	3,830		
TP	mg/L	6						
	lb/d	400	1.2	480	1.4	560		

The headworks has sufficient capacity for the increased PHF as noted previously.

There is enough capacity in the existing three secondary clarifiers and RAS pumps assuming the clarifiers operate as intended. The replacement of the clarifier mechanism for No. 3 may be necessary to properly withdraw sludge equally between the clarifiers and prevent high blankets.

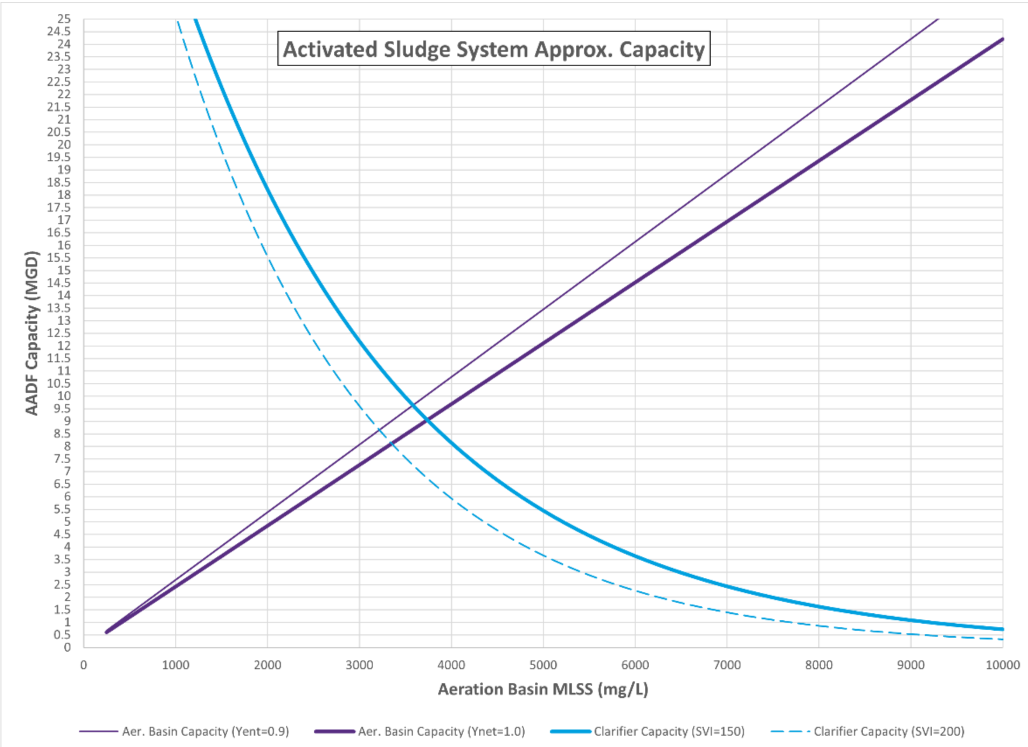


Figure 6.1 Activated Sludge Capacity for 8 MGD AADF (SRT 7 days)

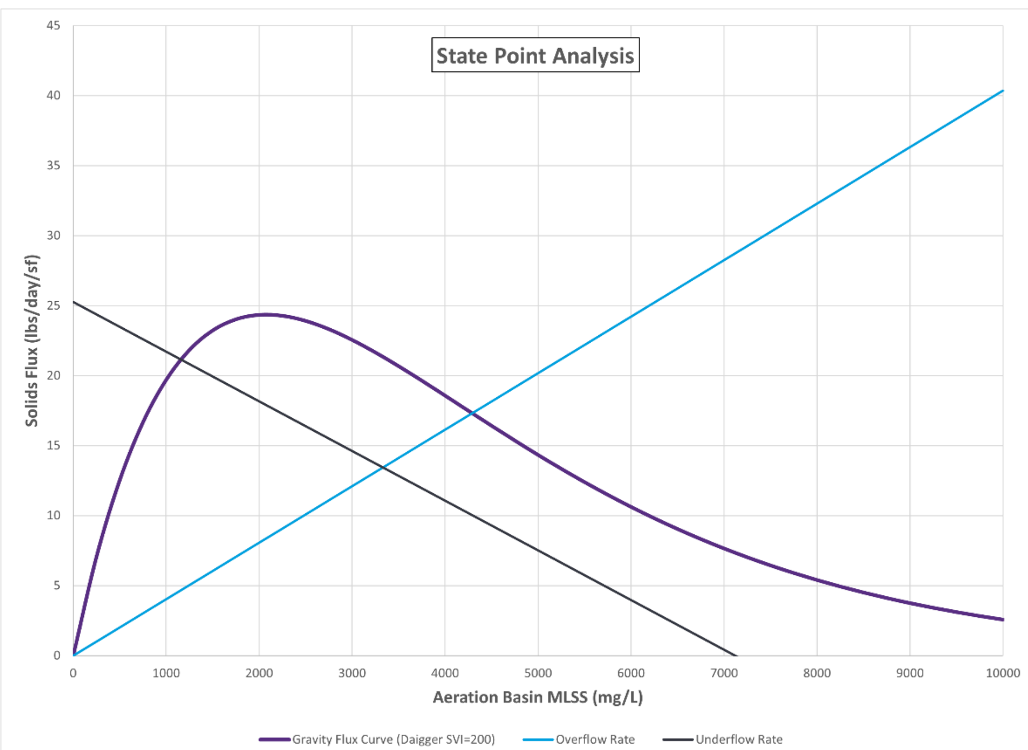


Figure 6.2 State Point Analysis for 8 MGD AADF

The existing ABW and disk filters have sufficient capacity for the increased PHF.

Table 6.2 Filter Design Parameters at 8 MGD AADF Peak Loading

Type	Shallow Bed Traveling Bridge	Disk (Pile Cloth Media)	Total
	ABW	AquaDisk	
Qty	2	2	4
Surface Area (per filter)	1,440	1,291	2,731
Total Surface Area	2,880	2,582	5,462
Max Filtration Rate (gpm/sf)	2	4	
Capacity at Max Filtration Rate (MGD)	8.3	14.9	23.2
Class I Reliability Capacity Requirement (75% PHF)			15.0
Capacity Class I (MGD)	8.3	7.4	15.7

The existing four chlorine contact chambers and sodium hypochlorite system have sufficient capacity for the increased PHF.

The sludge holding time in the aerated sludge holding tanks is over seven days with one tank out of service, which is sufficient. There is enough existing BFP processing capacity with one unit out of service and with the current active times of twelve hours per day on weekdays.

There is sufficient hydraulic capacity for this increased PHF of 20 MGD. The 36-inch filtered effluent pipes are sufficient for this flow. Some of the weir gates may need to be adjusted. Guidance on this will be provided to the County with re-rate report as a separate project.

SECTION 7 SUMMARY AND CONCLUSION

7.1 EXPANSION TIMING

Influent flows and loadings to Manatee County's NRWRF have increased at an accelerated rate over the past several years. TMRADF equivalent flow projections from the May 2022 Wastewater Collection System Master Plan Updates Workshop estimate the NRWRF will be at the current permitted capacity in 2026. The linear trend from the last four years of actual TMRADF projects NRWRF being at permitted capacity in 2026, assuming flow continues to increase at the same rate. Therefore, it is recommended that: 1. An immediate re-rate evaluation and permit application be conducted; 2. Manatee County plan for the design and construction of a 12.5 MGD AADF expansion of the NRWRF to be online by 2029 at the latest assuming a re-rate prior; 3. The County and EOR watch the influent flows closely to see if the trend from the past four years continues, or if the rate of growth decreases or increases. An expansion to 10 MGD AADF is not recommended due to the need for another expansion to immediately follow based on current flow projections. Based on assumptions the soonest the design and construction could begin would be in fiscal years 2025 and 2027 respectively.

7.2 EXPANSION TO 10 MGD

This alternative is not recommended as noted throughout this CER.

All existing unit processes within the NRWRF were evaluated at a conceptual level to identify improvements necessary to meet the future capacity requirements at the facility capacity of 10 MGD AADF. In general, expansion of the existing MLE process will require or are recommended to include the following improvements to expand to the 10 MGD AADF capacity with current effluent permit limits and desired effluent TN of 10 mg/L or less.

- Headworks improvements and rehabilitation
- Conversion of existing Carrousel basin 125 HP aerators to VFD control with instrumentation and adjustable weir gates
- Upgrade of Secondary Clarifier No. 3 mechanism
- Addition of a fourth secondary clarifier
- Replacement of existing RAS pumps to increase capacity

- Additional parallel RAS line
- Conversation of existing granular media ABW filters to AquaDiamond filters (50' laterals estimated for 12.5 MGD expansion)
- Upsizing of filter effluent piping
- Additional sodium hypochlorite storage
- Upgrade the effluent pump station capacity
- One gravity belt thickener, thickened sludge pump system, and canopy
- Construction of a new 7 MG Reject Pond using the footprint of the north portion of the east RCW pond

This is a lower cost alternative to get an incremental increase in facility treatment capacity. However, this alternative expands the existing MLE process, and if the County ultimately plans to expand by way of AGS, this alternative is not recommended. Refer to **Section 4.1.6** for discussion about why a 2.5 MGD expansion with AGS was not recommended and not included in this CER. Based on the latest flow projection update from 2022 workshop the need to expand to The County should watch the increase in flow and development in the area to help better estimate the trajectory for year over year increase in flows. Slopes of the linear projection of recent flows and the Methodology 1 show a 2.5 MGD increase in about five years, and an expansion from 10 MGD AADF to 12.5 MGD AADF will be required right after expansion to 10 MGD AADF. This alterative is not recommended if back-to-back expansions would be needed.

The total OPCC for the expansion of the NRWRF to 10 MGD AADF using the current MLE process is $106,400,000 based on materials, equipment, and installation costs as of November 2022. The total OPCC including an estimate of potential cost inflation between present day and 2027, estimated bid opening year, is $135,800,000.

7.3 EXPANSION TO 12.5 MGD AADF WITH MLE

This alternative is not recommended. The next alternative listed for expansion to 12.5 MGD AADF by adding an AGS parallel process is the recommended alternative.

All existing unit processes within the NRWRF were evaluated at a conceptual level to identify improvements necessary to meet the future capacity requirements at the facility capacity of 12.5 MGD AADF with expansion of the existing MLE secondary treatment system. In general, expansion of the existing MLE process will require or recommended to include the following improvements to expand to the 12.5 MGD AADF capacity with expansion of the existing MLE process and current effluent permit limits and desired effluent TN of 10 mg/L or less.

- Headworks improvements and rehabilitation
- Addition of a third Carrousel MLE anoxic/aeration basin with the latest design and equipment
- New electrical building for MLE expansion and VFDs for existing aerators
- Conversion of existing Carrousel basin 125 HP aerators to VFD control with instrumentation and adjustable weir gates
- Upgrade of Secondary Clarifier No. 3 mechanism
- Addition of a fourth secondary clarifier
- Replacement of existing RAS pumps to increase capacity
- Additional parallel RAS line
- Conversion of existing granular media ABW filters to AquaDiamond filters (50' laterals estimated for 12.5 MGD expansion)
- Upsizing of filter effluent piping
- Additional sodium hypochlorite storage
- Conversion of effluent pump station to low service pump station
- New high service pump station
- New 5 MG ground storage tank
- One gravity belt thickener, sludge pump system, and canopy
- New 7MG Reject Pond using a portion of the East RCW pond

The total OPCC for the expansion of the NRWRF to 12.5 MGD AADF using the current MLE process is $178,745,000 based on materials, equipment, and installation costs as of November 2022. The total

OPCC including an estimate of potential cost inflation between present day and 2027, estimated bid opening year, is $228,130,000. The estimated O&M 20-year net present value for this alternative was $7.9 million dollars.

7.4 EXPANSION TO 12.5 MGD AADF WITH AGS

This is the recommended alternative for expansion to 12.5 MGD AADF.

Expansion to 12.5 MGD AADF by adding a new parallel AGS secondary treatment process, AquaNereda, was evaluated. The footprint and total tankage requirement were estimated to be less than expansion of the MLE process. In general, expansion with AGS will require the following improvements to expand to the 12.5 MGD AADF capacity with current effluent permit limits and desired effluent TN of 10 mg/L or less.

- Headworks improvements and rehabilitation
- Addition of a new 5 MGD AGS treatment system
- New electrical building for AGS expansion and VFDs for existing aerators
- Modifications to the Headworks Splitter Box and Return Streams
- Conversion of existing Carrousel basin 125 HP aerators to VFD control with instrumentation and adjustable weir gates.
- Upgrade of Secondary Clarifier No. 3 mechanism
- Replacement of existing RAS pumps to increase capacity
- Additional parallel RAS line
- Conversion of existing granular media ABW filters to AquaDiamond filters (50’ laterals estimated for 12.5 MGD expansion)
- Upsizing of filter effluent piping
- Additional sodium hypochlorite storage
- Conversion of effluent pump station to low service pump station
- New high service pump station
- New 5 MG ground storage tank
- One gravity belt thickener sludge pump system, and canopy
- New 7 MG Reject Pond using a portion of the east RCW pond

The total OPCC for the expansion of the NRWRF with a new parallel AGS process is $182,203,000 based on materials, equipment, and installation costs as of November 2022. The total OPCC including an estimate of potential cost inflation between present day and the date of project bid is $232,543,000.

The estimated O&M 20-year net present value for this alternative was $6.9 million dollars, which was $1 million dollars less than the MLE expansion alternative. The biggest difference in operational costs was for aeration.

The estimated capital costs are about the same for expansion to 12.5 MG AADF with AGS compared to expanding the existing MLE process. The O&M net present value for the expansion to 12.5 MGD AADF with AGS is about 15% less than expansion of the existing MLE system. The lower O&M costs are mainly due to lower power requirements for aeration with the fine bubble diffusion in deep tanks compared to the existing mechanical surface aerators.

It is recommended to expand by way of adding a parallel AGS process based on similar capital cost and lower O&M costs compared to expansion of the MLE process. Manatee County has stated that they are comfortable operating the dual processes.

7.5 EXPANSION TO MEET AWT REQUIREMENTS

A conceptual alternative for expansion of the NRWRF by converting to an AGS secondary treatment process, AquaNereda, to meet Florida AWT requirements was also evaluated. This is described in **Section 5** contained herein. Expansion of the NRWRF to meet AWT requirements with an AGS system will require a complete conversion and replacement of the existing secondary treatment process to achieve an effluent TN concentration of 3.0 mg/L. The AGS system would also be capable of achieving an effluent TP of 1.0 mg/L if required.

As described in **Section 5**, conversion of the NRWRF to an AGS process to meet AWT requirements will require all new AGS reactors to be constructed. There is plenty of available open land for this. Space for future improvements will be available in the leftover decommissioned MLE areas not needed for the AGS system. Expansion of the NRWRF utilizing the AquaNereda AGS process is expected to require the following improvements:

- Headworks improvements and rehabilitation
- Addition of a new 12.5 MGD AGS treatment system

- New electrical building for AGS expansion
- Modifications to the Headworks Splitter Box and Return Streams
- Decommissioning of the existing MLE Carrousel basins, secondary clarifiers, and associated components
- Conversation of existing granular media ABW filters to AquaDiamond filters (50’ laterals estimated for 12.5 MGD expansion)
- Upsizing of filter effluent piping
- Additional sodium hypochlorite storage
- Conversion of effluent pump station to low service pump station
- New high service pump station
- New 5 MG ground storage tank
- Two gravity belt thickeners (one duty / one standby), sludge pump system, and canopy
- Replacement of BFP polymer system
- New 7 MG Reject Pond using a portion of the east RCW pond

The total OPCC for the expansion of the NRWRF to meet AWT requirements using an AGS process is $268,753,000 based on materials, equipment, and installation costs as of November 2022. The total OPCC including an estimate of potential cost inflation between present day and the date of project bid is $343,008,000.

7.6 RECOMMENDATIONS

Planning and design of expansion of the NRWRF to 12.5 MGD AADF with a parallel AGS process is recommended as soon as possible. It is not feasible for the design and construction of expansion of the NRWRF to be online before the existing permitted capacity of 7.5 MGD TMRADF is exceeded. Therefore, a re-rate is needed to provide additional time for an expansion to be implemented. The NRWRF has additional treatment capacity with the existing processes. A follow-up evaluation will determine the exact capacity, and with an updated CAR the reports can be included with re-rate permit application. Preliminary estimates indicated that the existing NRWRF can treat up to 8.0 MGD AADF without any improvements to the facility. Based on the information available at the time of this CER the existing capacity will be exceeded sometime between 2026 and 2028. It is recommended that a more detailed flow projection be conducted with the updated CAR mentioned above. The County Utilities and EOR should monitor the development in the NRWRF service area and the influent flows closely over the next couple years to better estimate when the expansion needs to be online. Based on the urgency for the need to expand the capacity of the NRWRF an alternate project delivery is recommended. Additional follow up evaluations are summarized below.

Expansion to 12.5 MGD AADF by adding a parallel AGS process is recommended and estimated to have the lowest life cycle costs. This alternative allows for a future complete conversion to AGS with built-in capabilities to meet AWT limits in the future if required. The County stated they are comfortable with operating dual secondary treatment processes.

The following evaluations are recommended to be conducted as soon as possible:

- Follow-up re-rate determination and permit application, which should include:
    - Flow projection update that is consistent with recent increases in flow
    - Updated CAR

Based on the re-rate evaluation the County may need to treat Piney Point wastewater onsite and possibly redirect leachate to provide as much capacity at the NRWRF to treat the municipal wastewater.

7.7 RECOMMENDED MONITORING IMPROVEMENTS

Several monitoring improvements are recommended in the immediate term to better assist detailed design of the expansion to the NRWRF. As of the date of this final CER it is too soon to begin the detailed sampling needed for preliminary engineering for the expansion. Until detailed sampling is needed it is recommended to increase the frequency of the current sampling to 200 samples a year. In addition to that, Piney Point flow monitoring for discharges into the collections system and sampling every six months of Piney Point water quality (for gypsum stacks discharging into the collection system) will help reduce some of the uncertainty for the contribution of influent loading from Piney Point.

The recommended detailed sampling during preliminary engineering is as follows:

- Raw Wastewater including Piney Point:
  - Influent COD, $cBOD_5$, TSS, VSS, TKN, NH_3, NO_3, TP, PO_4, SO_4, dissolved sulfide (S^-), pH, Alkalinity, TDS, (flow-weighted composites, minimum four to five days per week)
  - One week of influent characterization per MOP 31
- Raw Wastewater without Piney Point (if feasible):
  - Influent COD, $cBOD_5$, TSS, VSS, TKN, NH_3, NO_3, TP, PO_4, SO_4, dissolved sulfide (S^-), pH, Alkalinity, TDS, (flow-weighted composites, minimum four to five days per week)
  - One week of influent characterization per MOP 31
- Piney Point Wastewater
  - Flow monitoring
  - Updated water quality data
- Secondary effluent TKN, NH_3, NO_3, NO_2, and TN (flow-weighted composites, once a week)
- Final effluent TKN, NO_3, and TN (flow-weighted composites, minimum four to five days per week)

It is important to emphasize that the simulation results should not be perceived as absolute in wastewater operation optimization because of specific limitations associated with any biological model used, the availability (only one set of influent pollutant determination per week) and quality of the data used for input in the simulator, and the scaling from lab-scale data to full-scale operation data.

APPENDIX A:

NRWRF NPDES PERMIT

ENGINEERS SURVEYORS PLANNERS

Butler, Linda

From:	Butler, Linda on behalf of SWD_WF_Permitting (Shared Mailbox)
Sent:	Tuesday, October 20, 2015 12:34 PM
To:	C. Mike Gore (mike.gore@mymanatee.org)
Cc:	Kaur, Ramandeep; Gracik, Elaine; McGucken, Vicki; Sia Mollanazar, P.E. (sia.mollanazar@mymanatee.org); Kenneth Labarr (kenneth.labarr@mymanatee.org); 'Jeff.Goodwin@mymanatee.org'; Andre Rachmaninoff (andre.rachmaninoff@mymanatee.org); 'DMilton@Carollo.com'; Curll, Ryan
Subject:	Manatee County North Regional WRF, FLA012617-026-DW1P/NRL, Final Permit
Attachments:	NOPI FLA012617-026-DW1P-NRL.pdf; Permit FLA012617-026.pdf; DMR R-001 FLA012617-026.docx; DMR R-002 FLA012617-026.docx; DMR RMP-Q FLA012617-026.docx; DMR Daily Part B FLA012617-026.docx; DMR Pretreatment FLA012617-026.docx; DMR RWS-A FLA012617-026.docx; Statement of Basis FLA012617-026.pdf

Dear Mr. Gore:

Attached please find the above-subject documents. In an effort to reduce costs and waste, our agency is moving to electronic, rather than paper, correspondence. This is the only copy that you will receive, unless you request otherwise.

Acrobat Reader 6.0 or greater is required to read the documents and is available for downloading at: http://www.adobe.com/products/acrobat/readstep.html

If you have any questions concerning the contents of the attached documents, please contact FDEP Engineering Specialist Ryan Curll at 813-470-5947 or Ryan.Curll@dep.state.fl.us

Sincerely,

Linda Butler
Operations Analyst I
FDEP - Southwest District
13051 North Telecom Parkway
Temple Terrace, FL 33637-0926
Direct Line: (813) 470-5719
Email: Linda.Butler@dep.state.fl.us

Florida Department of
Environmental Protection

Southwest District Office
13051 North Telecom Parkway
Temple Terrace, FL 33637-0926

October 20, 2015

In the Matter of an
Application for Permit by:

Manatee County Utilities Department
Mike Gore, Utilities Department Director
4410 66th Street West
Bradenton, Florida 34210
Mike.Gore@mymanatee.org

File Number FLA012617-026-DW1P/NRL
Manatee County
Manatee County North Regional WRF

NOTICE OF PERMIT ISSUANCE

Enclosed is Permit Number FLA012617 to operate the Manatee County North Regional WRF, issued under Chapter 403, Florida Statutes.

Monitoring requirements under this permit are effective on the first day of the second month following the effective date of the permit. Until such time, the permittee shall continue to monitor and report in accordance with previously effective permit requirements, if any.

The Department's proposed agency action shall become final unless a timely petition for an administrative hearing is filed under Sections 120.569 and 120.57, Florida Statutes, within fourteen days of receipt of notice. The procedures for petitioning for a hearing are set forth below.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) under Sections 120.569 and 120.57, Florida Statutes. The petition must contain the information set forth below and must be filed (received by the Clerk) in the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000.

Under Rule 62-110.106(4), Florida Administrative Code, a person may request an extension of the time for filing a petition for an administrative hearing. The request must be filed (received by the Clerk) in the Office of General Counsel before the end of the time period for filing a petition for an administrative hearing.

Petitions by the applicant or any of the persons listed below must be filed within fourteen days of receipt of this written notice. Petitions filed by any persons other than those entitled to written notice under Section 120.60(3), Florida Statutes, must be filed within fourteen days of publication of the notice or within fourteen days of receipt of the written notice, whichever occurs first. Section 120.60(3), Florida Statutes, however, also allows that any person who has asked the Department in writing for notice of agency action may file a petition within fourteen days of receipt of such notice, regardless of the date of publication.

The petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. The failure of any person to file a petition or request for an extension of time within fourteen days of receipt of notice shall constitute a waiver of that person's right to request an administrative determination (hearing) under Sections 120.569 and 120.57, Florida Statutes. Any subsequent intervention (in a proceeding initiated by another party) will be only at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205, Florida Administrative Code.

A petition that disputes the material facts on which the Department's action is based must contain the following information, as indicated in Rule 28-106.201, Florida Administrative Code:

(a) The name and address of each agency affected and each agency's file or identification number, if known;
(b) The name, address, any e-mail address, any facsimile number, and telephone number of the petitioner, if the petitioner is not represented by an attorney or a qualified representative; the name, address, and telephone number of the petitioner's representative, if any, which shall be the address for service purposes during the course of the proceeding; and an explanation of how the petitioner's substantial interests will be affected by the determination;
(c) A statement of when and how the petitioner received notice of the Department's decision;
(d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;
(e) A concise statement of the ultimate facts alleged, including the specific facts the petitioner contends warrant reversal or modification of the Department's proposed action;
(f) A statement of the specific rules or statutes the petitioner contends require reversal or modification of the Department's proposed action, including an explanation of how the alleged facts relate to the specific rules or statutes; and
(g) A statement of the relief sought by the petitioner, stating precisely the action petitioner wishes the Department to take with respect to the Department's proposed action.

Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means that the Department's final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any such final decision of the Department have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

Mediation under Section 120.573, Florida Statutes, is not available for this proceeding.

This permit action is final and effective on the date filed with the Clerk of the Department unless a petition (or request for an extension of time) is filed in accordance with the above. Upon the timely filing of a petition (or request for an extension of time), this permit will not be effective until further order of the Department.

Any party to the permit has the right to seek judicial review of the permit action under Section 120.68, Florida Statutes, by the filing of a notice of appeal under Rules 9.110 and 9.190, Florida Rules of Appellate Procedure, with the Clerk of the Department in the Office of General Counsel, 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida, 32399-3000, and by filing a copy of the notice of appeal accompanied by the applicable filing fees with the appropriate district court of appeal. The notice of appeal must be filed within 30 days from the date when this permit action is filed with the Clerk of the Department.

Executed in Hillsborough County, Florida

STATE OF FLORIDA DEPARTMENT OF
ENVIRONMENTAL PROTECTION

Stephen G. Morgan

For Kelly Boatwright
Program Administrator
Permitting & Waste Cleanup Program
Southwest District

FILING AND ACKNOWLEDGMENT

FILED, on this date, under Section 120.52, Florida Statutes, with the designated Deputy Clerk, receipt of which is hereby acknowledged.

October 20, 2015

[Clerk] **[Date]**

CERTIFICATE OF SERVICE

The undersigned hereby certifies that this NOTICE OF PERMIT ISSUANCE and all copies were mailed before the close of business on October 20, 2015 to the listed persons.

October 20, 2015

Name Date

Copies Furnished To:
Ramandeep Kaur, PhD, FDEP SWD, Ramandeep.Kaur@dep.state.fl.us
Elaine Gracik, FDEP SWD, Elaine.Gracik@dep.state.fl.us
Vicki McGucken, FDEP SWD, Vicki.McGucken@dep.state.fl.us
Sia Mollanazar, P.E., Manatee County, Sia.Mollanazar@mymanatee.org
Kenneth Labarr, Manatee County, Kenneth.Labarr@mymanatee.org
Jeff Goodwin, Manatee County, Jeff.Goodwin@mymanatee.org
Andre Rachmaninoff, Manatee County, Andre.Rachmaninoff@mymanatee.org
Dean Milton, P.E., Carollo Engineers, Inc., DMilton@carollo.com

STATE OF FLORIDA
DOMESTIC WASTEWATER FACILITY PERMIT

PERMITTEE:
Manatee County Utilities Department

RESPONSIBLE OFFICIAL:
Mike Gore, Utilities Department Director
4410 66th Street West
Bradenton, Florida 34210
(941) 792-8811
Mike.Gore@mymanatee.org

PERMIT NUMBER: FLA012617
FILE NUMBER: FLA012617-026-DW1P/NRL
EFFECTIVE DATE: February 3, 2016
EXPIRATION DATE: February 2, 2026

FACILITY:

Manatee County North Regional WRF
8500 69th St E
Palmetto, FL 34221-9064
Manatee County
Latitude: 27°35' 02" N Longitude: 82°28' 37" W

This permit is issued under the provisions of Chapter 403, Florida Statutes (F.S.), and applicable rules of the Florida Administrative Code (F.A.C.). This permit does not constitute authorization to discharge wastewater other than as expressly stated in this permit. The above named permittee is hereby authorized to operate the facilities in accordance with the documents attached hereto and specifically described as follows:

WASTEWATER TREATMENT:

Operation of an existing 7.5 Million Gallon per Day (MGD) Three-Month Rolling Average Daily Flow (TMRADF), Type I, oxidation ditch activated sludge domestic wastewater treatment facility consisting of: a head works with two automatic bar screens, one manual bar screen, and a forced flow vortex grit removal unit; two Carrousel oxidation ditches (each with a 0.6 Million Gallons [MG] anoxic basin and a 3.1 MG aeration basin, for a total oxidation ditch volume of 7.4 MG), three clarifiers (each with a volume of 1 MG and a surface area of 9,500 Square Feet [SF], for a total clarification volume of 3 MG and total surface area of 28,500 SF), a 32,000 gallon mixing/flow splitter basin, two automatic backwash traveling bridge filters (each with a surface area of 1,440 SF, for a total surface area of 2,880 SF), two automatic backwash cloth media disk filters (each rated at 3 MGD for a total disk filter capacity of 6 MGD), and four chlorine contact chambers (two chlorine contact chambers with a volume of 71,810 gallons and two chlorine contact chamber with a volume of 89,180 gallons for total volume of 321,980 gallons). Disinfection is achieved using sodium hypochlorite. Waste activated sludge is directed from the clarifiers to three aerated sludge holding tanks (each with a volume of 1.012 MG, for a total holding tank volume of 3.036 MG), and three belt filter presses. The North Regional WRF is a source facility for residuals processing at the Manatee County Southeast Regional Water Reclamation Facility (Permit FLA012618).

Modification:

Construction of a 3 MG equalization basin and installation of a forced flow vortex grit removal unit and one belt filter press. The modification will include the construction and installation of a cover and odor control, a splitter box, a new electrical building, a pump-back station, a platform with stairway, as well as all of the necessary electrical, instrumentation and controls with SCADA modifications, and all necessary new piping and appurtenances.

After Modification:

Operation of an existing 7.5 Million Gallon per Day (MGD) Three-Month Rolling Average Daily Flow (TMRADF), Type I, oxidation ditch activated sludge domestic wastewater treatment facility consisting of: a head works with two automatic bar screens, one manual bar screen, and two forced flow vortex grit removal units; a 3 MG equalization basin, two Carrousel oxidation ditches (each with a 0.6 Million Gallons [MG] anoxic basin and a 3.1 MG aeration basin, for a total oxidation ditch volume of 7.4 MG), three clarifiers (each with a volume of 1 MG and a surface area of 9,500 Square Feet [SF], for a total clarification volume of 3 MG and total surface area of 28,500 SF), a 32,000 gallon mixing/flow splitter basin, two automatic backwash traveling bridge filters (each with a surface area of 1,440 SF, for a total surface area of 2,880 SF), two automatic backwash cloth media disk filters (each rated at 3 MGD for a total disk filter capacity of 6 MGD), and four chlorine contact chambers (two chlorine contact chambers with a volume of 71,810 gallons each and two chlorine contact chamber with a volume of 89,180 gallons each for total volume of 321,980 gallons). Disinfection is achieved using sodium hypochlorite. Waste activated sludge is directed from the clarifiers to three aerated sludge holding tanks (each with a volume of 1.012 MG, for a total holding tank volume of 3.036 MG), and four belt filter presses. The North Regional WRF is a source facility for residuals processing at the Manatee County Southeast Regional Water Reclamation Facility (Permit FLA012618).

REUSE OR DISPOSAL:

Land Application R-001: An existing 7.5 MGD Annual Average Daily Flow (AADF) permitted capacity Part III slow-rate public access reuse (PAR) system (R-001). The MC North Regional WRF serves as a source plant for the Manatee County Master Reuse System (Permit FLA474029). A 49.0 MG PAR storage pond is located onsite. The Manatee County Master Reuse System Permit contains additional PAR storage information.

Land Application R-002: An existing Part IV rapid-rate land application system (R-002). R-002 consists of a single-cell Rapid Infiltration Basin (RIB). R-002 is used to store reject water until it is returned to the headworks for further treatment when no other discharge location is available. R-002’s southwestern embankment is equipped with an overflow structure to the 49.0 MG PAR storage pond. An overflow from R-002 to the storage pond will require the water in the storage pond to be sent to the plant for retreatment. R-002 is located approximately at Latitude 27° 35' 04" N, Longitude 82° 28' 29" W.

IN ACCORDANCE WITH: The limitations, monitoring requirements, and other conditions set forth in this cover sheet and Part I through Part IX on pages 1 through 21 of this permit.

I. RECLAIMED WATER AND EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

A. Reuse and Land Application Systems

1. During the period beginning on the effective date and lasting through the expiration date of this permit, the permittee is authorized to direct reclaimed water to Reuse System R-001. Such reclaimed water shall be limited and monitored by the permittee as specified below and reported in accordance with Permit Condition I.B.8:

			Reclaimed Water Limitations		Monitoring Requirements			
Parameter	Units	Max/Min	Limit	Statistical Basis	Frequency of Analysis	Sample Type	Monitoring Site Number	Notes
Flow, to R-001	MGD	Max Max	7.5 Report	Annual Average Monthly Average	Monthly	Calculated	FLW-06	See I.A.2 and I.A.3
BOD, Carbonaceous 5 day, 20C	mg/L	Max Max Max Max	20.0 30.0 45.0 60.0	Annual Average Monthly Average Weekly Average Single Sample	5 Days/Week	24-hr FPC	EFA-01	
Solids, Total Suspended	mg/L	Max	5.0	Single Sample	Daily; 24 hours	Grab	EFB-01	
pH	s.u.	Min Max	6.0 8.5	Single Sample Single Sample	Continuous	Meter	EFA-01	See I.A.4
Coliform, Fecal	#/100mL	Max	25	Single Sample	Daily; 24 hours	Grab	EFA-01	
Coliform, Fecal, % less than detection	percent	Min	75	Monthly Total	Monthly	Calculated	EFA-01	See I.A.5
Chlorine, Total Residual (For Disinfection)	mg/L	Min	1.0	Single Sample	Continuous	Meter	EFA-01	See I.A.4, I.A.6, I.A.9 and I.A.11
Turbidity	NTU	Max	Report	Single Sample	Continuous	Meter	EFB-01	See I.A.7 and I.A.9
Nitrogen, Total	mg/L	Max	Report	Single Sample	Monthly	24-hr FPC	EFA-01	
Phosphorus, Total (as P)	mg/L	Max	Report	Single Sample	Monthly	24-hr FPC	EFA-01	
Giardia	cysts/100L	Max	Report	Single Sample	Every 2 years	Grab	EFA-01	See I.A.10
Cryptosporidium	oocysts/100L	Max	Report	Single Sample	Every 2 years	Grab	EFA-01	See I.A.10

2. Reclaimed water samples shall be taken at the monitoring site locations listed in Permit Condition I.A.1. and as described below:

Monitoring Site Number	Description of Monitoring Site
EFA-01	Effluent sampling point after disinfection and prior to discharge to R-001
EFB-01	Turbidity and TSS monitoring location after filtration and prior to disinfection
FLW-04	Flow to the Golf Course.
FLW-05	Flow Meter After High Service Pumps.
FLW-06	Total Flow to R-001 (FLW-06) = (FLW-04) + (FLW-05)

3. Recording flow meters and totalizers shall be utilized to measure flow and calibrated at least annually. *[62-601.200(17) and .500(6)]*

4. Hourly measurement of pH and total residual chlorine for disinfection during the period of required operator attendance may be substituted for continuous measurement. *[Chapter 62-601, Figure 2]*

5. To report the "% less than detection," count the number of fecal coliform observations that were less than detection, divide by the total number of fecal coliform observations in the month, and multiply by 100% (round to the nearest integer). *[62-600.440(5)(f)]*

6. The minimum total chlorine residual shall be limited as described in the approved operating protocol, such that the permit limitation for fecal coliform bacteria will be achieved. In no case shall the total chlorine residual be less than 1.0 mg/L. *[62-600.440(5)(b); 62-610.460(2); and 62-610.463(2)]*

7. The maximum turbidity shall be limited as described in the approved operating protocol, such that the permit limitations for total suspended solids and fecal coliforms will be achieved. *[62-610.463(2)]*

8. The treatment facilities shall be operated in accordance with all approved operating protocols. Only reclaimed water that meets the criteria established in the approved operating protocol(s) may be released to system storage or to the reuse system. Reclaimed water that fails to meet the criteria in the approved operating protocol(s) shall be directed *[62-610.320(6) and 62-610.463(2)]*

9. Instruments for continuous on-line monitoring of total residual chlorine and turbidity shall be equipped with an automated data logging or recording device. *[62-610.463(2)]*

10. Intervals between sampling for Giardia and Cryptosporidium shall not exceed two years. *[62-610.463(4)]*

11. Total residual chlorine must be maintained for a minimum contact time of 15 minutes based on peak hourly flow. *[62-610.510, 62-600.440(4)(b) and (5)(b)]*

12. During the period beginning on the effective date and lasting through the expiration date of this permit, the permittee is authorized to direct reclaimed water to Reuse System R-002. Such reclaimed water shall be limited and monitored by the permittee as specified below and reported in accordance with Permit Condition I.B.8:

			Reclaimed Water Limitations		Monitoring Requirements			
Parameter	Units	Max/Min	Limit	Statistical Basis	Frequency of Monitoring	Sample Type	Monitoring Site Number	Notes
Flow, to R-002	MGD	Max Max	Report Report	Annual Average Monthly Average	Monthly	Calculated	FLW-09	See I.A.3 and I.A.13
BOD, Carbonaceous 5 day, 20C	mg/L	Max Max Max Max	20.0 30.0 45.0 60.0	Annual Average Monthly Average Weekly Average Single Sample	5 Days/Week	24-hr FPC	EFA-01	
Solids, Total Suspended	mg/L	Max Max Max Max	20.0 30.0 45.0 60.0	Annual Average Monthly Average Weekly Average Single Sample	5 Days/Week	24-hr FPC	EFA-01	
pH	s.u.	Min Max	6.0 8.5	Single Sample Single Sample	Continuous	Meter	EFA-01	See I.A.4
Coliform, Fecal	#/100mL	Max Max	200 800	Annual Average Single Sample	5 Days/Week	Grab	EFA-01	
Chlorine, Total Residual (For Disinfection)	mg/L	Min	0.5	Single Sample	Continuous	Meter	EFA-01	See I.A.4, I.A.6, I.A.9 and I.A.11
Nitrogen, Nitrate, Total (as N)	mg/L	Max	12.0	Single Sample	5 Days/Week	24-hr FPC	EFA-01	

13. Reclaimed water samples shall be taken at the monitoring site locations listed in Permit Condition I.A.12 and as described below:

Monitoring Site Number	Description of Monitoring Site
EFA-01	Effluent sampling point after disinfection and prior to discharge to R-001
FLW-07	Flow to R-002, continuously measured by a surface level transducer.
FLW-08	Flow from R-002 to the headworks, continuously measured by a surface level transducer.
FLW-09	Flow to R-002 (percolation) (FLW-09) = (FLW-07) - (FLW-08)

B. Other Limitations and Monitoring and Reporting Requirements

1. During the period beginning on the effective date and lasting through the expiration date of this permit, the treatment facility shall be limited and monitored by the permittee as specified below and reported in accordance with condition I.B.8:

			Limitations		Monitoring Requirements			
Parameter	Units	Max/Min	Limit	Statistical Basis	Frequency of Analysis	Sample Type	Monitoring Site Number	Notes
Flow, Total Plant	MGD	Max Max	7.5 Report	3-Month Rolling Average Monthly Average	Continuous	Recording Flow Meter	FLW-03	See I.B.3
Percent Capacity, (TMADF/Permitted Capacity) x 100	percent	Max	Report	Monthly Average	Monthly	Calculated	FLW-03	
BOD, Carbonaceous 5 day, 20C (Influent)	mg/L	Max	Report	Monthly Average	Weekly	24-hr FPC	INF-01	See I.B.4
Solids, Total Suspended (Influent)	mg/L	Max	Report	Monthly Average	Weekly	24-hr FPC	INF-01	See I.B.4

2. Samples shall be taken at the monitoring site locations listed in Permit Condition I.B.1. and as described below:

Monitoring Site Number	Description of Monitoring Site
FLW-03	Total plant flow measured at the headworks
INF-01	Influent sampling point prior to treatment and ahead of the return activated sludge line.

3. A recording flow meter with totalizer shall be utilized to measure flow and calibrated at least once every 12 months. *[62-601.200(17) and .500(6)]*

4. Influent samples shall be collected so that they do not contain digester supernatant or return activated sludge, or any other plant process recycled waters. *[62-601.500(4)]*

5. Sampling results for giardia and cryptosporidium shall be reported on DEP Form 62-610.300(4)(a)4, Pathogen Monitoring, which is attached to this permit. This form shall be submitted to the Department's Southwest District Office and to DEP's Reuse Coordinator in Tallahassee. *[62-610.300(4)(a)]*

6. The sample collection, analytical test methods and method detection limits (MDLs) applicable to this permit shall be conducted using a sufficiently sensitive method to ensure compliance with applicable water quality standards and effluent limitations and shall be in accordance with Rule 62-4.246, Chapters 62-160 and 62-601, F.A.C., and 40 CFR 136, as appropriate. The list of Department established analytical methods, and corresponding MDLs (method detection limits) and PQLs (practical quantitation limits), which is titled "FAC 62-4 MDL/PQL Table (April 26, 2006)" is available at http://www.dep.state.fl.us/labs/library/index.htm. The MDLs and PQLs as described in this list shall constitute the minimum acceptable MDL/PQL values and the Department shall not accept results for which the laboratory's MDLs or PQLs are greater than those described above unless alternate MDLs and/or PQLs have been specifically approved by the Department for this permit. Any method included in the list may be used for reporting as long as it meets the following requirements:

   a. The laboratory's reported MDL and PQL values for the particular method must be equal or less than the corresponding method values specified in the Department's approved MDL and PQL list;

   b. The laboratory reported MDL for the specific parameter is less than or equal to the permit limit or the applicable water quality criteria, if any, stated in Chapter 62-302, F.A.C. Parameters that are listed as "report only" in the permit shall use methods that provide an MDL, which is equal to or less than the applicable water quality criteria stated in 62-302, F.A.C.; and

   c. If the MDLs for all methods available in the approved list are above the stated permit limit or applicable water quality criteria for that parameter, then the method with the lowest stated MDL shall be used.

   When the analytical results are below method detection or practical quantitation limits, the permittee shall report the actual laboratory MDL and/or PQL values for the analyses that were performed following the instructions on the applicable discharge monitoring report.

   Where necessary, the permittee may request approval of alternate methods or for alternative MDLs or PQLs for any approved analytical method. Approval of alternate laboratory MDLs or PQLs are not necessary if the laboratory reported MDLs and PQLs are less than or equal to the permit limit or the applicable water quality criteria, if any, stated in Chapter 62-302, F.A.C. Approval of an analytical method not included in the above-referenced list is not necessary if the analytical method is approved in accordance with 40 CFR 136 or deemed acceptable by the Department. *[62-4.246, 62-160]*

7. The permittee shall provide safe access points for obtaining representative influent, reclaimed water, and effluent samples which are required by this permit. *[62-601.500(5)]*

8. Monitoring requirements under this permit are effective on the first day of the second month following the effective date of the permit. Until such time, the permittee shall continue to monitor and report in accordance with previously effective permit requirements, if any. During the period of operation authorized by this permit, the permittee shall complete and submit to the Department Discharge Monitoring Reports (DMRs) in

accordance with the frequencies specified by the REPORT type (i.e. monthly, quarterly, semiannual, annual, etc.) indicated on the DMR forms attached to this permit. Unless specified otherwise in this permit, monitoring results for each monitoring period shall be submitted in accordance with the associated DMR due dates below. DMRs shall be submitted for each required monitoring period including periods of no discharge.

REPORT Type on DMR	Monitoring Period	Mail or Electronically Submit by
Monthly	first day of month - last day of month	28th day of following month
Quarterly	January 1 - March 31 April 1 - June 30 July 1 - September 30 October 1 - December 31	April 28 July 28 October 28 January 28
Semiannual	January 1 - June 30 July 1 - December 31	July 28 January 28
Annual	January 1 - December 31	January 28

The permittee may submit either paper or electronic DMR forms. If submitting paper DMR forms, the permittee shall make copies of the attached DMR forms, without altering the original format or content unless approved by the Department, and shall mail the completed DMR forms to the Department's Southwest District Office at the address specified in Permit Condition I.B.13 by the twenty-eighth (28th) of the month following the month of operation.

If submitting electronic DMR forms, the permittee shall use the electronic DMR system(s) approved in writing by the Department and shall electronically submit the completed DMR forms to the Department by the twenty-eighth (28th) of the month following the month of operation. Data submitted in electronic format is equivalent to data submitted on signed and certified paper DMR forms.

[62-620.610(18)][62-601.300(1),(2), and (3)]

9. During the period of operation authorized by this permit, reclaimed water or effluent shall be monitored annually for the primary and secondary drinking water standards contained in Chapter 62-550, F.A.C., (except for asbestos, color, odor, and corrosivity). These monitoring results shall be reported to the Department annually on the DMR. During years when a permit is not renewed, a certification stating that no new non-domestic wastewater dischargers have been added to the collection system since the last reclaimed water or effluent analysis was conducted may be submitted in lieu of the report. The annual reclaimed water or effluent analysis report or the certification shall be completed and submitted in a timely manner so as to be received by the Department at the address identified on the DMR by June 28 of each year. Approved analytical methods identified in Rule 62-620.100(3)(j), F.A.C., shall be used for the analysis. If no method is included for a parameter, methods specified in Chapter 62-550, F.A.C., shall be used. *[62-601.300(4)][62-601.500(3)][62-610.300(4)]*

10. The permittee shall submit an Annual Reuse Report using DEP Form 62-610.300(4)(a)2. on or before January 1 of each year. *[62-610.870(3)]*

11. Operating protocol(s) shall be reviewed and updated periodically to ensure continuous compliance with the minimum treatment and disinfection requirements. Updated operating protocols shall be submitted to the Department's Southwest District Office for review and approval upon revision of the operating protocol(s) and with each permit application. *[62-610.320(6)][62-610.463(2)]*

12. The permittee shall maintain an inventory of storage systems. The inventory shall be submitted to the Department's Southwest District Office at least 30 days before reclaimed water will be introduced into any new storage system. The inventory of storage systems shall be attached to the annual submittal of the Annual Reuse Report. *[62-610.464(5)]*

13. Unless specified otherwise in this permit, all reports and other information required by this permit, including 24-hour notifications, shall be submitted to or reported to, as appropriate, the Department's Southwest District Office at the address specified below:

Florida Department of Environmental Protection
Southwest District Office
13051 N Telecom Pkwy
Temple Terrace, Florida 33637-0926
Email Address: swd_dw@dep.state.fl.us

Phone Number - (813) 470-5700
FAX Number - (813) 470-5996

[62-620.305]

14. All reports and other information shall be signed in accordance with the requirements of Rule 62-620.305, F.A.C. *[62-620.305]*

II. BIOSOLIDS MANAGEMENT REQUIREMENTS

A. Basic Requirements

1. Biosolids generated by this facility may be transferred to a Biosolids Treatment Facility (BTF) or disposed of in a Class I solid waste landfill. Transferring biosolids to an alternative BTF does not require a permit modification. However, use of an alternative BTF requires submittal of a copy of the agreement pursuant to Rule 62-640.880(1)(c), F.A.C., along with a written notification to the Department at least 30 days before transport of the biosolids. *[62-620.320(6), 62-640.880(1)]*

2. The permittee shall monitor and keep records of the quantities of biosolids generated, received from source facilities, treated, distributed and marketed, land applied, used as a biofuel or for bioenergy, transferred to another facility, or landfilled. These records shall be kept for a minimum of five years. *[62-640.650(4)(a)]*

3. Biosolids quantities shall be monitored by the permittee as specified below. Results shall be reported on the permittee's Discharge Monitoring Report for Monitoring Group RMP-Q in accordance with Condition I.B.8.

			Biosolids Limitations		Monitoring Requirements		
Parameter	Units	Max/ Min	Limit	Statistical Basis	Frequency of Analysis	Sample Type	Monitoring Site Number
Biosolids Quantity (Transferred)	dry tons	Max	Report	Monthly Total	Monthly	Calculated	RMP-01
Biosolids Quantity (Landfilled)	dry tons	Max	Report	Monthly Total	Monthly	Calculated	RMP-02

[62-640.650(5)(a)1]

4. Biosolids quantities shall be calculated as listed in Permit Condition II.A.3 and as described below:

Monitoring Site Number	Description of Monitoring Site Calculations
RMP-01	Biosolids Quantity (Transferred to BTF)
RMP-02	Biosolids Quantity (Landfilled)

5. The treatment, management, transportation, use, land application, or disposal of biosolids shall not cause a violation of the odor prohibition in subsection 62-296.320(2), F.A.C. *[62-640.400(6)]*

6. Storage of biosolids or other solids at this facility shall be in accordance with the Facility Biosolids Storage Plan. *[62-640.300(4)]*

7. Biosolids shall not be spilled from or tracked off the treatment facility site by the hauling vehicle. *[62-640.400(9)]*

B. Disposal

1. Disposal of biosolids, septage, and "other solids" in a solid waste disposal facility, or disposal by placement on land for purposes other than soil conditioning or fertilization, such as at a monofill, surface impoundment, waste pile, or dedicated site, shall be in accordance with Chapter 62-701, F.A.C. *[62-640.100(6)(b) & (c)]*

C. Transfer

1. The permittee shall not be held responsible for treatment and management violations that occur after its biosolids have been accepted by a permitted biosolids treatment facility with which the source facility has an agreement in accordance with subsection 62-640.880(1)(c), F.A.C., for further treatment, management, or disposal. *[62-640.880(1)(b)]*

2. The permittee shall keep hauling records to track the transport of biosolids between the facilities. The hauling records shall contain the following information:

Source Facility	Biosolids Treatment Facility or Treatment Facility
1. Date and time shipped	1. Date and time received
2. Amount of biosolids shipped	2. Amount of biosolids received
3. Degree of treatment (if applicable)	3. Name and ID number of source facility
4. Name and ID Number of treatment facility	4. Signature of hauler
5. Signature of responsible party at source facility	5. Signature of responsible party at treatment facility
6. Signature of hauler and name of hauling firm	

A copy of the source facility hauling records for each shipment shall be provided upon delivery of the biosolids to the biosolids treatment facility or treatment facility. The treatment facility permittee shall report to the Department within 24 hours of discovery any discrepancy in the quantity of biosolids leaving the source facility and arriving at the biosolids treatment facility or treatment facility.

[62-640.880(4)]

D. Receipt

1. If the permittee intends to accept biosolids from other facilities, a permit revision is required pursuant to paragraph 62-640.880(2)(d), F.A.C. *[62-640.880(2)(d)]*

II. GROUND WATER REQUIREMENTS

Ground water monitoring requirements are contained in the Manatee County Master Reuse System (MCMRS), Permit No. FLA474029.

III. ADDITIONAL REUSE AND LAND APPLICATION REQUIREMENTS

E. Part III Public Access System(s)

1. Cross-connections to the potable water system are prohibited. *[62-610.469(7)]*

2. A cross-connection control program shall be implemented and/or remain in effect within the areas where reclaimed water will be provided for use and shall be in compliance with the Rule 62-555.360, F.A.C. *[62-610.469(7)]*

3. The permittee shall conduct inspections within the reclaimed water service area to verify proper connections, to minimize illegal cross-connections, and to verify both the proper use of reclaimed water and that the proper backflow prevention assemblies or devices have been installed and tested. Inspections are required when a customer first connects to the reuse distribution system. Subsequent inspections are required as specified in the cross-connection control and inspection program. *[62-610.469(7)(h)]*

4. If an actual or potential (e.g. no dual check device on residential connections served by a reuse system) cross-connection between the potable and reclaimed water systems is discovered, the permittee shall:

   a. Immediately discontinue potable water and/or reclaimed water service to the affected area if an actual cross-connection is discovered.

   b. If the potable water system is contaminated, clear the potable water lines.

   c. Eliminate the cross-connection and install a backflow prevention device as required by the Rule 62-555.360.F.A.C.

   d. Test the affected area for other possible cross-connections.

   e. Within 24 hours, notify the Department's Southwest District Office's domestic wastewater and drinking water programs.

   f. Within 5 days of discovery of an actual or potential cross-connection, submit a written report to the Department's Southwest District Office detailing: a description of the cross-connection, how the cross-connection was discovered, the exact date and time of discovery, approximate time that the cross-connection existed, the location, the cause, steps taken to eliminate the cross-connection, whether reclaimed water was consumed, and reports of possible illness, whether the drinking water system was contaminated and the steps taken to clear the drinking water system, when the cross-connection was eliminated, plan of action for testing for other possible cross-connections in the area, and an evaluation of the cross-connection control and inspection program to ensure that future cross-connections do not occur.

   [62-555.350(3) and 62-555.360][62-620.610(20)]

5. Maximum obtainable separation of reclaimed water lines and potable water lines shall be provided and the minimum separation distances specified in Rule 62-610.469(7), F.A.C., shall be provided. Reuse facilities shall be color coded or marked. Underground piping which is not manufactured of metal or concrete shall be color coded using Pantone Purple 522C using light stable colorants. Underground metal and concrete pipe shall be color coded or marked using purple as the predominant color. *[62-610.469(7)]*

6. In constructing reclaimed water distribution piping, the permittee shall maintain a 75-foot setback distance from a reclaimed water transmission facility to public water supply wells. No setback distances are required to other potable water supply wells or to any non-potable water supply wells. *[62-610.471(3)]*

7. A setback distance of 75 feet shall be maintained between the edge of the wetted area and potable water supply wells, unless the utility adopts and enforces an ordinance prohibiting potable water supply wells within the reuse service area. No setback distances are required to any non-potable water supply well, to any surface water, to any developed areas, or to any private swimming pools, hot tubs, spas, saunas, picnic tables, barbecue pits, or barbecue grills. *[62-610.471(1), (2), (5), and (7)]*

8. Reclaimed water shall not be used to fill swimming pools, hot tubs, or wading pools. *[62-610.469(4)]*

9. Low trajectory nozzles, or other means to minimize aerosol formation shall be used within 100 feet from outdoor public eating, drinking, or bathing facilities. *[62-610.471(6)]*

10. A setback distance of 100 feet shall be maintained from indoor aesthetic features using reclaimed water to adjacent indoor public eating and drinking facilities. *[62-610.471(8)]*

11. The public shall be notified of the use of reclaimed water. This shall be accomplished by posting of advisory signs in areas where reuse is practiced, notes on scorecards, or other methods. *[62-610.468(2)]*

12. All new advisory signs and labels on vaults, service boxes, or compartments that house hose bibbs along with all labels on hose bibbs, valves, and outlets shall bear the words "do not drink" and "no beber" along with the equivalent standard international symbol. In addition to the words "do not drink" and "no beber," advisory signs posted at storage ponds and decorative water features shall also bear the words "do not swim" and "no nadar" along with the equivalent standard international symbols. Existing advisory signs and labels shall be retrofitted, modified, or replaced in order to comply with the revised wording requirements. For existing advisory signs and labels this retrofit, modification, or replacement shall occur within 365 days after the date of this permit. For labels on existing vaults, service boxes, or compartments housing hose bibbs this retrofit, modification, or replacement shall occur within 730 days after the date of this permit. *[62-610.468, 62-610.469]*

13. The permittee shall ensure that users of reclaimed water are informed about the origin, nature, and characteristics of reclaimed water; the manner in which reclaimed water can be safely used; and limitations on the use of reclaimed water. Notification is required at the time of initial connection to the reclaimed water distribution system and annually after the reuse system is placed into operation. A description of on-going public notification activities shall be included in the Annual Reuse Report. *[62-610.468(6)]*

14. Routine aquatic weed control and regular maintenance of storage pond embankments and access areas are required. *[62-610.414(8)]*

15. Overflows from emergency discharge facilities on storage ponds shall be reported as abnormal events in accordance with Permit Condition IX.20. *[62-610.800(9)]*

F. Part IV Rapid Infiltration Basins

1. Advisory signs shall be posted around the site boundaries to designate the nature of the project area. *[62-610.518]*

2. Rapid infiltration basins shall be routinely maintained to control vegetation growth and to maintain percolation capability by scarification or removal of deposited solids. Basin bottoms shall be maintained to be level. *[62-610.523(6) and (7)]*

3. Routine aquatic weed control and regular maintenance of storage pond embankments and access areas are required. *[62-610.514 and 62-610.414]*

4. Overflows from emergency discharge facilities on storage ponds or on infiltration ponds, basins, or trenches shall be reported as abnormal events in accordance with Permit Condition IX.20. *[62-610.800(9)]*

IV. OPERATION AND MAINTENANCE REQUIREMENTS

A. Staffing Requirements

1. During the period of operation authorized by this permit, the wastewater facilities shall be operated under the supervision of a(n) operator(s) certified in accordance with Chapter 62-602, F.A.C. In accordance with Chapter 62-699, F.A.C., this facility is a Category III, Class B facility and, at a minimum, operators with appropriate certification must be on the site as follows:

   A Class C or higher operator for 24 hours/day for 7 days/week. The lead operator must be a Class B operator, or higher.

2. The lead/chief operator shall be employed at the plant full time. "Full time" shall mean at least 4 days per week, working a minimum of 35 hours per week, including leave time. A licensed operator shall be on-site and in charge of each required shift for periods of required staffing time when the lead/chief operator is not on-site. An operator meeting the lead/chief operator class for the treatment plant shall be available during all periods of plant operation. "Available" means able to be contacted as needed to initiate the appropriate action in a timely manner. *[62-699.311(10), (6) and (1)]*

B. Capacity Analysis Report and Operation and Maintenance Performance Report Requirements

1. Submit an updated capacity analysis report prepared in accordance with Rule 62-600.405, F.A.C., five years from the date of issuance of this permit. [62-600.405(5)] (Only applicable to facilities that meet the criteria in Section 403.087(3), F.S. and are being issued permits for terms exceeding five years.)

2. The application to renew this permit shall include an updated capacity analysis report prepared in accordance with Rule 62-600.405, F.A.C. *[62-600.405(5)]*

3. The application to renew this permit shall include a detailed operation and maintenance performance report prepared in accordance with Rule 62-600.735, F.A.C. *[62-600.735(1)]*

C. Recordkeeping Requirements

1. The permittee shall maintain the following records and make them available for inspection on the site of the permitted facility.

   a. Records of all compliance monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, including, if applicable, a copy of the laboratory certification showing the certification number of the laboratory, for at least three years from the date the sample or measurement was taken;

   b. Copies of all reports required by the permit for at least three years from the date the report was prepared;

   c. Records of all data, including reports and documents, used to complete the application for the permit for at least three years from the date the application was filed;

   d. Monitoring information, including a copy of the laboratory certification showing the laboratory certification number, related to the residuals use and disposal activities for the time period set forth in Chapter 62-640, F.A.C., for at least three years from the date of sampling or measurement;

   e. A copy of the current permit;

   f. A copy of the current operation and maintenance manual as required by Chapter 62-600, F.A.C.;

   g. A copy of any required record drawings;

   h. Copies of the licenses of the current certified operators;

   i. Copies of the logs and schedules showing plant operations and equipment maintenance for three years from the date of the logs or schedules. The logs shall, at a minimum, include identification of the plant; the signature and license number of the operator(s) and the signature of the person(s) making any entries; date and time in and out; specific operation and maintenance activities, including any preventive maintenance or repairs made or requested; results of tests performed and samples taken, unless documented on a laboratory sheet; and notation of any notification or reporting completed in accordance with Rule 62-602.650(3), F.A.C. The logs shall be maintained on-site in a location accessible to 24-hour inspection, protected from weather damage, and current to the last operation and maintenance performed; and

   j. Records of biosolids quantities, treatment, monitoring, and hauling for at least five years.

   [62-620.350, 62-602.650, 62-640.650(4)]

V. SCHEDULES

1. The permittee is not authorized to discharge to waters of the state after the expiration date of this permit, unless the following scheduled items are completed:

Implementation Step		Completion Date
a.	Submit an application for permit renewal.	At least 180 days before existing permit expiration date.
b.	Submit a revised Operating Protocol to the Department's Compliance Assurance Program for review and approval prior to placing the new facilities into operation.	Ninety (90) days prior to the completion of construction.
c.	Provide appropriate documentation as required in permit Conditions VII. 9 & 10 for any new facilities or unit processes.	As required by permit Conditions VII. 9 & 10

VI. INDUSTRIAL PRETREATMENT PROGRAM REQUIREMENTS

1. This facility's pretreatment program requirements are included in the Manatee County Southwest Regional WWTP permit issued by the Department under Permit Number FLA012619.

2. As required by Rules 62-625.600(8) and (12), F.A.C., the permittee shall submit DMRs for Monitoring Site Numbers PRT-I, PRT-E, and PRT-R to the Manatee County Southwest Regional WWTP (FLA012619) for inclusion in the annual report.*[62-625.600(8)]*

3. Samples for Monitoring Site Numbers PRT-I, PRT-E, and PRT-R shall be taken at the monitoring site locations described below:

Monitoring Location Site Number	**Description of Monitoring Location**
PRT-I	Pretreatment influent
PRT-E	Pretreatment effluent
PRT-R	Pretreatment residuals

VII. OTHER SPECIFIC CONDITIONS

1. In the event that the treatment facilities or equipment no longer function as intended, are no longer safe in terms of public health and safety, or odor, noise, aerosol drift, or lighting adversely affects neighboring developed areas at the levels prohibited by Rule 62-600.400(2)(a), F.A.C., corrective action (which may include additional maintenance or modifications of the permitted facilities) shall be taken by the permittee. Other corrective action may be required to ensure compliance with rules of the Department. Additionally, the treatment, management, use or land application of residuals shall not cause a violation of the odor prohibition in Rule 62-296.320(2), F.A.C. *[62-600.410(8) and 62-640.400(6)]*

2. The deliberate introduction of stormwater in any amount into collection/transmission systems designed solely for the introduction (and conveyance) of domestic/industrial wastewater; or the deliberate introduction of stormwater into collection/transmission systems designed for the introduction or conveyance of combinations of storm and domestic/industrial wastewater in amounts which may reduce the efficiency of pollutant removal by the treatment plant is prohibited, except as provided by Rule 62-610.472, F.A.C. *[62-604.130(3)]*

3. Collection/transmission system overflows shall be reported to the Department in accordance with Permit Condition IX. 20. *[62-604.550] [62-620.610(20)]*

4. The operating authority of a collection/transmission system and the permittee of a treatment plant are prohibited from accepting connections of wastewater discharges which have not received necessary pretreatment or which contain materials or pollutants (other than normal domestic wastewater constituents):

   a. Which may cause fire or explosion hazards; or

   b. Which may cause excessive corrosion or other deterioration of wastewater facilities due to chemical action or pH levels; or

   c. Which are solid or viscous and obstruct flow or otherwise interfere with wastewater facility operations or treatment; or

   d. Which result in the wastewater temperature at the introduction of the treatment plant exceeding 40^{o}C or otherwise inhibiting treatment; or

   e. Which result in the presence of toxic gases, vapors, or fumes that may cause worker health and safety problems.

   [62-604.130(5)]

5. The treatment facility, storage ponds for Part II systems, rapid infiltration basins, and/or infiltration trenches shall be enclosed with a fence or otherwise provided with features to discourage the entry of animals and unauthorized persons. *[62-610.518(1) and 62-600.400(2)(b)]*

6. Screenings and grit removed from the wastewater facilities shall be collected in suitable containers and hauled to a Department approved Class I landfill or to a landfill approved by the Department for receipt/disposal of screenings and grit. *[62-701.300(1)(a)]*

7. Where required by Chapter 471 or Chapter 492, F.S., applicable portions of reports that must be submitted under this permit shall be signed and sealed by a professional engineer or a professional geologist, as appropriate. *[62-620.310(4)]*

8. The permittee shall provide verbal notice to the Department's Southwest District Office as soon as practical after discovery of a sinkhole or other karst feature within an area for the management or application of wastewater, wastewater residuals (sludges), or reclaimed water. The permittee shall immediately implement measures appropriate to control the entry of contaminants, and shall detail these measures to the Department's Southwest District Office in a written report within 7 days of the sinkhole discovery. *[62-620.320(6)]*

9. Prior to placing the new facilities into operation or any individual unit processes into operation, for any purpose other than testing for leaks and equipment operation, the permittee shall complete and submit to the Department DEP Form 62-620.910(12), Notification of Completion of Construction for Domestic Wastewater Facilities. *[62-620.630(2)]*

10. Within six months after a facility is placed in operation, the permittee shall provide written certification to the Department on Form 62-620.910(13) that record drawings pursuant to Chapter 62-600, F.A.C., and that an operation and maintenance manual pursuant to Chapters 62-600 and 62-610, F.A.C., as applicable, are available at the location specified on the form. *[62-620.630(7)]*

VIII. GENERAL CONDITIONS

1. The terms, conditions, requirements, limitations, and restrictions set forth in this permit are binding and enforceable pursuant to Chapter 403, Florida Statutes. Any permit noncompliance constitutes a violation of Chapter 403, Florida Statutes, and is grounds for enforcement action, permit termination, permit revocation and reissuance, or permit revision. *[62-620.610(1)]*

2. This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviations from the approved drawings, exhibits, specifications, or conditions of this permit constitutes grounds for revocation and enforcement action by the Department. *[62-620.610(2)]*

3. As provided in subsection 403.087(7), F.S., the issuance of this permit does not convey any vested rights or any exclusive privileges. Neither does it authorize any injury to public or private property or any invasion of personal rights, nor authorize any infringement of federal, state, or local laws or regulations. This permit is not a waiver of or approval of any other Department permit or authorization that may be required for other aspects of the total project which are not addressed in this permit. *[62-620.610(3)]*

4. This permit conveys no title to land or water, does not constitute state recognition or acknowledgment of title, and does not constitute authority for the use of submerged lands unless herein provided and the necessary title or leasehold interests have been obtained from the State. Only the Trustees of the Internal Improvement Trust Fund may express State opinion as to title. *[62-620.610(4)]*

5. This permit does not relieve the permittee from liability and penalties for harm or injury to human health or welfare, animal or plant life, or property caused by the construction or operation of this permitted source; nor does it allow the permittee to cause pollution in contravention of Florida Statutes and Department rules, unless specifically authorized by an order from the Department. The permittee shall take all reasonable steps to minimize or prevent any discharge, reuse of reclaimed water, or residuals use or disposal in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit. *[62-620.610(5)]*

6. If the permittee wishes to continue an activity regulated by this permit after its expiration date, the permittee shall apply for and obtain a new permit. *[62-620.610(6)]*

7. The permittee shall at all times properly operate and maintain the facility and systems of treatment and control, and related appurtenances, that are installed and used by the permittee to achieve compliance with the conditions of this permit. This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to maintain or achieve compliance with the conditions of the permit. *[62-620.610(7)]*

8. This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit revision, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition. *[62-620.610(8)]*

9. The permittee, by accepting this permit, specifically agrees to allow authorized Department personnel, including an authorized representative of the Department and authorized EPA personnel, when applicable, upon presentation of credentials or other documents as may be required by law, and at reasonable times, depending upon the nature of the concern being investigated, to:

   a. Enter upon the permittee's premises where a regulated facility, system, or activity is located or conducted, or where records shall be kept under the conditions of this permit;

   b. Have access to and copy any records that shall be kept under the conditions of this permit;

   c. Inspect the facilities, equipment, practices, or operations regulated or required under this permit; and

   d. Sample or monitor any substances or parameters at any location necessary to assure compliance with this permit or Department rules.

   [62-620.610(9)]

10. In accepting this permit, the permittee understands and agrees that all records, notes, monitoring data, and other information relating to the construction or operation of this permitted source which are submitted to the Department may be used by the Department as evidence in any enforcement case involving the permitted source arising under the Florida Statutes or Department rules, except as such use is proscribed by Section 403.111, F.S., or Rule 62-620.302, F.A.C. Such evidence shall only be used to the extent that it is consistent with the Florida Rules of Civil Procedure and applicable evidentiary rules. *[62-620.610(10)]*

11. When requested by the Department, the permittee shall within a reasonable time provide any information required by law which is needed to determine whether there is cause for revising, revoking and reissuing, or terminating this permit, or to determine compliance with the permit. The permittee shall also provide to the

Department upon request copies of records required by this permit to be kept. If the permittee becomes aware of relevant facts that were not submitted or were incorrect in the permit application or in any report to the Department, such facts or information shall be promptly submitted or corrections promptly reported to the Department. *[62-620.610(11)]*

12. Unless specifically stated otherwise in Department rules, the permittee, in accepting this permit, agrees to comply with changes in Department rules and Florida Statutes after a reasonable time for compliance; provided, however, the permittee does not waive any other rights granted by Florida Statutes or Department rules. A reasonable time for compliance with a new or amended surface water quality standard, other than those standards addressed in Rule 62-302.500, F.A.C., shall include a reasonable time to obtain or be denied a mixing zone for the new or amended standard. *[62-620.610(12)]*

13. The permittee, in accepting this permit, agrees to pay the applicable regulatory program and surveillance fee in accordance with Rule 62-4.052, F.A.C. *[62-620.610(13)]*

14. This permit is transferable only upon Department approval in accordance with Rule 62-620.340, F.A.C. The permittee shall be liable for any noncompliance of the permitted activity until the transfer is approved by the Department. *[62-620.610(14)]*

15. The permittee shall give the Department written notice at least 60 days before inactivation or abandonment of a wastewater facility or activity and shall specify what steps will be taken to safeguard public health and safety during and following inactivation or abandonment. *[62-620.610(15)]*

16. The permittee shall apply for a revision to the Department permit in accordance with Rules 62-620.300, F.A.C., and the Department of Environmental Protection Guide to Permitting Wastewater Facilities or Activities Under Chapter 62-620, F.A.C., at least 90 days before construction of any planned substantial modifications to the permitted facility is to commence or with Rule 62-620.325(2), F.A.C., for minor modifications to the permitted facility. A revised permit shall be obtained before construction begins except as provided in Rule 62-620.300, F.A.C. *[62-620.610(16)]*

17. The permittee shall give advance notice to the Department of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements. The permittee shall be responsible for any and all damages which may result from the changes and may be subject to enforcement action by the Department for penalties or revocation of this permit. The notice shall include the following information:

    a. A description of the anticipated noncompliance;

    b. The period of the anticipated noncompliance, including dates and times; and

    c. Steps being taken to prevent future occurrence of the noncompliance.

    [62-620.610(17)]

18. Sampling and monitoring data shall be collected and analyzed in accordance with Rule 62-4.246 and Chapters 62-160, 62-601, and 62-610, F.A.C., and 40 CFR 136, as appropriate.

    a. Monitoring results shall be reported at the intervals specified elsewhere in this permit and shall be reported on a Discharge Monitoring Report (DMR), DEP Form 62-620.910(10), or as specified elsewhere in the permit.

    b. If the permittee monitors any contaminant more frequently than required by the permit, using Department approved test procedures, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR.

    c. Calculations for all limitations which require averaging of measurements shall use an arithmetic mean unless otherwise specified in this permit.

    d. Except as specifically provided in Rule 62-160.300, F.A.C., any laboratory test required by this permit shall be performed by a laboratory that has been certified by the Department of Health Environmental Laboratory Certification Program (DOH ELCP). Such certification shall be for the matrix, test method and analyte(s) being measured to comply with this permit. For domestic wastewater facilities, testing for parameters listed in Rule 62-160.300(4), F.A.C., shall be conducted under the direction of a certified operator.

e. Field activities including on-site tests and sample collection shall follow the applicable standard operating procedures described in DEP-SOP-001/01 adopted by reference in Chapter 62-160, F.A.C.

f. Alternate field procedures and laboratory methods may be used where they have been approved in accordance with Rules 62-160.220, and 62-160.330, F.A.C.

[62-620.610(18)]

19. Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule detailed elsewhere in this permit shall be submitted no later than 14 days following each schedule date. *[62-620.610(19)]*

20. The permittee shall report to the Department's Southwest District Office any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within five days of the time the permittee becomes aware of the circumstances. The written submission shall contain: a description of the noncompliance and its cause; the period of noncompliance including exact dates and time, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

a. The following shall be included as information which must be reported within 24 hours under this condition:
(1) Any unanticipated bypass which causes any reclaimed water or effluent to exceed any permit limitation or results in an unpermitted discharge,
(2) Any upset which causes any reclaimed water or the effluent to exceed any limitation in the permit,
(3) Violation of a maximum daily discharge limitation for any of the pollutants specifically listed in the permit for such notice, and
(4) Any unauthorized discharge to surface or ground waters.

b. Oral reports as required by this subsection shall be provided as follows:
(1) For unauthorized releases or spills of treated or untreated wastewater reported pursuant to subparagraph (a)4. that are in excess of 1,000 gallons per incident, or where information indicates that public health or the environment will be endangered, oral reports shall be provided to the STATE WATCH OFFICE TOLL FREE NUMBER (800) 320-0519, as soon as practical, but no later than 24 hours from the time the permittee becomes aware of the discharge. The permittee, to the extent known, shall provide the following information to the State Watch Office:
(a) Name, address, and telephone number of person reporting;
(b) Name, address, and telephone number of permittee or responsible person for the discharge;
(c) Date and time of the discharge and status of discharge (ongoing or ceased);
(d) Characteristics of the wastewater spilled or released (untreated or treated, industrial or domestic wastewater);
(e) Estimated amount of the discharge;
(f) Location or address of the discharge;
(g) Source and cause of the discharge;
(h) Whether the discharge was contained on-site, and cleanup actions taken to date;
(i) Description of area affected by the discharge, including name of water body affected, if any; and
(j) Other persons or agencies contacted.
(2) Oral reports, not otherwise required to be provided pursuant to subparagraph b.1 above, shall be provided to the Department's Southwest District Office within 24 hours from the time the permittee becomes aware of the circumstances.

c. If the oral report has been received within 24 hours, the noncompliance has been corrected, and the noncompliance did not endanger health or the environment, the Department's Southwest District Office shall waive the written report.

[62-620.610(20)]

21. The permittee shall report all instances of noncompliance not reported under Permit Conditions IX.17., IX.18., or IX.19. of this permit at the time monitoring reports are submitted. This report shall contain the same information required by Permit Condition IX.20. of this permit. *[62-620.610(21)]*

22. Bypass Provisions.

    a. "Bypass" means the intentional diversion of waste streams from any portion of a treatment works.

    b. Bypass is prohibited, and the Department may take enforcement action against a permittee for bypass, unless the permittee affirmatively demonstrates that:
       (1) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage; and
       (2) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and
       (3) The permittee submitted notices as required under Permit Condition IX.22.c. of this permit.

    c. If the permittee knows in advance of the need for a bypass, it shall submit prior notice to the Department, if possible at least 10 days before the date of the bypass. The permittee shall submit notice of an unanticipated bypass within 24 hours of learning about the bypass as required in Permit Condition IX.20. of this permit. A notice shall include a description of the bypass and its cause; the period of the bypass, including exact dates and times; if the bypass has not been corrected, the anticipated time it is expected to continue; and the steps taken or planned to reduce, eliminate, and prevent recurrence of the bypass.

    d. The Department shall approve an anticipated bypass, after considering its adverse effect, if the permittee demonstrates that it will meet the three conditions listed in Permit Condition IX.22.b.(1) through (3) of this permit.

    e. A permittee may allow any bypass to occur which does not cause reclaimed water or effluent limitations to be exceeded if it is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of Permit Condition IX.22.b. through d. of this permit.

    [62-620.610(22)]

23. Upset Provisions.

    a. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based effluent limitations because of factors beyond the reasonable control of the permittee.
       (1) An upset does not include noncompliance caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, careless or improper operation.
       (2) An upset constitutes an affirmative defense to an action brought for noncompliance with technology based permit effluent limitations if the requirements of upset provisions of Rule 62-620.610, F.A.C., are met.

    b. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed contemporaneous operating logs, or other relevant evidence that:
       (1) An upset occurred and that the permittee can identify the cause(s) of the upset;
       (2) The permitted facility was at the time being properly operated;
       (3) The permittee submitted notice of the upset as required in Permit Condition IX.20. of this permit; and
       (4) The permittee complied with any remedial measures required under Permit Condition IX.5. of this permit.

    c. In any enforcement proceeding, the burden of proof for establishing the occurrence of an upset rests with the permittee.

    d. Before an enforcement proceeding is instituted, no representation made during the Department review of a claim that noncompliance was caused by an upset is final agency action subject to judicial review.

    [62-620.610(23)]

Executed in Hillsborough County, Florida.

STATE OF FLORIDA DEPARTMENT OF
ENVIRONMENTAL PROTECTION

For Stephen G. Thompson

Kelley M. Boatwright
Program Administrator
Permitting & Waste Cleanup Program
Southwest District

DEPARTMENT OF ENVIRONMENTAL PROTECTION DISCHARGE MONITORING REPORT - PART A

When completed mail this report to: Department of Environmental Protection, Southwest District Office, Compliance Assurance Program, Attn: Domestic Wastewater, 13051 N. Telecom Parkway, Temple Terrace, FL 33637-0926, swd_dw@dep.state.fl.us

PERMITTEE NAME:	Manatee County Utilities Department	PERMIT NUMBER:	FLA012617-026-DW1P/NRL		
MAILING ADDRESS:	4410 66th Street West Bradenton, Florida 34210				
		LIMIT:	Final	REPORT FREQUENCY:	Monthly
		CLASS SIZE:	N/A	PROGRAM:	Domestic
FACILITY:	Manatee County North Regional WRF	MONITORING GROUP NUMBER:	R-001		
LOCATION:	8500 69th St E Palmetto, FL 34221-9064	MONITORING GROUP DESCRIPTION:	Manatee County Master Reuse System, including Influent		
		RE-SUBMITTED DMR:	☐		
		NO DISCHARGE FROM SITE:	☐		
COUNTY:	Manatee	MONITORING PERIOD From:	____________________	To:	____________________
OFFICE:	Southwest District				

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Flow, to R-001	Sample Measurement										
PARM Code 50050 Y Mon. Site No. FLW-06	Permit Requirement		7.5 (An.Avg.)	MGD						Monthly	Calculated
Flow, to R-001	Sample Measurement										
PARM Code 50050 1 Mon. Site No. FLW-06	Permit Requirement		Report (Mo.Avg.)	MGD						Monthly	Calculated
BOD, Carbonaceous 5 day, 20C	Sample Measurement										
PARM Code 80082 Y Mon. Site No. EFA-01	Permit Requirement					20.0 (An.Avg.)		mg/L		5 Days/Week	24-hr FPC
BOD, Carbonaceous 5 day, 20C	Sample Measurement										
PARM Code 80082 A Mon. Site No. EFA-01	Permit Requirement				60.0 (Max.)	45.0 (Max.Wk.Avg.)	30.0 (Mo.Avg.)	mg/L		5 Days/Week	24-hr FPC
Solids, Total Suspended	Sample Measurement										
PARM Code 00530 A Mon. Site No. EFA-01	Permit Requirement						5.0 (Max.)	mg/L		Daily; 24 hours	Grab
pH	Sample Measurement										
PARM Code 00400 B Mon. Site No. EFB-01	Permit Requirement				6.0 (Min.)		8.5 (Max.)	s.u.		Continuous	Meter

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

NAME/TITLE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	TELEPHONE NO	DATE (mm/dd/yyyy)

COMMENT AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here):

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: R-001

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ________________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Coliform, Fecal	Sample Measurement										
PARM Code 74055 A Mon. Site No. EFA-01	Permit Requirement						25 (Max.)	#/100mL		Daily; 24 hours	Grab
Coliform, Fecal, % less than detection	Sample Measurement										
PARM Code 51005 A Mon. Site No. EFA-01	Permit Requirement				75 (Min.Mo.Total)			percent		Monthly	Calculated
Chlorine, Total Residual (For Disinfection)	Sample Measurement										
PARM Code 50060 A Mon. Site No. EFA-01	Permit Requirement				1.0 (Min.)			mg/L		Continuous	Meter
Turbidity	Sample Measurement										
PARM Code 00070 B Mon. Site No. EFB-01	Permit Requirement						Report (Max.)	NTU		Continuous	Meter
Nitrogen, Total	Sample Measurement										
PARM Code 00600 A Mon. Site No. EFA-01	Permit Requirement						Report (Max.)	mg/L		Monthly	24-hr FPC
Phosphorus, Total (as P)	Sample Measurement										
PARM Code 00665 A Mon. Site No. EFA-01	Permit Requirement						Report (Max.)	mg/L		Monthly	24-hr FPC
Flow, Facility Total	Sample Measurement										
PARM Code 50050 P Mon. Site No. FLW-03	Permit Requirement	Report (Mo.Avg.)	7.5 (3Mo.Avg.)	MGD						Continuous	Flow Totalizer
Percent Capacity, (TMADF/Permitted Capacity) x 100	Sample Measurement										
PARM Code 00180 1 Mon. Site No. FLW-03	Permit Requirement						Report (Mo.Avg.)	percent		Monthly	Calculated
BOD, Carbonaceous 5 day, 20C (Influent)	Sample Measurement										
PARM Code 80082 G Mon. Site No. INF-01	Permit Requirement						Report (Mo.Avg.)	mg/L		Weekly	24-hr FPC
Solids, Total Suspended (Influent)	Sample Measurement										
PARM Code 00530 G Mon. Site No. INF-01	Permit Requirement						Report (Mo.Avg.)	mg/L		Weekly	24-hr FPC

INSTRUCTIONS FOR COMPLETING THE WASTEWATER DISCHARGE MONITORING REPORT

Read these instructions before completing the DMR. Hard copies and/or electronic copies of the required parts of the DMR were provided with the permit. All required information shall be completed in full and typed or printed in ink. A signed, original DMR shall be mailed to the address printed on the DMR by the 28th of the month following the monitoring period. Facilities who submit their DMR(s) electronically through eDMR do not need to submit a hardcopy DMR. The DMR shall not be submitted before the end of the monitoring period.

The DMR consists of three parts--A, B, and D--all of which may or may not be applicable to every facility. Facilities may have one or more Part A's for reporting effluent or reclaimed water data. All domestic wastewater facilities will have a Part B for reporting daily sample results. Part D is used for reporting ground water monitoring well data.

When results are not available, the following codes should be used on parts A and D of the DMR and an explanation provided where appropriate. Note: Codes used on Part B for raw data are different.

CODE	DESCRIPTION/INSTRUCTIONS
ANC	Analysis not conducted.
DRY	Dry Well
FLD	Flood disaster.
IFS	Insufficient flow for sampling.
LS	Lost sample.
MNR	Monitoring not required this period.

CODE	DESCRIPTION/INSTRUCTIONS
NOD	No discharge from/to site.
OPS	Operations were shut down so no sample could be taken.
OTH	Other. Please enter an explanation of why monitoring data were not available.
SEF	Sampling equipment failure.

When reporting analytical results that fall below a laboratory's reported method detection limits or practical quantification limits, the following instructions should be used, unless indicated otherwise in the permit or on the DMR:

1. Results greater than or equal to the PQL shall be reported as the measured quantity.
2. Results less than the PQL and greater than or equal to the MDL shall be reported as the laboratory's MDL value. These values shall be deemed equal to the MDL when necessary to calculate an average for that parameter and when determining compliance with permit limits.
3. Results less than the MDL shall be reported by entering a less than sign ("<") followed by the laboratory's MDL value, e.g. < 0.001. A value of one-half the MDL or one-half the effluent limit, whichever is lower, shall be used for that sample when necessary to calculate an average for that parameter. Values less than the MDL are considered to demonstrate compliance with an effluent limitation.

PART A -DISCHARGE MONITORING REPORT (DMR)

Part A of the DMR is comprised of one or more sections, each having its own header information. Facility information is preprinted in the header as well as the monitoring group number, whether the limits and monitoring requirements are interim or final, and the required submittal frequency (e.g. monthly, annually, quarterly, etc.). Submit Part A based on the required reporting frequency in the header and the instructions shown in the permit. The following should be completed by the permittee or authorized representative:

Resubmitted DMR: Check this box if this DMR is being re-submitted because there was information missing from or information that needed correction on a previously submitted DMR. The information that is being revised should be clearly noted on the re-submitted DMR (e.g. highlight, circle, etc.)
No Discharge From Site: Check this box if no discharge occurs and, as a result, there are no data or codes to be entered for all of the parameters on the DMR for the entire monitoring group number; however, if the monitoring group includes other monitoring locations (e.g., influent sampling), the "NOD" code should be used to individually denote those parameters for which there was no discharge.
Monitoring Period: Enter the month, day, and year for the first and last day of the monitoring period (i.e. the month, the quarter, the year, etc.) during which the data on this report were collected and analyzed.
Sample Measurement: Before filling in sample measurements in the table, check to see that the data collected correspond to the limit indicated on the DMR (i.e. interim or final) and that the data correspond to the monitoring group number in the header. Enter the data or calculated results for each parameter on this row in the non-shaded area above the limit. Be sure the result being entered corresponds to the appropriate statistical base code (e.g. annual average, monthly average, single sample maximum, etc.) and units. Data qualifier codes are not to be reported on Part A.
No. Ex.: Enter the number of sample measurements during the monitoring period that exceeded the permit limit for each parameter in the non-shaded area. If none, enter zero.
Frequency of Analysis: The shaded areas in this column contain the minimum number of times the measurement is required to be made according to the permit. Enter the actual number of times the measurement was made in the space above the shaded area.
Sample Type: The shaded areas in this column contain the type of sample (e.g. grab, composite, continuous) required by the permit. Enter the actual sample type that was taken in the space above the shaded area.
Signature: This report must be signed in accordance with Rule 62-620.305, F.A.C. Type or print the name and title of the signing official. Include the telephone number where the official may be reached in the event there are questions concerning this report. Enter the date when the report is signed.
Comment and Explanation of Any Violations: Use this area to explain any exceedances, any upset or by-pass events, or other items which require explanation. If more space is needed, reference all attachments in this area.

PART B - DAILY SAMPLE RESULTS

Monitoring Period: Enter the month, day, and year for the first and last day of the monitoring period (i.e. the month, the quarter, the year, etc.) during which the data on this report were collected and analyzed.
Daily Monitoring Results: Transfer all analytical data from your facility's laboratory or a contract laboratory's data sheets for all day(s) that samples were collected. Record the data in the units indicated. Table 1 in Chapter 62-160, F.A.C., contains a complete list of all the data qualifier codes that your laboratory may use when reporting analytical results. However, when transferring numerical results onto Part B of the DMR, only the following data qualifier codes should be used and an explanation provided where appropriate.

CODE	DESCRIPTION/INSTRUCTIONS
<	The compound was analyzed for but not detected.
A	Value reported is the mean (average) of two or more determinations.
J	Estimated value, value not accurate.
Q	Sample held beyond the actual holding time.
Y	Laboratory analysis was from an unpreserved or improperly preserved sample.

To calculate the monthly average, add each reported value to get a total. For flow, divide this total by the number of days in the month. For all other parameters, divide the total by the number of observations.
Plant Staffing: List the name, certificate number, and class of all state certified operators operating the facility during the monitoring period. Use additional sheets as necessary.

PART D - GROUND WATER MONITORING REPORT

Monitoring Period: Enter the month, day, and year for the first and last day of the monitoring period (i.e. the month, the quarter, the year, etc.) during which the data on this report were collected and analyzed.
Date Sample Obtained: Enter the date the sample was taken. Also, check whether or not the well was purged before sampling.
Time Sample Obtained: Enter the time the sample was taken.
Sample Measurement: Record the results of the analysis. If the result was below the minimum detection limit, indicate that. Data qualifier codes are not to be reported on Part D.
Detection Limits: Record the detection limits of the analytical methods used.
Analysis Method: Indicate the analytical method used. Record the method number from Chapter 62-160 or Chapter 62-601, F.A.C., or from other sources.
Sampling Equipment Used: Indicate the procedure used to collect the sample (e.g. airlift, bucket/bailer, centrifugal pump, etc.)
Samples Filtered: Indicate whether the sample obtained was filtered by laboratory (L), filtered in field (F), or unfiltered (N).
Signature: This report must be signed in accordance with Rule 62-620.305, F.A.C. Type or print the name and title of the signing official. Include the telephone number where the official may be reached in the event there are questions concerning this report. Enter the date when the report is signed.
Comments and Explanation: Use this space to make any comments on or explanations of results that are unexpected. If more space is needed, reference all attachments in this area.

SPECIAL INSTRUCTIONS FOR LIMITED WET WEATHER DISCHARGES

Flow (Limited Wet Weather Discharge): Enter the measured average flow rate during the period of discharge or divide gallons discharged by duration of discharge (converted into days). Record in million gallons per day (MGD).
Flow (Upstream): Enter the average flow rate in the receiving stream upstream from the point of discharge for the period of discharge. The average flow rate can be calculated based on two measurements; one made at the start and one made at the end of the discharge period. Measurements are to be made at the upstream gauging station described in the permit.
Actual Stream Dilution Ratio: To calculate the Actual Stream Dilution Ratio, divide the average upstream flow rate by the average discharge flow rate. Enter the Actual Stream Dilution Ratio accurate to the nearest 0.1.
No. of Days the SDF > Stream Dilution Ratio: For each day of discharge, compare the minimum Stream Dilution Factor (SDF) from the permit to the calculated Stream Dilution Ratio. On Part B of the DMR, enter an asterisk (*) if the SDF is greater than the Stream Dilution Ratio on any day of discharge. On Part A of the DMR, add up the days with an "*" and record the total number of days the Stream Dilution Factor was greater than the Stream Dilution Ratio.
$CBOD_5$: Enter the average $CBOD_5$ of the reclaimed water discharged during the period shown in duration of discharge.
TKN: Enter the average TKN of the reclaimed water discharged during the period shown in duration of discharge.
Actual Rainfall: Enter the actual rainfall for each day on Part B. Enter the actual cumulative rainfall to date for this calendar year and the actual total monthly rainfall on Part A. The cumulative rainfall to date for this calendar year is the total amount of rain, in inches, that has been recorded since January 1 of the current year through the month for which this DMR contains data.
Rainfall During Average Rainfall Year: On Part A, enter the total monthly rainfall during the average rainfall year and the cumulative rainfall for the average rainfall year. The cumulative rainfall for the average rainfall year is the amount of rain, in inches, which fell during the average rainfall year from January through the month for which this DMR contains data.
No. of Days LWWD Activated During Calendar Year: Enter the cumulative number of days that the limited wet weather discharge was activated since January 1 of the current year.
Reason for Discharge: Attach to the DMR a brief explanation of the factors contributing to the need to activate the limited wet weather discharge.

DEPARTMENT OF ENVIRONMENTAL PROTECTION DISCHARGE MONITORING REPORT - PART A

When completed mail this report to: Department of Environmental Protection, Southwest District Office, Compliance Assurance Program, Attn: Domestic Wastewater, 13051 N. Telecom Parkway, Temple Terrace, FL 33637-0926, swd_dw@dep.state.fl.us

PERMITTEE NAME:	Manatee County Utilities Department	PERMIT NUMBER:	FLA012617-026-DW1P/NRL		
MAILING ADDRESS:	4410 66th Street West Bradenton, Florida 34210	LIMIT:	Final	REPORT FREQUENCY:	Monthly
		CLASS SIZE:	N/A	PROGRAM:	Domestic
FACILITY:	Manatee County North Regional WRF	MONITORING GROUP NUMBER:	R-002		
LOCATION:	8500 69th St E Palmetto, FL 34221-9064	MONITORING GROUP DESCRIPTION:	Unlined Reject Pond		
		RE-SUBMITTED DMR:	☐		
		NO DISCHARGE FROM SITE:	☐		
COUNTY:	Manatee	MONITORING PERIOD From:	____________	To:	____________
OFFICE:	Southwest District				

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Flow, to R-002	Sample Measurement										
PARM Code 50050 Y Mon. Site No. FLW-09	Permit Requirement		Report (An.Avg.)	MGD						Monthly	Calculated
Flow, to R-002	Sample Measurement										
PARM Code 50050 1 Mon. Site No. FLW-09	Permit Requirement		Report (Mo.Avg.)	MGD						Monthly	Calculated
BOD, Carbonaceous 5 day, 20C	Sample Measurement										
PARM Code 80082 Y Mon. Site No. EFA-01	Permit Requirement					20.0 (An.Avg.)		mg/L		5 Days/Week	24-hr FPC
BOD, Carbonaceous 5 day, 20C	Sample Measurement										
PARM Code 80082 A Mon. Site No. EFA-01	Permit Requirement				60.0 (Max.)	45.0 (Max.Wk.Avg.)	30.0 (Mo.Avg.)	mg/L		5 Days/Week	24-hr FPC
Solids, Total Suspended	Sample Measurement										
PARM Code 00530 Y Mon. Site No. EFB-01	Permit Requirement					20.0 (An.Avg.)		mg/L		5 Days/Week	24-hr FPC
Solids, Total Suspended	Sample Measurement										
PARM Code 00530 A Mon. Site No. EFB-01	Permit Requirement				60.0 (Max.)	45.0 (Max.Wk.Avg.)	30.0 (Mo.Avg.)	mg/L		5 Days/Week	24-hr FPC

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

NAME/TITLE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	TELEPHONE NO	DATE (mm/dd/yyyy)

COMMENT AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here):

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: R-002

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: _______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
pH	Sample Measurement										
PARM Code 00400 A Mon. Site No. EFA-01	Permit Requirement				6.0 (Min.)		8.5 (Max.)	s.u.		Continuous	Meter
Coliform, Fecal	Sample Measurement										
PARM Code 74055 Y Mon. Site No. EFA-01	Permit Requirement					200 (An.Avg.)		#/100mL		5 Days/Week	Grab
Coliform, Fecal	Sample Measurement										
PARM Code 74055 A Mon. Site No. EFA-01	Permit Requirement						800 (Max.)	#/100mL		5 Days/Week	Grab
Chlorine, Total Residual (For Disinfection)	Sample Measurement										
PARM Code 50060 A Mon. Site No. EFA-01	Permit Requirement				0.5 (Min.)			mg/L		Continuous	Meter
Nitrogen, Nitrate, Total (as N)	Sample Measurement										
PARM Code 00620 A Mon. Site No. EFA-01	Permit Requirement						12.0 (Max.)	mg/L		5 Days/Week	24-hr FPC

INSTRUCTIONS FOR COMPLETING THE WASTEWATER DISCHARGE MONITORING REPORT

Read these instructions before completing the DMR. Hard copies and/or electronic copies of the required parts of the DMR were provided with the permit. All required information shall be completed in full and typed or printed in ink. A signed, original DMR shall be mailed to the address printed on the DMR by the 28th of the month following the monitoring period. Facilities who submit their DMR(s) electronically through eDMR do not need to submit a hardcopy DMR. The DMR shall not be submitted before the end of the monitoring period.

The DMR consists of three parts--A, B, and D--all of which may or may not be applicable to every facility. Facilities may have one or more Part A's for reporting effluent or reclaimed water data. All domestic wastewater facilities will have a Part B for reporting daily sample results. Part D is used for reporting ground water monitoring well data.

When results are not available, the following codes should be used on parts A and D of the DMR and an explanation provided where appropriate. Note: Codes used on Part B for raw data are different.

CODE	DESCRIPTION/INSTRUCTIONS
ANC	Analysis not conducted.
DRY	Dry Well
FLD	Flood disaster.
IFS	Insufficient flow for sampling.
LS	Lost sample.
MNR	Monitoring not required this period.

CODE	DESCRIPTION/INSTRUCTIONS
NOD	No discharge from/to site.
OPS	Operations were shut down so no sample could be taken.
OTH	Other. Please enter an explanation of why monitoring data were not available.
SEF	Sampling equipment failure.

When reporting analytical results that fall below a laboratory's reported method detection limits or practical quantification limits, the following instructions should be used, unless indicated otherwise in the permit or on the DMR:

1. Results greater than or equal to the PQL shall be reported as the measured quantity.
2. Results less than the PQL and greater than or equal to the MDL shall be reported as the laboratory's MDL value. These values shall be deemed equal to the MDL when necessary to calculate an average for that parameter and when determining compliance with permit limits.
3. Results less than the MDL shall be reported by entering a less than sign ("<") followed by the laboratory's MDL value, e.g. < 0.001. A value of one-half the MDL or one-half the effluent limit, whichever is lower, shall be used for that sample when necessary to calculate an average for that parameter. Values less than the MDL are considered to demonstrate compliance with an effluent limitation.

PART A -DISCHARGE MONITORING REPORT (DMR)

Part A of the DMR is comprised of one or more sections, each having its own header information. Facility information is preprinted in the header as well as the monitoring group number, whether the limits and monitoring requirements are interim or final, and the required submittal frequency (e.g. monthly, annually, quarterly, etc.). Submit Part A based on the required reporting frequency in the header and the instructions shown in the permit. The following should be completed by the permittee or authorized representative:

Resubmitted DMR: Check this box if this DMR is being re-submitted because there was information missing from or information that needed correction on a previously submitted DMR. The information that is being revised should be clearly noted on the re-submitted DMR (e.g. highlight, circle, etc.)
No Discharge From Site: Check this box if no discharge occurs and, as a result, there are no data or codes to be entered for all of the parameters on the DMR for the entire monitoring group number; however, if the monitoring group includes other monitoring locations (e.g., influent sampling), the "NOD" code should be used to individually denote those parameters for which there was no discharge.
Monitoring Period: Enter the month, day, and year for the first and last day of the monitoring period (i.e. the month, the quarter, the year, etc.) during which the data on this report were collected and analyzed.
Sample Measurement: Before filling in sample measurements in the table, check to see that the data collected correspond to the limit indicated on the DMR (i.e. interim or final) and that the data correspond to the monitoring group number in the header. Enter the data or calculated results for each parameter on this row in the non-shaded area above the limit. Be sure the result being entered corresponds to the appropriate statistical base code (e.g. annual average, monthly average, single sample maximum, etc.) and units. Data qualifier codes are not to be reported on Part A.
No. Ex.: Enter the number of sample measurements during the monitoring period that exceeded the permit limit for each parameter in the non-shaded area. If none, enter zero.
Frequency of Analysis: The shaded areas in this column contain the minimum number of times the measurement is required to be made according to the permit. Enter the actual number of times the measurement was made in the space above the shaded area.
Sample Type: The shaded areas in this column contain the type of sample (e.g. grab, composite, continuous) required by the permit. Enter the actual sample type that was taken in the space above the shaded area.
Signature: This report must be signed in accordance with Rule 62-620.305, F.A.C. Type or print the name and title of the signing official. Include the telephone number where the official may be reached in the event there are questions concerning this report. Enter the date when the report is signed.
Comment and Explanation of Any Violations: Use this area to explain any exceedances, any upset or by-pass events, or other items which require explanation. If more space is needed, reference all attachments in this area.

PART B - DAILY SAMPLE RESULTS

Monitoring Period: Enter the month, day, and year for the first and last day of the monitoring period (i.e. the month, the quarter, the year, etc.) during which the data on this report were collected and analyzed.
Daily Monitoring Results: Transfer all analytical data from your facility's laboratory or a contract laboratory's data sheets for all day(s) that samples were collected. Record the data in the units indicated. Table 1 in Chapter 62-160, F.A.C., contains a complete list of all the data qualifier codes that your laboratory may use when reporting analytical results. However, when transferring numerical results onto Part B of the DMR, only the following data qualifier codes should be used and an explanation provided where appropriate.

CODE	DESCRIPTION/INSTRUCTIONS
<	The compound was analyzed for but not detected.
A	Value reported is the mean (average) of two or more determinations.
J	Estimated value, value not accurate.
Q	Sample held beyond the actual holding time.
Y	Laboratory analysis was from an unpreserved or improperly preserved sample.

To calculate the monthly average, add each reported value to get a total. For flow, divide this total by the number of days in the month. For all other parameters, divide the total by the number of observations.
Plant Staffing: List the name, certificate number, and class of all state certified operators operating the facility during the monitoring period. Use additional sheets as necessary.

PART D - GROUND WATER MONITORING REPORT

Monitoring Period: Enter the month, day, and year for the first and last day of the monitoring period (i.e. the month, the quarter, the year, etc.) during which the data on this report were collected and analyzed.
Date Sample Obtained: Enter the date the sample was taken. Also, check whether or not the well was purged before sampling.
Time Sample Obtained: Enter the time the sample was taken.
Sample Measurement: Record the results of the analysis. If the result was below the minimum detection limit, indicate that. Data qualifier codes are not to be reported on Part D.
Detection Limits: Record the detection limits of the analytical methods used.
Analysis Method: Indicate the analytical method used. Record the method number from Chapter 62-160 or Chapter 62-601, F.A.C., or from other sources.
Sampling Equipment Used: Indicate the procedure used to collect the sample (e.g. airlift, bucket/bailer, centrifugal pump, etc.)
Samples Filtered: Indicate whether the sample obtained was filtered by laboratory (L), filtered in field (F), or unfiltered (N).
Signature: This report must be signed in accordance with Rule 62-620.305, F.A.C. Type or print the name and title of the signing official. Include the telephone number where the official may be reached in the event there are questions concerning this report. Enter the date when the report is signed.
Comments and Explanation: Use this space to make any comments on or explanations of results that are unexpected. If more space is needed, reference all attachments in this area.

SPECIAL INSTRUCTIONS FOR LIMITED WET WEATHER DISCHARGES

Flow (Limited Wet Weather Discharge): Enter the measured average flow rate during the period of discharge or divide gallons discharged by duration of discharge (converted into days). Record in million gallons per day (MGD).
Flow (Upstream): Enter the average flow rate in the receiving stream upstream from the point of discharge for the period of discharge. The average flow rate can be calculated based on two measurements; one made at the start and one made at the end of the discharge period. Measurements are to be made at the upstream gauging station described in the permit.
Actual Stream Dilution Ratio: To calculate the Actual Stream Dilution Ratio, divide the average upstream flow rate by the average discharge flow rate. Enter the Actual Stream Dilution Ratio accurate to the nearest 0.1.
No. of Days the SDF > Stream Dilution Ratio: For each day of discharge, compare the minimum Stream Dilution Factor (SDF) from the permit to the calculated Stream Dilution Ratio. On Part B of the DMR, enter an asterisk (*) if the SDF is greater than the Stream Dilution Ratio on any day of discharge. On Part A of the DMR, add up the days with an "*" and record the total number of days the Stream Dilution Factor was greater than the Stream Dilution Ratio.
$CBOD_5$: Enter the average $CBOD_5$ of the reclaimed water discharged during the period shown in duration of discharge.
TKN: Enter the average TKN of the reclaimed water discharged during the period shown in duration of discharge.
Actual Rainfall: Enter the actual rainfall for each day on Part B. Enter the actual cumulative rainfall to date for this calendar year and the actual total monthly rainfall on Part A. The cumulative rainfall to date for this calendar year is the total amount of rain, in inches, that has been recorded since January 1 of the current year through the month for which this DMR contains data.
Rainfall During Average Rainfall Year: On Part A, enter the total monthly rainfall during the average rainfall year and the cumulative rainfall for the average rainfall year. The cumulative rainfall for the average rainfall year is the amount of rain, in inches, which fell during the average rainfall year from January through the month for which this DMR contains data.
No. of Days LWWD Activated During Calendar Year: Enter the cumulative number of days that the limited wet weather discharge was activated since January 1 of the current year.
Reason for Discharge: Attach to the DMR a brief explanation of the factors contributing to the need to activate the limited wet weather discharge.

DEPARTMENT OF ENVIRONMENTAL PROTECTION DISCHARGE MONITORING REPORT - PART A

When completed mail this report to: Department of Environmental Protection, Southwest District Office, Compliance Assurance Program, Attn: Domestic Wastewater, 13051 N. Telecom Parkway, Temple Terrace, FL 33637-0926, swd_dw@dep.state.fl.us

PERMITTEE NAME: Manatee County Utilities Department
MAILING ADDRESS: 4410 66th Street West
Bradenton, Florida 34210

FACILITY: Manatee County North Regional WRF
LOCATION: 8500 69th St E
Palmetto, FL 34221-9064

COUNTY: Manatee
OFFICE: Southwest District

PERMIT NUMBER: FLA012617-026-DW1P/NRL

LIMIT: Final
CLASS SIZE: N/A
MONITORING GROUP NUMBER: RMP-Q
MONITORING GROUP DESCRIPTION: Biosolids Quantity
RE-SUBMITTED DMR: ☐
NO DISCHARGE FROM SITE: ☐
MONITORING PERIOD From: ____________________ To: ____________________

REPORT FREQUENCY: Monthly
PROGRAM: Domestic

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Biosolids Quantity (Transferred)	Sample Measurement										
PARM Code B0007 + Mon. Site No. RMP-01	Permit Requirement		Report (Mo.Total)	dry tons						Monthly	Calculated
Biosolids Quantity (Landfilled)	Sample Measurement										
PARM Code B0008 + Mon. Site No. RMP-02	Permit Requirement		Report (Mo.Total)	dry tons						Monthly	Calculated

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

NAME/TITLE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	TELEPHONE NO	DATE (mm/dd/yyyy)

COMMENT AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here):

INSTRUCTIONS FOR COMPLETING THE WASTEWATER DISCHARGE MONITORING REPORT

Read these instructions before completing the DMR. Hard copies and/or electronic copies of the required parts of the DMR were provided with the permit. All required information shall be completed in full and typed or printed in ink. A signed, original DMR shall be mailed to the address printed on the DMR by the 28th of the month following the monitoring period. Facilities who submit their DMR(s) electronically through eDMR do not need to submit a hardcopy DMR. The DMR shall not be submitted before the end of the monitoring period.

The DMR consists of three parts--A, B, and D--all of which may or may not be applicable to every facility. Facilities may have one or more Part A's for reporting effluent or reclaimed water data. All domestic wastewater facilities will have a Part B for reporting daily sample results. Part D is used for reporting ground water monitoring well data.

When results are not available, the following codes should be used on parts A and D of the DMR and an explanation provided where appropriate. Note: Codes used on Part B for raw data are different.

CODE	DESCRIPTION/INSTRUCTIONS
ANC	Analysis not conducted.
DRY	Dry Well
FLD	Flood disaster.
IFS	Insufficient flow for sampling.
LS	Lost sample.
MNR	Monitoring not required this period.

CODE	DESCRIPTION/INSTRUCTIONS
NOD	No discharge from/to site.
OPS	Operations were shut down so no sample could be taken.
OTH	Other. Please enter an explanation of why monitoring data were not available.
SEF	Sampling equipment failure.

When reporting analytical results that fall below a laboratory's reported method detection limits or practical quantification limits, the following instructions should be used, unless indicated otherwise in the permit or on the DMR:

1. Results greater than or equal to the PQL shall be reported as the measured quantity.
2. Results less than the PQL and greater than or equal to the MDL shall be reported as the laboratory's MDL value. These values shall be deemed equal to the MDL when necessary to calculate an average for that parameter and when determining compliance with permit limits.
3. Results less than the MDL shall be reported by entering a less than sign ("<") followed by the laboratory's MDL value, e.g. < 0.001. A value of one-half the MDL or one-half the effluent limit, whichever is lower, shall be used for that sample when necessary to calculate an average for that parameter. Values less than the MDL are considered to demonstrate compliance with an effluent limitation.

PART A -DISCHARGE MONITORING REPORT (DMR)

Part A of the DMR is comprised of one or more sections, each having its own header information. Facility information is preprinted in the header as well as the monitoring group number, whether the limits and monitoring requirements are interim or final, and the required submittal frequency (e.g. monthly, annually, quarterly, etc.). Submit Part A based on the required reporting frequency in the header and the instructions shown in the permit. The following should be completed by the permittee or authorized representative:

Resubmitted DMR: Check this box if this DMR is being re-submitted because there was information missing from or information that needed correction on a previously submitted DMR. The information that is being revised should be clearly noted on the re-submitted DMR (e.g. highlight, circle, etc.)
No Discharge From Site: Check this box if no discharge occurs and, as a result, there are no data or codes to be entered for all of the parameters on the DMR for the entire monitoring group number; however, if the monitoring group includes other monitoring locations (e.g., influent sampling), the "NOD" code should be used to individually denote those parameters for which there was no discharge.
Monitoring Period: Enter the month, day, and year for the first and last day of the monitoring period (i.e. the month, the quarter, the year, etc.) during which the data on this report were collected and analyzed.
Sample Measurement: Before filling in sample measurements in the table, check to see that the data collected correspond to the limit indicated on the DMR (i.e. interim or final) and that the data correspond to the monitoring group number in the header. Enter the data or calculated results for each parameter on this row in the non-shaded area above the limit. Be sure the result being entered corresponds to the appropriate statistical base code (e.g. annual average, monthly average, single sample maximum, etc.) and units. Data qualifier codes are not to be reported on Part A.
No. Ex.: Enter the number of sample measurements during the monitoring period that exceeded the permit limit for each parameter in the non-shaded area. If none, enter zero.
Frequency of Analysis: The shaded areas in this column contain the minimum number of times the measurement is required to be made according to the permit. Enter the actual number of times the measurement was made in the space above the shaded area.
Sample Type: The shaded areas in this column contain the type of sample (e.g. grab, composite, continuous) required by the permit. Enter the actual sample type that was taken in the space above the shaded area.
Signature: This report must be signed in accordance with Rule 62-620.305, F.A.C. Type or print the name and title of the signing official. Include the telephone number where the official may be reached in the event there are questions concerning this report. Enter the date when the report is signed.
Comment and Explanation of Any Violations: Use this area to explain any exceedances, any upset or by-pass events, or other items which require explanation. If more space is needed, reference all attachments in this area.

PART B - DAILY SAMPLE RESULTS

Monitoring Period: Enter the month, day, and year for the first and last day of the monitoring period (i.e. the month, the quarter, the year, etc.) during which the data on this report were collected and analyzed.
Daily Monitoring Results: Transfer all analytical data from your facility's laboratory or a contract laboratory's data sheets for all day(s) that samples were collected. Record the data in the units indicated. Table 1 in Chapter 62-160, F.A.C., contains a complete list of all the data qualifier codes that your laboratory may use when reporting analytical results. However, when transferring numerical results onto Part B of the DMR, only the following data qualifier codes should be used and an explanation provided where appropriate.

CODE	DESCRIPTION/INSTRUCTIONS
<	The compound was analyzed for but not detected.
A	Value reported is the mean (average) of two or more determinations.
J	Estimated value, value not accurate.
Q	Sample held beyond the actual holding time.
Y	Laboratory analysis was from an unpreserved or improperly preserved sample.

To calculate the monthly average, add each reported value to get a total. For flow, divide this total by the number of days in the month. For all other parameters, divide the total by the number of observations.
Plant Staffing: List the name, certificate number, and class of all state certified operators operating the facility during the monitoring period. Use additional sheets as necessary.

PART D - GROUND WATER MONITORING REPORT

Monitoring Period: Enter the month, day, and year for the first and last day of the monitoring period (i.e. the month, the quarter, the year, etc.) during which the data on this report were collected and analyzed.
Date Sample Obtained: Enter the date the sample was taken. Also, check whether or not the well was purged before sampling.
Time Sample Obtained: Enter the time the sample was taken.
Sample Measurement: Record the results of the analysis. If the result was below the minimum detection limit, indicate that. Data qualifier codes are not to be reported on Part D.
Detection Limits: Record the detection limits of the analytical methods used.
Analysis Method: Indicate the analytical method used. Record the method number from Chapter 62-160 or Chapter 62-601, F.A.C., or from other sources.
Sampling Equipment Used: Indicate the procedure used to collect the sample (e.g. airlift, bucket/bailer, centrifugal pump, etc.)
Samples Filtered: Indicate whether the sample obtained was filtered by laboratory (L), filtered in field (F), or unfiltered (N).
Signature: This report must be signed in accordance with Rule 62-620.305, F.A.C. Type or print the name and title of the signing official. Include the telephone number where the official may be reached in the event there are questions concerning this report. Enter the date when the report is signed.
Comments and Explanation: Use this space to make any comments on or explanations of results that are unexpected. If more space is needed, reference all attachments in this area.

SPECIAL INSTRUCTIONS FOR LIMITED WET WEATHER DISCHARGES

Flow (Limited Wet Weather Discharge): Enter the measured average flow rate during the period of discharge or divide gallons discharged by duration of discharge (converted into days). Record in million gallons per day (MGD).
Flow (Upstream): Enter the average flow rate in the receiving stream upstream from the point of discharge for the period of discharge. The average flow rate can be calculated based on two measurements; one made at the start and one made at the end of the discharge period. Measurements are to be made at the upstream gauging station described in the permit.
Actual Stream Dilution Ratio: To calculate the Actual Stream Dilution Ratio, divide the average upstream flow rate by the average discharge flow rate. Enter the Actual Stream Dilution Ratio accurate to the nearest 0.1.
No. of Days the SDF > Stream Dilution Ratio: For each day of discharge, compare the minimum Stream Dilution Factor (SDF) from the permit to the calculated Stream Dilution Ratio. On Part B of the DMR, enter an asterisk (*) if the SDF is greater than the Stream Dilution Ratio on any day of discharge. On Part A of the DMR, add up the days with an "*" and record the total number of days the Stream Dilution Factor was greater than the Stream Dilution Ratio.
$CBOD_5$: Enter the average $CBOD_5$ of the reclaimed water discharged during the period shown in duration of discharge.
TKN: Enter the average TKN of the reclaimed water discharged during the period shown in duration of discharge.
Actual Rainfall: Enter the actual rainfall for each day on Part B. Enter the actual cumulative rainfall to date for this calendar year and the actual total monthly rainfall on Part A. The cumulative rainfall to date for this calendar year is the total amount of rain, in inches, that has been recorded since January 1 of the current year through the month for which this DMR contains data.
Rainfall During Average Rainfall Year: On Part A, enter the total monthly rainfall during the average rainfall year and the cumulative rainfall for the average rainfall year. The cumulative rainfall for the average rainfall year is the amount of rain, in inches, which fell during the average rainfall year from January through the month for which this DMR contains data.
No. of Days LWWD Activated During Calendar Year: Enter the cumulative number of days that the limited wet weather discharge was activated since January 1 of the current year.
Reason for Discharge: Attach to the DMR a brief explanation of the factors contributing to the need to activate the limited wet weather discharge.

DAILY SAMPLE RESULTS - PART B

Permit Number: FLA012617-026-DW1P/NRL Facility: Manatee County North Regional WRF
Monitoring Period From: ____________________ To: ____________________

	BOD, Carbonaceous 5 day, 20C mg/L	Chlorine, Total Residual (For Disinfection) mg/L	Coliform, Fecal #/100mL	Nitrogen, Nitrate, Total (as N) mg/L	Nitrogen, Total mg/L	Phosphorus, Total (as P) mg/L	Solids, Total Suspended mg/L	pH Min. s.u.	pH Max. s.u.	Turbidity NTU	Flow MGD
Code	80082	50060	74055	00620	00600	00665	00530	00400	00400	00070	50050
Mon. Site	EFA-01	EFA-01	EFA-01	EFA-01	EFA-01	EFA-01	EFA-01	EFA-01	EFA-01	EFB-01	FLW-03
1											
2											
3											
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28											
29											
30											
31											
Total											
Mo. Avg.											

PLANT STAFFING:

Day Shift Operator Class: ________ Certificate No: ______________ Name: ______________________________

Evening Shift Operator Class: ________ Certificate No: ______________ Name: ______________________________

Night Shift Operator Class: ________ Certificate No: ______________ Name: ______________________________

Lead Operator Class: ________ Certificate No: ______________ Name: ______________________________

DAILY SAMPLE RESULTS - PART B

Permit Number: FLA012617-026-DW1P/NRL Facility: Manatee County North Regional WRF
Monitoring Period From: ____________________ To: ____________________

	BOD, Carbonaceous 5 day, 20C (Influent) mg/L	Solids, Total Suspended (Influent) mg/L	pH Min. s.u.	pH Max. s.u.							
Code	80082	00530	00400	00400							
Mon. Site	INF-01	INF-01	EFB-01	EFB-01							
1											
2											
3											
4											
5											
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30											
31											
Total											
Mo. Avg.											

PLANT STAFFING:

Day Shift Operator Class: ________ Certificate No: ______________ Name: ______________________________

Evening Shift Operator Class: ________ Certificate No: ______________ Name: ______________________________

Night Shift Operator Class: ________ Certificate No: ______________ Name: ______________________________

Lead Operator Class: ________ Certificate No: ______________ Name: ______________________________

INSTRUCTIONS FOR COMPLETING THE WASTEWATER DISCHARGE MONITORING REPORT

Read these instructions before completing the DMR. Hard copies and/or electronic copies of the required parts of the DMR were provided with the permit. All required information shall be completed in full and typed or printed in ink. A signed, original DMR shall be mailed to the address printed on the DMR by the 28th of the month following the monitoring period. Facilities who submit their DMR(s) electronically through eDMR do not need to submit a hardcopy DMR. The DMR shall not be submitted before the end of the monitoring period.

The DMR consists of three parts--A, B, and D--all of which may or may not be applicable to every facility. Facilities may have one or more Part A's for reporting effluent or reclaimed water data. All domestic wastewater facilities will have a Part B for reporting daily sample results. Part D is used for reporting ground water monitoring well data.

When results are not available, the following codes should be used on parts A and D of the DMR and an explanation provided where appropriate. Note: Codes used on Part B for raw data are different.

CODE	DESCRIPTION/INSTRUCTIONS
ANC	Analysis not conducted.
DRY	Dry Well
FLD	Flood disaster.
IFS	Insufficient flow for sampling.
LS	Lost sample.
MNR	Monitoring not required this period.

CODE	DESCRIPTION/INSTRUCTIONS
NOD	No discharge from/to site.
OPS	Operations were shut down so no sample could be taken.
OTH	Other. Please enter an explanation of why monitoring data were not available.
SEF	Sampling equipment failure.

When reporting analytical results that fall below a laboratory's reported method detection limits or practical quantification limits, the following instructions should be used, unless indicated otherwise in the permit or on the DMR:

1. Results greater than or equal to the PQL shall be reported as the measured quantity.
2. Results less than the PQL and greater than or equal to the MDL shall be reported as the laboratory's MDL value. These values shall be deemed equal to the MDL when necessary to calculate an average for that parameter and when determining compliance with permit limits.
3. Results less than the MDL shall be reported by entering a less than sign ("<") followed by the laboratory's MDL value, e.g. < 0.001. A value of one-half the MDL or one-half the effluent limit, whichever is lower, shall be used for that sample when necessary to calculate an average for that parameter. Values less than the MDL are considered to demonstrate compliance with an effluent limitation.

PART A -DISCHARGE MONITORING REPORT (DMR)

Part A of the DMR is comprised of one or more sections, each having its own header information. Facility information is preprinted in the header as well as the monitoring group number, whether the limits and monitoring requirements are interim or final, and the required submittal frequency (e.g. monthly, annually, quarterly, etc.). Submit Part A based on the required reporting frequency in the header and the instructions shown in the permit. The following should be completed by the permittee or authorized representative:

Resubmitted DMR: Check this box if this DMR is being re-submitted because there was information missing from or information that needed correction on a previously submitted DMR. The information that is being revised should be clearly noted on the re-submitted DMR (e.g. highlight, circle, etc.)
No Discharge From Site: Check this box if no discharge occurs and, as a result, there are no data or codes to be entered for all of the parameters on the DMR for the entire monitoring group number; however, if the monitoring group includes other monitoring locations (e.g., influent sampling), the "NOD" code should be used to individually denote those parameters for which there was no discharge.
Monitoring Period: Enter the month, day, and year for the first and last day of the monitoring period (i.e. the month, the quarter, the year, etc.) during which the data on this report were collected and analyzed.
Sample Measurement: Before filling in sample measurements in the table, check to see that the data collected correspond to the limit indicated on the DMR (i.e. interim or final) and that the data correspond to the monitoring group number in the header. Enter the data or calculated results for each parameter on this row in the non-shaded area above the limit. Be sure the result being entered corresponds to the appropriate statistical base code (e.g. annual average, monthly average, single sample maximum, etc.) and units. Data qualifier codes are not to be reported on Part A.
No. Ex.: Enter the number of sample measurements during the monitoring period that exceeded the permit limit for each parameter in the non-shaded area. If none, enter zero.
Frequency of Analysis: The shaded areas in this column contain the minimum number of times the measurement is required to be made according to the permit. Enter the actual number of times the measurement was made in the space above the shaded area.
Sample Type: The shaded areas in this column contain the type of sample (e.g. grab, composite, continuous) required by the permit. Enter the actual sample type that was taken in the space above the shaded area.
Signature: This report must be signed in accordance with Rule 62-620.305, F.A.C. Type or print the name and title of the signing official. Include the telephone number where the official may be reached in the event there are questions concerning this report. Enter the date when the report is signed.
Comment and Explanation of Any Violations: Use this area to explain any exceedances, any upset or by-pass events, or other items which require explanation. If more space is needed, reference all attachments in this area.

PART B - DAILY SAMPLE RESULTS

Monitoring Period: Enter the month, day, and year for the first and last day of the monitoring period (i.e. the month, the quarter, the year, etc.) during which the data on this report were collected and analyzed.
Daily Monitoring Results: Transfer all analytical data from your facility's laboratory or a contract laboratory's data sheets for all day(s) that samples were collected. Record the data in the units indicated. Table 1 in Chapter 62-160, F.A.C., contains a complete list of all the data qualifier codes that your laboratory may use when reporting analytical results. However, when transferring numerical results onto Part B of the DMR, only the following data qualifier codes should be used and an explanation provided where appropriate.

CODE	DESCRIPTION/INSTRUCTIONS
<	The compound was analyzed for but not detected.
A	Value reported is the mean (average) of two or more determinations.
J	Estimated value, value not accurate.
Q	Sample held beyond the actual holding time.
Y	Laboratory analysis was from an unpreserved or improperly preserved sample.

To calculate the monthly average, add each reported value to get a total. For flow, divide this total by the number of days in the month. For all other parameters, divide the total by the number of observations.
Plant Staffing: List the name, certificate number, and class of all state certified operators operating the facility during the monitoring period. Use additional sheets as necessary.

PART D - GROUND WATER MONITORING REPORT

Monitoring Period: Enter the month, day, and year for the first and last day of the monitoring period (i.e. the month, the quarter, the year, etc.) during which the data on this report were collected and analyzed.
Date Sample Obtained: Enter the date the sample was taken. Also, check whether or not the well was purged before sampling.
Time Sample Obtained: Enter the time the sample was taken.
Sample Measurement: Record the results of the analysis. If the result was below the minimum detection limit, indicate that. Data qualifier codes are not to be reported on Part D.
Detection Limits: Record the detection limits of the analytical methods used.
Analysis Method: Indicate the analytical method used. Record the method number from Chapter 62-160 or Chapter 62-601, F.A.C., or from other sources.
Sampling Equipment Used: Indicate the procedure used to collect the sample (e.g. airlift, bucket/bailer, centrifugal pump, etc.)
Samples Filtered: Indicate whether the sample obtained was filtered by laboratory (L), filtered in field (F), or unfiltered (N).
Signature: This report must be signed in accordance with Rule 62-620.305, F.A.C. Type or print the name and title of the signing official. Include the telephone number where the official may be reached in the event there are questions concerning this report. Enter the date when the report is signed.
Comments and Explanation: Use this space to make any comments on or explanations of results that are unexpected. If more space is needed, reference all attachments in this area.

SPECIAL INSTRUCTIONS FOR LIMITED WET WEATHER DISCHARGES

Flow (Limited Wet Weather Discharge): Enter the measured average flow rate during the period of discharge or divide gallons discharged by duration of discharge (converted into days). Record in million gallons per day (MGD).
Flow (Upstream): Enter the average flow rate in the receiving stream upstream from the point of discharge for the period of discharge. The average flow rate can be calculated based on two measurements; one made at the start and one made at the end of the discharge period. Measurements are to be made at the upstream gauging station described in the permit.
Actual Stream Dilution Ratio: To calculate the Actual Stream Dilution Ratio, divide the average upstream flow rate by the average discharge flow rate. Enter the Actual Stream Dilution Ratio accurate to the nearest 0.1.
No. of Days the SDF > Stream Dilution Ratio: For each day of discharge, compare the minimum Stream Dilution Factor (SDF) from the permit to the calculated Stream Dilution Ratio. On Part B of the DMR, enter an asterisk (*) if the SDF is greater than the Stream Dilution Ratio on any day of discharge. On Part A of the DMR, add up the days with an "*" and record the total number of days the Stream Dilution Factor was greater than the Stream Dilution Ratio.
$CBOD_5$: Enter the average $CBOD_5$ of the reclaimed water discharged during the period shown in duration of discharge.
TKN: Enter the average TKN of the reclaimed water discharged during the period shown in duration of discharge.
Actual Rainfall: Enter the actual rainfall for each day on Part B. Enter the actual cumulative rainfall to date for this calendar year and the actual total monthly rainfall on Part A. The cumulative rainfall to date for this calendar year is the total amount of rain, in inches, that has been recorded since January 1 of the current year through the month for which this DMR contains data.
Rainfall During Average Rainfall Year: On Part A, enter the total monthly rainfall during the average rainfall year and the cumulative rainfall for the average rainfall year. The cumulative rainfall for the average rainfall year is the amount of rain, in inches, which fell during the average rainfall year from January through the month for which this DMR contains data.
No. of Days LWWD Activated During Calendar Year: Enter the cumulative number of days that the limited wet weather discharge was activated since January 1 of the current year.
Reason for Discharge: Attach to the DMR a brief explanation of the factors contributing to the need to activate the limited wet weather discharge.

DEPARTMENT OF ENVIRONMENTAL PROTECTION DISCHARGE MONITORING REPORT - PART A

When completed mail this report to: Department of Environmental Protection, Southwest District Office, Compliance Assurance Program, Attn: Domestic Wastewater, 13051 N. Telecom Parkway, Temple Terrace, FL 33637-0926, swd_dw@dep.state.fl.us

PERMITTEE NAME:	Manatee County Utilities Department	PERMIT NUMBER:	FLA012617-026-DW1P/NRL		
MAILING ADDRESS:	4410 66th Street West Bradenton, Florida 34210	LIMIT:	Final	REPORT FREQUENCY:	Annually
		CLASS SIZE:	N/A	PROGRAM:	Domestic
FACILITY:	Manatee County North Regional WRF	MONITORING GROUP NUMBER:	PRT-I		
LOCATION:	8500 69th St E Palmetto, FL 34221-9064	MONITORING GROUP DESCRIPTION:	Influent Pretreatment		
		RE-SUBMITTED DMR:	☐		
		NO DISCHARGE FROM SITE:	☐		
COUNTY:	Manatee	MONITORING PERIOD From:	____________________	To:	____________________
OFFICE:	Southwest District				

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
pH	Sample Measurement										
PARM Code 00400 G Mon. Site No. PRT-I	Permit Requirement				Report (Min.)		Report (Max.)	s.u.		Annually	Grab
Oil and Grease, hexane extr method	Sample Measurement										
PARM Code 00552 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	mg/L		Annually	Grab
Benzene	Sample Measurement										
PARM Code 34030 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Bromoform	Sample Measurement										
PARM Code 32104 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Carbon tetrachloride	Sample Measurement										
PARM Code 32102 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Chlorobenzene	Sample Measurement										
PARM Code 34301 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab

*FOR THOSE PARAMETERS THAT ARE SAMPLED ANNUALLY, THE MAXIMUM AND AVERAGE CONCENTRATIONS ARE EQUIVALENT AND SHALL BE REPORTED AS SUCH ON THE DMR.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

NAME/TITLE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	TELEPHONE NO	DATE (mm/dd/yyyy)

COMMENT AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here):

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF | MONITORING GROUP NUMBER: PRT-I | PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Chlorodibromomethane	Sample Measurement										
PARM Code 34306 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Chloroethane	Sample Measurement										
PARM Code 85811 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
2-chloroethyl vinyl ether (mixed)	Sample Measurement										
PARM Code 34576 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Chloroform	Sample Measurement										
PARM Code 32106 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Dichlorobromomethane	Sample Measurement										
PARM Code 32101 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,2-dichlorobenzene	Sample Measurement										
PARM Code 34536 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,3-dichlorobenzene	Sample Measurement										
PARM Code 34566 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,4-dichlorobenzene	Sample Measurement										
PARM Code 34571 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,1-dichloroethane	Sample Measurement										
PARM Code 34496 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,2-dichloroethane	Sample Measurement										
PARM Code 32103 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: PRT-I

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
1,1-dichloroethylene	Sample Measurement										
PARM Code 34501 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,2-dichloropropane	Sample Measurement										
PARM Code 34541 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,3-dichloropropene	Sample Measurement										
PARM Code 77163 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Ethylbenzene	Sample Measurement										
PARM Code 34371 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Methyl bromide	Sample Measurement										
PARM Code 34413 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Methyl chloride	Sample Measurement										
PARM Code 34418 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Methylene chloride	Sample Measurement										
PARM Code 34423 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,1,2,2-tetrachloroethane	Sample Measurement										
PARM Code 34516 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Tetrachloroethylene	Sample Measurement										
PARM Code 34475 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Toluene	Sample Measurement										
PARM Code 34010 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: PRT-I

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
1,2-trans-dichloroethylene	Sample Measurement										
PARM Code 34546 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,1,1-trichloroethane	Sample Measurement										
PARM Code 34506 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,1,2-trichloroethane	Sample Measurement										
PARM Code 34511 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Trichloroethylene	Sample Measurement										
PARM Code 39180 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Vinyl chloride	Sample Measurement										
PARM Code 39175 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
2-chlorophenol	Sample Measurement										
PARM Code 34586 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
2,4-dichlorophenol	Sample Measurement										
PARM Code 34601 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
2,4-dimethylphenol	Sample Measurement										
PARM Code 34606 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
4,6-dinitro-o-cresol	Sample Measurement										
PARM Code 34657 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
2,4-dinitrophenol	Sample Measurement										
PARM Code 34616 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF | MONITORING GROUP NUMBER: PRT-I | PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
2-nitrophenol	Sample Measurement										
PARM Code 34591 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
4-nitrophenol	Sample Measurement										
PARM Code 34646 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
p-chloro-m-cresol	Sample Measurement										
PARM Code 82627 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Pentachlorophenol	Sample Measurement										
PARM Code 39032 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Phenol, Single Compound	Sample Measurement										
PARM Code 34694 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
2,4,6-trichlorophenol	Sample Measurement										
PARM Code 34621 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Acenaphthene	Sample Measurement										
PARM Code 34205 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Acenaphthylene	Sample Measurement										
PARM Code 34200 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Anthracene	Sample Measurement										
PARM Code 34220 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Benzidine	Sample Measurement										
PARM Code 39120 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: PRT-I

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Benzo(a)anthracene	Sample Measurement										
PARM Code 34526 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Benzo(a)pyrene	Sample Measurement										
PARM Code 34247 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Benzo(b)fluoranthene (3,4-benzo)	Sample Measurement										
PARM Code 79531 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Benzo(ghi)perylene	Sample Measurement										
PARM Code 34521 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Benzo(k)fluoranthene	Sample Measurement										
PARM Code 34242 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Bis (2-chloroethoxy) methane	Sample Measurement										
PARM Code 34278 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Bis (2-chloroethyl) ether	Sample Measurement										
PARM Code 34273 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Bis (2-chloroisopropyl) ether	Sample Measurement										
PARM Code 34283 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Bis (2-ethylhexyl) phthalate	Sample Measurement										
PARM Code 39100 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
4-bromophenyl phenyl ether	Sample Measurement										
PARM Code 34636 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF | MONITORING GROUP NUMBER: PRT-I | PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Butyl benzyl phthalate	Sample Measurement										
PARM Code 34292 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
2-chloronaphthalene	Sample Measurement										
PARM Code 34581 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
4-chlorophenyl phenyl ether	Sample Measurement										
PARM Code 34641 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Chrysene	Sample Measurement										
PARM Code 34320 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Dibenzo (a,h) anthracene	Sample Measurement										
PARM Code 34556 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
3,3'-dichlorobenzidine	Sample Measurement										
PARM Code 34631 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Diethyl phthalate	Sample Measurement										
PARM Code 34336 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Dimethyl phthalate	Sample Measurement										
PARM Code 34341 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Di-n-butyl phthalate	Sample Measurement										
PARM Code 39110 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
2,4-dinitrotoluene	Sample Measurement										
PARM Code 34611 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF | MONITORING GROUP NUMBER: PRT-I | PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
2,6-dinitrotoluene	Sample Measurement										
PARM Code 34626 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Di-n-octyl phthalate	Sample Measurement										
PARM Code 34596 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
1,2-diphenylhydrazine	Sample Measurement										
PARM Code 34346 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Fluoranthene	Sample Measurement										
PARM Code 34376 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Fluorene	Sample Measurement										
PARM Code 34381 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Hexachlorobenzene	Sample Measurement										
PARM Code 39700 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Hexachlorobutadiene	Sample Measurement										
PARM Code 39702 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Hexachlorocyclopentadiene	Sample Measurement										
PARM Code 34386 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Hexachloroethane	Sample Measurement										
PARM Code 34396 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Indeno (1,2,3-Cd) pyrene	Sample Measurement										
PARM Code 34403 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: PRT-I

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: _____________________ To: ________________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Isophorone	Sample Measurement										
PARM Code 34408 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Naphthalene	Sample Measurement										
PARM Code 34696 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Nitrobenzene	Sample Measurement										
PARM Code 34447 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
N-nitrosodimethylamine	Sample Measurement										
PARM Code 34438 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
N-nitrosodi-n-propylamine	Sample Measurement										
PARM Code 34428 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
N-nitrosodiphenylamine	Sample Measurement										
PARM Code 34433 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Phenanthrene	Sample Measurement										
PARM Code 34461 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Pyrene	Sample Measurement										
PARM Code 34469 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
1,2,4-trichlorobenzene	Sample Measurement										
PARM Code 34551 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Aldrin	Sample Measurement										
PARM Code 39330 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF | MONITORING GROUP NUMBER: PRT-I | PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ________________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Alpha-bhc	Sample Measurement										
PARM Code 39336 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
B-bhc-beta	Sample Measurement										
PARM Code 39338 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Gamma BHC (Lindane)	Sample Measurement										
PARM Code 39782 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Delta benzene hexachloride	Sample Measurement										
PARM Code 34259 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Chlordane (tech mix. and metabolites)	Sample Measurement										
PARM Code 39350 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
4,4'-DDT (p,p'-DDT)	Sample Measurement										
PARM Code 39300 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
4,4'-DDE (p,p'-DDE)	Sample Measurement										
PARM Code 39320 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
4,4'-DDD (p,p'-DDD)	Sample Measurement										
PARM Code 39310 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Dieldrin	Sample Measurement										
PARM Code 39380 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
A-endosulfan-alpha	Sample Measurement										
PARM Code 34361 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: PRT-I

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ________________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
B-endosulfan-beta	Sample Measurement										
PARM Code 34356 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Endosulfan sulfate	Sample Measurement										
PARM Code 34351 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Endrin	Sample Measurement										
PARM Code 39390 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Endrin aldehyde	Sample Measurement										
PARM Code 34366 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Heptachlor	Sample Measurement										
PARM Code 39410 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Heptachlor epoxide	Sample Measurement										
PARM Code 39420 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
PCB-1242	Sample Measurement										
PARM Code 39496 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
PCB-1254	Sample Measurement										
PARM Code 39504 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
PCB-1221	Sample Measurement										
PARM Code 39488 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
PCB-1232	Sample Measurement										
PARM Code 39492 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF MONITORING GROUP NUMBER: PRT-I PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
PCB-1248	Sample Measurement										
PARM Code 39500 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
PCB-1260	Sample Measurement										
PARM Code 39508 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
PCB-1016	Sample Measurement										
PARM Code 34671 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Toxaphene	Sample Measurement										
PARM Code 39400 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Antimony, Total Recoverable	Sample Measurement										
PARM Code 01268 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Arsenic, Total Recoverable	Sample Measurement										
PARM Code 00978 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Beryllium, Total Recoverable	Sample Measurement										
PARM Code 00998 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Cadmium, Total Recoverable	Sample Measurement										
PARM Code 01113 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Chromium, Total Recoverable	Sample Measurement										
PARM Code 01118 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Copper, Total Recoverable	Sample Measurement										
PARM Code 01119 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF | MONITORING GROUP NUMBER: PRT-I | PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ________________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Lead, Total Recoverable	Sample Measurement										
PARM Code 01114 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Mercury, Total Recoverable	Sample Measurement										
PARM Code 71901 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Nickel, Total Recoverable	Sample Measurement										
PARM Code 01074 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Selenium, Total Recoverable	Sample Measurement										
PARM Code 00981 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Silver, Total Recoverable	Sample Measurement										
PARM Code 01079 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Thallium, Total Recoverable	Sample Measurement										
PARM Code 00982 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Zinc, Total Recoverable	Sample Measurement										
PARM Code 01094 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Cyanide, Total Recoverable	Sample Measurement										
PARM Code 78248 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Phenolic Compounds, Total Recoverable	Sample Measurement										
PARM Code 70029 G Mon. Site No. PRT-I	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab

DEPARTMENT OF ENVIRONMENTAL PROTECTION DISCHARGE MONITORING REPORT - PART A

When completed mail this report to: Department of Environmental Protection, Southwest District Office, Compliance Assurance Program, Attn: Domestic Wastewater, 13051 N. Telecom Parkway, Temple Terrace, FL 33637-0926, swd_dw@dep.state.fl.us

PERMITTEE NAME:	Manatee County Utilities Department	PERMIT NUMBER:	FLA012617-026-DW1P/NRL		
MAILING ADDRESS:	4410 66th Street West Bradenton, Florida 34210	LIMIT:	Final	REPORT FREQUENCY:	Annually
		CLASS SIZE:	N/A	PROGRAM:	Domestic
FACILITY:	Manatee County North Regional WRF	MONITORING GROUP NUMBER:	PRT-E		
LOCATION:	8500 69th St E Palmetto, FL 34221-9064	MONITORING GROUP DESCRIPTION:	Effluent Pretreatment		
		RE-SUBMITTED DMR:	☐		
		NO DISCHARGE FROM SITE:	☐		
COUNTY:	Manatee	MONITORING PERIOD From:	____________________	To:	____________________
OFFICE:	Southwest District				

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
pH	Sample Measurement										
PARM Code 00400 1 Mon. Site No. PRT-E	Permit Requirement				Report (Min.)		Report (Max.)	s.u.		Annually	Grab
Oil and Grease, hexane extr method	Sample Measurement										
PARM Code 00552 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	mg/L		Annually	Grab
Benzene	Sample Measurement										
PARM Code 34030 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Bromoform	Sample Measurement										
PARM Code 32104 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Carbon tetrachloride	Sample Measurement										
PARM Code 32102 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Chlorobenzene	Sample Measurement										
PARM Code 34301 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab

*FOR THOSE PARAMETERS THAT ARE SAMPLED ANNUALLY, THE MAXIMUM AND AVERAGE CONCENTRATIONS ARE EQUIVALENT AND SHALL BE REPORTED AS SUCH ON THE DMR.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

NAME/TITLE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	TELEPHONE NO	DATE (mm/dd/yyyy)

COMMENT AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here):

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: PRT-E

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ________________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Chlorodibromomethane	Sample Measurement										
PARM Code 34306 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Chloroethane	Sample Measurement										
PARM Code 85811 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
2-chloroethyl vinyl ether (mixed)	Sample Measurement										
PARM Code 34576 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Chloroform	Sample Measurement										
PARM Code 32106 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Dichlorobromomethane	Sample Measurement										
PARM Code 32101 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,2-dichlorobenzene	Sample Measurement										
PARM Code 34536 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,3-dichlorobenzene	Sample Measurement										
PARM Code 34566 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,4-dichlorobenzene	Sample Measurement										
PARM Code 34571 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,1-dichloroethane	Sample Measurement										
PARM Code 34496 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,2-dichloroethane	Sample Measurement										
PARM Code 32103 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: PRT-E

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
1,1-dichloroethylene	Sample Measurement										
PARM Code 34501 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,2-dichloropropane	Sample Measurement										
PARM Code 34541 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,3-dichloropropene	Sample Measurement										
PARM Code 77163 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Ethylbenzene	Sample Measurement										
PARM Code 34371 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Methyl bromide	Sample Measurement										
PARM Code 34413 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Methyl chloride	Sample Measurement										
PARM Code 34418 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Methylene chloride	Sample Measurement										
PARM Code 34423 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,1,2,2-tetrachloroethane	Sample Measurement										
PARM Code 34516 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Tetrachloroethylene	Sample Measurement										
PARM Code 34475 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Toluene	Sample Measurement										
PARM Code 34010 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: PRT-E

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
1,2-trans-dichloroethylene	Sample Measurement										
PARM Code 34546 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,1,1-trichloroethane	Sample Measurement										
PARM Code 34506 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
1,1,2-trichloroethane	Sample Measurement										
PARM Code 34511 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Trichloroethylene	Sample Measurement										
PARM Code 39180 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Vinyl chloride	Sample Measurement										
PARM Code 39175 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
2-chlorophenol	Sample Measurement										
PARM Code 34586 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
2,4-dichlorophenol	Sample Measurement										
PARM Code 34601 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
2,4-dimethylphenol	Sample Measurement										
PARM Code 34606 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
4,6-dinitro-o-cresol	Sample Measurement										
PARM Code 34657 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
2,4-dinitrophenol	Sample Measurement										
PARM Code 34616 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: PRT-E

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
2-nitrophenol	Sample Measurement										
PARM Code 34591 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
4-nitrophenol	Sample Measurement										
PARM Code 34646 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
p-chloro-m-cresol	Sample Measurement										
PARM Code 82627 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Pentachlorophenol	Sample Measurement										
PARM Code 39032 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Phenol, Single Compound	Sample Measurement										
PARM Code 34694 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
2,4,6-trichlorophenol	Sample Measurement										
PARM Code 34621 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Acenaphthene	Sample Measurement										
PARM Code 34205 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Acenaphthylene	Sample Measurement										
PARM Code 34200 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Anthracene	Sample Measurement										
PARM Code 34220 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Benzidine	Sample Measurement										
PARM Code 39120 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: PRT-E

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ________________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Benzo(a)anthracene	Sample Measurement										
PARM Code 34526 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Benzo(a)pyrene	Sample Measurement										
PARM Code 34247 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Benzo(b)fluoranthene (3,4-benzo)	Sample Measurement										
PARM Code 79531 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Benzo(ghi)perylene	Sample Measurement										
PARM Code 34521 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Benzo(k)fluoranthene	Sample Measurement										
PARM Code 34242 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Bis (2-chloroethoxy) methane	Sample Measurement										
PARM Code 34278 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Bis (2-chloroethyl) ether	Sample Measurement										
PARM Code 34273 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Bis (2-chloroisopropyl) ether	Sample Measurement										
PARM Code 34283 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Bis (2-ethylhexyl) phthalate	Sample Measurement										
PARM Code 39100 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
4-bromophenyl phenyl ether	Sample Measurement										
PARM Code 34636 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: PRT-E

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Butyl benzyl phthalate	Sample Measurement										
PARM Code 34292 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
2-chloronaphthalene	Sample Measurement										
PARM Code 34581 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
4-chlorophenyl phenyl ether	Sample Measurement										
PARM Code 34641 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Chrysene	Sample Measurement										
PARM Code 34320 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Dibenzo (a,h) anthracene	Sample Measurement										
PARM Code 34556 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
3,3'-dichlorobenzidine	Sample Measurement										
PARM Code 34631 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Diethyl phthalate	Sample Measurement										
PARM Code 34336 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Dimethyl phthalate	Sample Measurement										
PARM Code 34341 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Di-n-butyl phthalate	Sample Measurement										
PARM Code 39110 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
2,4-dinitrotoluene	Sample Measurement										
PARM Code 34611 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: PRT-E

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
2,6-dinitrotoluene	Sample Measurement										
PARM Code 34626 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Di-n-octyl phthalate	Sample Measurement										
PARM Code 34596 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
1,2-diphenylhydrazine	Sample Measurement										
PARM Code 34346 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Fluoranthene	Sample Measurement										
PARM Code 34376 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Fluorene	Sample Measurement										
PARM Code 34381 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Hexachlorobenzene	Sample Measurement										
PARM Code 39700 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Hexachlorobutadiene	Sample Measurement										
PARM Code 39702 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Hexachlorocyclopentadiene	Sample Measurement										
PARM Code 34386 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Hexachloroethane	Sample Measurement										
PARM Code 34396 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Indeno (1,2,3-Cd) pyrene	Sample Measurement										
PARM Code 34403 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: PRT-E

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Isophorone	Sample Measurement										
PARM Code 34408 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Naphthalene	Sample Measurement										
PARM Code 34696 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Nitrobenzene	Sample Measurement										
PARM Code 34447 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
N-nitrosodimethylamine	Sample Measurement										
PARM Code 34438 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
N-nitrosodi-n-propylamine	Sample Measurement										
PARM Code 34428 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
N-nitrosodiphenylamine	Sample Measurement										
PARM Code 34433 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Phenanthrene	Sample Measurement										
PARM Code 34461 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Pyrene	Sample Measurement										
PARM Code 34469 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
1,2,4-trichlorobenzene	Sample Measurement										
PARM Code 34551 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Aldrin	Sample Measurement										
PARM Code 39330 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: PRT-E

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Alpha-bhc	Sample Measurement										
PARM Code 39336 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
B-bhc-beta	Sample Measurement										
PARM Code 39338 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Gamma BHC (Lindane)	Sample Measurement										
PARM Code 39782 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Delta benzene hexachloride	Sample Measurement										
PARM Code 34259 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Chlordane (tech mix. and metabolites)	Sample Measurement										
PARM Code 39350 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
4,4'-DDT (p,p'-DDT)	Sample Measurement										
PARM Code 39300 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
4,4'-DDE (p,p'-DDE)	Sample Measurement										
PARM Code 39320 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
4,4'-DDD (p,p'-DDD)	Sample Measurement										
PARM Code 39310 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Dieldrin	Sample Measurement										
PARM Code 39380 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
A-endosulfan-alpha	Sample Measurement										
PARM Code 34361 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: PRT-E

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ________________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
B-endosulfan-beta	Sample Measurement										
PARM Code 34356 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Endosulfan sulfate	Sample Measurement										
PARM Code 34351 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Endrin	Sample Measurement										
PARM Code 39390 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Endrin aldehyde	Sample Measurement										
PARM Code 34366 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Heptachlor	Sample Measurement										
PARM Code 39410 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Heptachlor epoxide	Sample Measurement										
PARM Code 39420 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
PCB-1242	Sample Measurement										
PARM Code 39496 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
PCB-1254	Sample Measurement										
PARM Code 39504 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
PCB-1221	Sample Measurement										
PARM Code 39488 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
PCB-1232	Sample Measurement										
PARM Code 39492 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: PRT-E

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
PCB-1248	Sample Measurement										
PARM Code 39500 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
PCB-1260	Sample Measurement										
PARM Code 39508 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
PCB-1016	Sample Measurement										
PARM Code 34671 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Toxaphene	Sample Measurement										
PARM Code 39400 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Antimony, Total Recoverable	Sample Measurement										
PARM Code 01268 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Arsenic, Total Recoverable	Sample Measurement										
PARM Code 00978 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Beryllium, Total Recoverable	Sample Measurement										
PARM Code 00998 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Cadmium, Total Recoverable	Sample Measurement										
PARM Code 01113 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Chromium, Total Recoverable	Sample Measurement										
PARM Code 01118 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Copper, Total Recoverable	Sample Measurement										
PARM Code 01119 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF | MONITORING GROUP NUMBER: PRT-E | PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Lead, Total Recoverable	Sample Measurement										
PARM Code 01114 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Mercury, Total Recoverable	Sample Measurement										
PARM Code 71901 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Nickel, Total Recoverable	Sample Measurement										
PARM Code 01074 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Selenium, Total Recoverable	Sample Measurement										
PARM Code 00981 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Silver, Total Recoverable	Sample Measurement										
PARM Code 01079 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Thallium, Total Recoverable	Sample Measurement										
PARM Code 00982 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Zinc, Total Recoverable	Sample Measurement										
PARM Code 01094 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	24-hr FPC
Cyanide, Total Recoverable	Sample Measurement										
PARM Code 78248 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab
Phenolic Compounds, Total Recoverable	Sample Measurement										
PARM Code 70029 1 Mon. Site No. PRT-E	Permit Requirement					Report (An.Avg.)	Report (Max.)	ug/L		Annually	Grab

DEPARTMENT OF ENVIRONMENTAL PROTECTION DISCHARGE MONITORING REPORT - PART A

When completed mail this report to: Department of Environmental Protection, Southwest District Office, Compliance Assurance Program, Attn: Domestic Wastewater, 13051 N. Telecom Parkway, Temple Terrace, FL 33637-0926, swd_dw@dep.state.fl.us

PERMITTEE NAME:	Manatee County Utilities Department	PERMIT NUMBER:	FLA012617-026-DW1P/NRL		
MAILING ADDRESS:	4410 66th Street West Bradenton, Florida 34210	LIMIT:	Final	REPORT FREQUENCY:	Annually
		CLASS SIZE:	N/A	PROGRAM:	Domestic
FACILITY:	Manatee County North Regional WRF	MONITORING GROUP NUMBER:	PRT-R		
LOCATION:	8500 69th St E Palmetto, FL 34221-9064	MONITORING GROUP DESCRIPTION:	Residuals Pretreatment		
		RE-SUBMITTED DMR:	☐		
		NO DISCHARGE FROM SITE:	☐		
COUNTY:	Manatee	MONITORING PERIOD From:	____________________	To:	____________________
OFFICE:	Southwest District				

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Arsenic Total, Dry Weight, Sludge	Sample Measurement										
PARM Code 49565 + Mon. Site No. PRT-R	Permit Requirement					Report (An.Avg.)	Report (Max.)	mg/kg		Annually	Composite
Cadmium, Sludge, Tot. Dry Wt. (Cd)	Sample Measurement										
PARM Code 78476 + Mon. Site No. PRT-R	Permit Requirement					Report (An.Avg.)	Report (Max.)	mg/kg		Annually	Composite
Copper, Sludge, Tot, Dry Wt. (as Cu)	Sample Measurement										
PARM Code 78475 + Mon. Site No. PRT-R	Permit Requirement					Report (An.Avg.)	Report (Max.)	mg/kg		Annually	Composite
Lead, Dry Weight	Sample Measurement										
PARM Code 78468 + Mon. Site No. PRT-R	Permit Requirement					Report (An.Avg.)	Report (Max.)	mg/kg		Annually	Composite
Mercury, Dry Weight	Sample Measurement										
PARM Code 78471 + Mon. Site No. PRT-R	Permit Requirement					Report (An.Avg.)	Report (Max.)	mg/kg		Annually	Composite
Molybdenum, Dry Weight	Sample Measurement										
PARM Code 78465 + Mon. Site No. PRT-R	Permit Requirement					Report (An.Avg.)	Report (Max.)	mg/kg		Annually	Composite

*FOR THOSE PARAMETERS THAT ARE SAMPLED ANNUALLY, THE MAXIMUM AND AVERAGE CONCENTRATIONS ARE EQUIVALENT AND SHALL BE REPORTED AS SUCH ON THE DMR.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

NAME/TITLE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	TELEPHONE NO	DATE (mm/dd/yyyy)

COMMENT AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here):

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: PRT-R

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Nickel, Dry Weight	Sample Measurement										
PARM Code 78469 + Mon. Site No. PRT-R	Permit Requirement					Report (An.Avg.)	Report (Max.)	mg/kg		Annually	Composite
Selenium Sludge Solid	Sample Measurement										
PARM Code 61518 + Mon. Site No. PRT-R	Permit Requirement					Report (An.Avg.)	Report (Max.)	mg/kg		Annually	Composite
Zinc, Dry Weight	Sample Measurement										
PARM Code 78467 + Mon. Site No. PRT-R	Permit Requirement					Report (An.Avg.)	Report (Max.)	mg/kg		Annually	Composite

INSTRUCTIONS FOR COMPLETING THE WASTEWATER DISCHARGE MONITORING REPORT

Read these instructions before completing the DMR. Hard copies and/or electronic copies of the required parts of the DMR were provided with the permit. All required information shall be completed in full and typed or printed in ink. A signed, original DMR shall be mailed to the address printed on the DMR by the 28th of the month following the monitoring period. Facilities who submit their DMR(s) electronically through eDMR do not need to submit a hardcopy DMR. The DMR shall not be submitted before the end of the monitoring period.

The DMR consists of three parts--A, B, and D--all of which may or may not be applicable to every facility. Facilities may have one or more Part A's for reporting effluent or reclaimed water data. All domestic wastewater facilities will have a Part B for reporting daily sample results. Part D is used for reporting ground water monitoring well data.

When results are not available, the following codes should be used on parts A and D of the DMR and an explanation provided where appropriate. Note: Codes used on Part B for raw data are different.

CODE	DESCRIPTION/INSTRUCTIONS
ANC	Analysis not conducted.
DRY	Dry Well
FLD	Flood disaster.
IFS	Insufficient flow for sampling.
LS	Lost sample.
MNR	Monitoring not required this period.

CODE	DESCRIPTION/INSTRUCTIONS
NOD	No discharge from/to site.
OPS	Operations were shut down so no sample could be taken.
OTH	Other. Please enter an explanation of why monitoring data were not available.
SEF	Sampling equipment failure.

When reporting analytical results that fall below a laboratory's reported method detection limits or practical quantification limits, the following instructions should be used, unless indicated otherwise in the permit or on the DMR:

1. Results greater than or equal to the PQL shall be reported as the measured quantity.
2. Results less than the PQL and greater than or equal to the MDL shall be reported as the laboratory's MDL value. These values shall be deemed equal to the MDL when necessary to calculate an average for that parameter and when determining compliance with permit limits.
3. Results less than the MDL shall be reported by entering a less than sign ("<") followed by the laboratory's MDL value, e.g. < 0.001. A value of one-half the MDL or one-half the effluent limit, whichever is lower, shall be used for that sample when necessary to calculate an average for that parameter. Values less than the MDL are considered to demonstrate compliance with an effluent limitation.

PART A -DISCHARGE MONITORING REPORT (DMR)

Part A of the DMR is comprised of one or more sections, each having its own header information. Facility information is preprinted in the header as well as the monitoring group number, whether the limits and monitoring requirements are interim or final, and the required submittal frequency (e.g. monthly, annually, quarterly, etc.). Submit Part A based on the required reporting frequency in the header and the instructions shown in the permit. The following should be completed by the permittee or authorized representative:

Resubmitted DMR: Check this box if this DMR is being re-submitted because there was information missing from or information that needed correction on a previously submitted DMR. The information that is being revised should be clearly noted on the re-submitted DMR (e.g. highlight, circle, etc.)
No Discharge From Site: Check this box if no discharge occurs and, as a result, there are no data or codes to be entered for all of the parameters on the DMR for the entire monitoring group number; however, if the monitoring group includes other monitoring locations (e.g., influent sampling), the "NOD" code should be used to individually denote those parameters for which there was no discharge.
Monitoring Period: Enter the month, day, and year for the first and last day of the monitoring period (i.e. the month, the quarter, the year, etc.) during which the data on this report were collected and analyzed.
Sample Measurement: Before filling in sample measurements in the table, check to see that the data collected correspond to the limit indicated on the DMR (i.e. interim or final) and that the data correspond to the monitoring group number in the header. Enter the data or calculated results for each parameter on this row in the non-shaded area above the limit. Be sure the result being entered corresponds to the appropriate statistical base code (e.g. annual average, monthly average, single sample maximum, etc.) and units. Data qualifier codes are not to be reported on Part A.
No. Ex.: Enter the number of sample measurements during the monitoring period that exceeded the permit limit for each parameter in the non-shaded area. If none, enter zero.
Frequency of Analysis: The shaded areas in this column contain the minimum number of times the measurement is required to be made according to the permit. Enter the actual number of times the measurement was made in the space above the shaded area.
Sample Type: The shaded areas in this column contain the type of sample (e.g. grab, composite, continuous) required by the permit. Enter the actual sample type that was taken in the space above the shaded area.
Signature: This report must be signed in accordance with Rule 62-620.305, F.A.C. Type or print the name and title of the signing official. Include the telephone number where the official may be reached in the event there are questions concerning this report. Enter the date when the report is signed.
Comment and Explanation of Any Violations: Use this area to explain any exceedances, any upset or by-pass events, or other items which require explanation. If more space is needed, reference all attachments in this area.

PART B - DAILY SAMPLE RESULTS

Monitoring Period: Enter the month, day, and year for the first and last day of the monitoring period (i.e. the month, the quarter, the year, etc.) during which the data on this report were collected and analyzed.
Daily Monitoring Results: Transfer all analytical data from your facility's laboratory or a contract laboratory's data sheets for all day(s) that samples were collected. Record the data in the units indicated. Table 1 in Chapter 62-160, F.A.C., contains a complete list of all the data qualifier codes that your laboratory may use when reporting analytical results. However, when transferring numerical results onto Part B of the DMR, only the following data qualifier codes should be used and an explanation provided where appropriate.

CODE	DESCRIPTION/INSTRUCTIONS
<	The compound was analyzed for but not detected.
A	Value reported is the mean (average) of two or more determinations.
J	Estimated value, value not accurate.
Q	Sample held beyond the actual holding time.
Y	Laboratory analysis was from an unpreserved or improperly preserved sample.

To calculate the monthly average, add each reported value to get a total. For flow, divide this total by the number of days in the month. For all other parameters, divide the total by the number of observations.
Plant Staffing: List the name, certificate number, and class of all state certified operators operating the facility during the monitoring period. Use additional sheets as necessary.

PART D - GROUND WATER MONITORING REPORT

Monitoring Period: Enter the month, day, and year for the first and last day of the monitoring period (i.e. the month, the quarter, the year, etc.) during which the data on this report were collected and analyzed.
Date Sample Obtained: Enter the date the sample was taken. Also, check whether or not the well was purged before sampling.
Time Sample Obtained: Enter the time the sample was taken.
Sample Measurement: Record the results of the analysis. If the result was below the minimum detection limit, indicate that. Data qualifier codes are not to be reported on Part D.
Detection Limits: Record the detection limits of the analytical methods used.
Analysis Method: Indicate the analytical method used. Record the method number from Chapter 62-160 or Chapter 62-601, F.A.C., or from other sources.
Sampling Equipment Used: Indicate the procedure used to collect the sample (e.g. airlift, bucket/bailer, centrifugal pump, etc.)
Samples Filtered: Indicate whether the sample obtained was filtered by laboratory (L), filtered in field (F), or unfiltered (N).
Signature: This report must be signed in accordance with Rule 62-620.305, F.A.C. Type or print the name and title of the signing official. Include the telephone number where the official may be reached in the event there are questions concerning this report. Enter the date when the report is signed.
Comments and Explanation: Use this space to make any comments on or explanations of results that are unexpected. If more space is needed, reference all attachments in this area.

SPECIAL INSTRUCTIONS FOR LIMITED WET WEATHER DISCHARGES

Flow (Limited Wet Weather Discharge): Enter the measured average flow rate during the period of discharge or divide gallons discharged by duration of discharge (converted into days). Record in million gallons per day (MGD).
Flow (Upstream): Enter the average flow rate in the receiving stream upstream from the point of discharge for the period of discharge. The average flow rate can be calculated based on two measurements; one made at the start and one made at the end of the discharge period. Measurements are to be made at the upstream gauging station described in the permit.
Actual Stream Dilution Ratio: To calculate the Actual Stream Dilution Ratio, divide the average upstream flow rate by the average discharge flow rate. Enter the Actual Stream Dilution Ratio accurate to the nearest 0.1.
No. of Days the SDF > Stream Dilution Ratio: For each day of discharge, compare the minimum Stream Dilution Factor (SDF) from the permit to the calculated Stream Dilution Ratio. On Part B of the DMR, enter an asterisk (*) if the SDF is greater than the Stream Dilution Ratio on any day of discharge. On Part A of the DMR, add up the days with an "*" and record the total number of days the Stream Dilution Factor was greater than the Stream Dilution Ratio.
$CBOD_5$: Enter the average $CBOD_5$ of the reclaimed water discharged during the period shown in duration of discharge.
TKN: Enter the average TKN of the reclaimed water discharged during the period shown in duration of discharge.
Actual Rainfall: Enter the actual rainfall for each day on Part B. Enter the actual cumulative rainfall to date for this calendar year and the actual total monthly rainfall on Part A. The cumulative rainfall to date for this calendar year is the total amount of rain, in inches, that has been recorded since January 1 of the current year through the month for which this DMR contains data.
Rainfall During Average Rainfall Year: On Part A, enter the total monthly rainfall during the average rainfall year and the cumulative rainfall for the average rainfall year. The cumulative rainfall for the average rainfall year is the amount of rain, in inches, which fell during the average rainfall year from January through the month for which this DMR contains data.
No. of Days LWWD Activated During Calendar Year: Enter the cumulative number of days that the limited wet weather discharge was activated since January 1 of the current year.
Reason for Discharge: Attach to the DMR a brief explanation of the factors contributing to the need to activate the limited wet weather discharge.

DEPARTMENT OF ENVIRONMENTAL PROTECTION DISCHARGE MONITORING REPORT - PART A

When completed mail this report to: Department of Environmental Protection, Southwest District Office, Compliance Assurance Program, Attn: Domestic Wastewater, 13051 N. Telecom Parkway, Temple Terrace, FL 33637-0926, swd_dw@dep.state.fl.us

PERMITTEE NAME:	Manatee County Utilities Department	PERMIT NUMBER:	FLA012617-026-DW1P/NRL		
MAILING ADDRESS:	4410 66th Street West Bradenton, Florida 34210	LIMIT:	Final	REPORT FREQUENCY:	Annually
		CLASS SIZE:	N/A	PROGRAM:	Domestic
FACILITY:	Manatee County North Regional WRF	MONITORING GROUP NUMBER:	RWS-A		
LOCATION:	8500 69th St E Palmetto, FL 34221-9064	MONITORING GROUP DESCRIPTION:	Annual Reclaimed Water or Effluent Analysis		
		RE-SUBMITTED DMR: ☐			
		NO DISCHARGE FROM SITE: ☐			
		MONITORING NOT REQUIRED: ☐			
COUNTY:	Manatee	MONITORING PERIOD From:	____________________	To:	____________________
OFFICE:	Southwest District				

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Antimony, Total Recoverable (GWS = 6)*	Sample Measurement										
PARM Code 01268 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Arsenic, Total Recoverable (GWS = 10)	Sample Measurement										
PARM Code 00978 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Barium, Total Recoverable (GWS = 2,000)	Sample Measurement										
PARM Code 01009 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Beryllium, Total Recoverable (GWS = 4)	Sample Measurement										
PARM Code 00998 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Cadmium, Total Recoverable (GWS = 5)	Sample Measurement										
PARM Code 01113 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Chromium, Total Recoverable (GWS =100)	Sample Measurement										
PARM Code 01118 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC

*GROUND WATER STANDARD (GWS) FOR REFERENCE AND REVIEW ONLY.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

NAME/TITLE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	TELEPHONE NO	DATE (mm/dd/yyyy)

COMMENT AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here):

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: RWS-A

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: _______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Cyanide, Free (amen. to chlorination)(GWS = 200)	Sample Measurement										
PARM Code 00722 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
Fluoride, Total (as F) (GWS = 4.0/2.0)	Sample Measurement										
PARM Code 00951 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	mg/L		Annually	24-hr FPC
Lead, Total Recoverable (GWS = 15)	Sample Measurement										
PARM Code 01114 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Mercury, Total Recoverable (GWS = 2)	Sample Measurement										
PARM Code 71901 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Nickel, Total Recoverable (GWS = 100)	Sample Measurement										
PARM Code 01074 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Nitrogen, Nitrate, Total (as N) (GWS = 10)	Sample Measurement										
PARM Code 00620 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	mg/L		Annually	24-hr FPC
Nitrogen, Nitrite, Total (as N) (GWS = 1)	Sample Measurement										
PARM Code 00615 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	mg/L		Annually	24-hr FPC
Nitrite plus Nitrate, Total 1 det. (as N)(GWS = 10)	Sample Measurement										
PARM Code 00630 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	mg/L		Annually	24-hr FPC
Selenium, Total Recoverable (GWS =50)	Sample Measurement										
PARM Code 00981 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Sodium, Total Recoverable (GWS = 160)	Sample Measurement										
PARM Code 00923 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	mg/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: RWS-A

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ________________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Thallium, Total Recoverable (GWS = 2)	Sample Measurement										
PARM Code 00982 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
1,1-dichloroethylene (GWS = 7)	Sample Measurement										
PARM Code 34501 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
1,1,1-trichloroethane (GWS = 200)	Sample Measurement										
PARM Code 34506 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
1,1,2-trichloroethane (GWS = 5)	Sample Measurement										
PARM Code 34511 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
1,2-dichloroethane (GWS = 3)	Sample Measurement										
PARM Code 32103 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
1,2-dichloropropane (GWS = 5)	Sample Measurement										
PARM Code 34541 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
1,2,4-trichlorobenzene (GWS = 70)	Sample Measurement										
PARM Code 34551 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Benzene (GWS = 1)	Sample Measurement										
PARM Code 34030 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
Carbon tetrachloride (GWS = 3)	Sample Measurement										
PARM Code 32102 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
Cis-1,2-dichloroethene (GWS = 70)	Sample Measurement										
PARM Code 81686 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: RWS-A

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ________________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Dichloromethane (methylene chloride)(GWS = 5)	Sample Measurement										
PARM Code 03821 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
Ethylbenzene (GWS = 700)	Sample Measurement										
PARM Code 34371 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
Monochlorobenzene (GWS = 100)	Sample Measurement										
PARM Code 34031 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
1,2-dichlorobenzene (GWS = 600)	Sample Measurement										
PARM Code 34536 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
1,4-dichlorobenzene (GWS = 75)	Sample Measurement										
PARM Code 34571 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
Styrene, Total (GWS = 100)	Sample Measurement										
PARM Code 77128 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
Tetrachloroethylene (GWS = 3)	Sample Measurement										
PARM Code 34475 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
Toluene (GWS = 1,000)	Sample Measurement										
PARM Code 34010 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
1,2-trans-dichloroethylene (GWS = 100)	Sample Measurement										
PARM Code 34546 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
Trichloroethylene (GWS = 3)	Sample Measurement										
PARM Code 39180 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: RWS-A

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ________________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Vinyl chloride (GWS = 1)	Sample Measurement										
PARM Code 39175 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
Xylenes (GWS = 10,000)	Sample Measurement										
PARM Code 81551 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
2,3,7,8-tetrachlorodibenzo-p-dioxin(GWS = 3x10^-5)	Sample Measurement										
PARM Code 34675 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
2,4-dichlorophenoxyacetic acid (GWS = 70)	Sample Measurement										
PARM Code 39730 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Silvex (GWS = 50)	Sample Measurement										
PARM Code 39760 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Alachlor (GWS = 2)	Sample Measurement										
PARM Code 39161 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Atrazine (GWS = 3)	Sample Measurement										
PARM Code 39033 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Benzo(a)pyrene (GWS = 0.2)	Sample Measurement										
PARM Code 34247 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Carbofuran (GWS = 40)	Sample Measurement										
PARM Code 81405 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Chlordane (tech mix. and metabolites)(GWS = 2)	Sample Measurement										
PARM Code 39350 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: RWS-A

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ________________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Dalapon (GWS = 200)	Sample Measurement										
PARM Code 38432 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Bis(2-ethylhexyl)adipate (GWS = 400)	Sample Measurement										
PARM Code 77903 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Bis (2-ethylhexyl) phthalate (GWS = 6)	Sample Measurement										
PARM Code 39100 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Dibromochloropropane (DBCP) (GWS = 0.2)	Sample Measurement										
PARM Code 82625 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
Dinoseb (GWS = 7)	Sample Measurement										
PARM Code 30191 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Diquat (GWS = 20)	Sample Measurement										
PARM Code 04443 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Endothall (GWS = 100)	Sample Measurement										
PARM Code 38926 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Endrin (GWS = 2)	Sample Measurement										
PARM Code 39390 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Ethylene dibromide (1,2-dibromoethane)(GWS = 0.02)	Sample Measurement										
PARM Code 77651 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	Grab
Glyphosate (GWS = 0.7)	Sample Measurement										
PARM Code 79743 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	mg/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: RWS-A

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ________________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Heptachlor (GWS = 0.4)	Sample Measurement										
PARM Code 39410 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Heptachlor epoxide (GWS = 0.2)	Sample Measurement										
PARM Code 39420 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Hexachlorobenzene (GWS = 1)	Sample Measurement										
PARM Code 39700 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Hexachlorocyclopentadiene (GWS = 50)	Sample Measurement										
PARM Code 34386 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Gamma BHC (Lindane) (GWS = 0.2)	Sample Measurement										
PARM Code 39782 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Methoxychlor (GWS = 40)	Sample Measurement										
PARM Code 39480 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Oxamyl (vydate) (GWS = 200)	Sample Measurement										
PARM Code 38865 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Pentachlorophenol (GWS = 1)	Sample Measurement										
PARM Code 39032 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Picloram (GWS = 500)	Sample Measurement										
PARM Code 39720 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Polychlorinated Biphenyls (PCBs)(GWS = 0.5)	Sample Measurement										
PARM Code 39516 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: RWS-A

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: _______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Simazine (GWS = 4)	Sample Measurement										
PARM Code 39055 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Toxaphene (GWS = 3)	Sample Measurement										
PARM Code 39400 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Trihalomethane, Total by summation(GWS = 0.080)	Sample Measurement										
PARM Code 82080 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	mg/L		Annually	Grab
Radium 226 + Radium 228, Total (GWS = 5)	Sample Measurement										
PARM Code 11503 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	pCi/L		Annually	24-hr FPC
Alpha, Gross Particle Activity (GWS = 15)	Sample Measurement										
PARM Code 80045 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	pCi/L		Annually	24-hr FPC
Aluminum, Total Recoverable (GWS = 0.2)	Sample Measurement										
PARM Code 01104 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	mg/L		Annually	24-hr FPC
Chloride (as Cl) (GWS = 250)	Sample Measurement										
PARM Code 00940 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	mg/L		Annually	24-hr FPC
Iron, Total Recoverable (GWS = 0.3)	Sample Measurement										
PARM Code 00980 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	mg/L		Annually	24-hr FPC
Copper, Total Recoverable (GWS = 1,000)	Sample Measurement										
PARM Code 01119 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Manganese, Total Recoverable (GWS = 50)	Sample Measurement										
PARM Code 11123 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC

DISCHARGE MONITORING REPORT - PART A (Continued)

FACILITY: Manatee County North Regional WRF

MONITORING GROUP NUMBER: RWS-A

PERMIT NUMBER: FLA012617-026-DW1P/NRL

MONITORING PERIOD From: ____________________ To: ______________

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
Silver, Total Recoverable (GWS = 100)	Sample Measurement										
PARM Code 01079 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
Sulfate, Total (GWS = 250)	Sample Measurement										
PARM Code 00945 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	mg/L		Annually	24-hr FPC
Zinc, Total Recoverable (GWS = 5,000)	Sample Measurement										
PARM Code 01094 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	ug/L		Annually	24-hr FPC
pH (GWS = 6.5-8.5)	Sample Measurement										
PARM Code 00400 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	s.u.		Annually	Grab
Solids, Total Dissolved (TDS) (GWS = 500)	Sample Measurement										
PARM Code 70295 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	mg/L		Annually	24-hr FPC
Foaming Agents (GWS = 0.5)	Sample Measurement										
PARM Code 01288 P Mon. Site No. RWS-A	Permit Requirement						Report (Max.)	mg/L		Annually	24-hr FPC

INSTRUCTIONS FOR COMPLETING THE WASTEWATER DISCHARGE MONITORING REPORT

Read these instructions before completing the DMR. Hard copies and/or electronic copies of the required parts of the DMR were provided with the permit. All required information shall be completed in full and typed or printed in ink. A signed, original DMR shall be mailed to the address printed on the DMR by the 28th of the month following the monitoring period. Facilities who submit their DMR(s) electronically through eDMR do not need to submit a hardcopy DMR. The DMR shall not be submitted before the end of the monitoring period.

The DMR consists of three parts--A, B, and D--all of which may or may not be applicable to every facility. Facilities may have one or more Part A's for reporting effluent or reclaimed water data. All domestic wastewater facilities will have a Part B for reporting daily sample results. Part D is used for reporting ground water monitoring well data.

When results are not available, the following codes should be used on parts A and D of the DMR and an explanation provided where appropriate. Note: Codes used on Part B for raw data are different.

CODE	DESCRIPTION/INSTRUCTIONS
ANC	Analysis not conducted.
DRY	Dry Well
FLD	Flood disaster.
IFS	Insufficient flow for sampling.
LS	Lost sample.
MNR	Monitoring not required this period.

CODE	DESCRIPTION/INSTRUCTIONS
NOD	No discharge from/to site.
OPS	Operations were shut down so no sample could be taken.
OTH	Other. Please enter an explanation of why monitoring data were not available.
SEF	Sampling equipment failure.

When reporting analytical results that fall below a laboratory's reported method detection limits or practical quantification limits, the following instructions should be used, unless indicated otherwise in the permit or on the DMR:

1. Results greater than or equal to the PQL shall be reported as the measured quantity.
2. Results less than the PQL and greater than or equal to the MDL shall be reported as the laboratory's MDL value. These values shall be deemed equal to the MDL when necessary to calculate an average for that parameter and when determining compliance with permit limits.
3. Results less than the MDL shall be reported by entering a less than sign ("<") followed by the laboratory's MDL value, e.g. < 0.001. A value of one-half the MDL or one-half the effluent limit, whichever is lower, shall be used for that sample when necessary to calculate an average for that parameter. Values less than the MDL are considered to demonstrate compliance with an effluent limitation.

PART A -DISCHARGE MONITORING REPORT (DMR)

Part A of the DMR is comprised of one or more sections, each having its own header information. Facility information is preprinted in the header as well as the monitoring group number, whether the limits and monitoring requirements are interim or final, and the required submittal frequency (e.g. monthly, annually, quarterly, etc.). Submit Part A based on the required reporting frequency in the header and the instructions shown in the permit. The following should be completed by the permittee or authorized representative:

Resubmitted DMR: Check this box if this DMR is being re-submitted because there was information missing from or information that needed correction on a previously submitted DMR. The information that is being revised should be clearly noted on the re-submitted DMR (e.g. highlight, circle, etc.)
No Discharge From Site: Check this box if no discharge occurs and, as a result, there are no data or codes to be entered for all of the parameters on the DMR for the entire monitoring group number; however, if the monitoring group includes other monitoring locations (e.g., influent sampling), the "NOD" code should be used to individually denote those parameters for which there was no discharge.
Monitoring Period: Enter the month, day, and year for the first and last day of the monitoring period (i.e. the month, the quarter, the year, etc.) during which the data on this report were collected and analyzed.
Sample Measurement: Before filling in sample measurements in the table, check to see that the data collected correspond to the limit indicated on the DMR (i.e. interim or final) and that the data correspond to the monitoring group number in the header. Enter the data or calculated results for each parameter on this row in the non-shaded area above the limit. Be sure the result being entered corresponds to the appropriate statistical base code (e.g. annual average, monthly average, single sample maximum, etc.) and units. Data qualifier codes are not to be reported on Part A.
No. Ex.: Enter the number of sample measurements during the monitoring period that exceeded the permit limit for each parameter in the non-shaded area. If none, enter zero.
Frequency of Analysis: The shaded areas in this column contain the minimum number of times the measurement is required to be made according to the permit. Enter the actual number of times the measurement was made in the space above the shaded area.
Sample Type: The shaded areas in this column contain the type of sample (e.g. grab, composite, continuous) required by the permit. Enter the actual sample type that was taken in the space above the shaded area.
Signature: This report must be signed in accordance with Rule 62-620.305, F.A.C. Type or print the name and title of the signing official. Include the telephone number where the official may be reached in the event there are questions concerning this report. Enter the date when the report is signed.
Comment and Explanation of Any Violations: Use this area to explain any exceedances, any upset or by-pass events, or other items which require explanation. If more space is needed, reference all attachments in this area.

PART B - DAILY SAMPLE RESULTS

Monitoring Period: Enter the month, day, and year for the first and last day of the monitoring period (i.e. the month, the quarter, the year, etc.) during which the data on this report were collected and analyzed.
Daily Monitoring Results: Transfer all analytical data from your facility's laboratory or a contract laboratory's data sheets for all day(s) that samples were collected. Record the data in the units indicated. Table 1 in Chapter 62-160, F.A.C., contains a complete list of all the data qualifier codes that your laboratory may use when reporting analytical results. However, when transferring numerical results onto Part B of the DMR, only the following data qualifier codes should be used and an explanation provided where appropriate.

CODE	DESCRIPTION/INSTRUCTIONS
<	The compound was analyzed for but not detected.
A	Value reported is the mean (average) of two or more determinations.
J	Estimated value, value not accurate.
Q	Sample held beyond the actual holding time.
Y	Laboratory analysis was from an unpreserved or improperly preserved sample.

To calculate the monthly average, add each reported value to get a total. For flow, divide this total by the number of days in the month. For all other parameters, divide the total by the number of observations.
Plant Staffing: List the name, certificate number, and class of all state certified operators operating the facility during the monitoring period. Use additional sheets as necessary.

PART D - GROUND WATER MONITORING REPORT

Monitoring Period: Enter the month, day, and year for the first and last day of the monitoring period (i.e. the month, the quarter, the year, etc.) during which the data on this report were collected and analyzed.
Date Sample Obtained: Enter the date the sample was taken. Also, check whether or not the well was purged before sampling.
Time Sample Obtained: Enter the time the sample was taken.
Sample Measurement: Record the results of the analysis. If the result was below the minimum detection limit, indicate that. Data qualifier codes are not to be reported on Part D.
Detection Limits: Record the detection limits of the analytical methods used.
Analysis Method: Indicate the analytical method used. Record the method number from Chapter 62-160 or Chapter 62-601, F.A.C., or from other sources.
Sampling Equipment Used: Indicate the procedure used to collect the sample (e.g. airlift, bucket/bailer, centrifugal pump, etc.)
Samples Filtered: Indicate whether the sample obtained was filtered by laboratory (L), filtered in field (F), or unfiltered (N).
Signature: This report must be signed in accordance with Rule 62-620.305, F.A.C. Type or print the name and title of the signing official. Include the telephone number where the official may be reached in the event there are questions concerning this report. Enter the date when the report is signed.
Comments and Explanation: Use this space to make any comments on or explanations of results that are unexpected. If more space is needed, reference all attachments in this area.

SPECIAL INSTRUCTIONS FOR LIMITED WET WEATHER DISCHARGES

Flow (Limited Wet Weather Discharge): Enter the measured average flow rate during the period of discharge or divide gallons discharged by duration of discharge (converted into days). Record in million gallons per day (MGD).
Flow (Upstream): Enter the average flow rate in the receiving stream upstream from the point of discharge for the period of discharge. The average flow rate can be calculated based on two measurements; one made at the start and one made at the end of the discharge period. Measurements are to be made at the upstream gauging station described in the permit.
Actual Stream Dilution Ratio: To calculate the Actual Stream Dilution Ratio, divide the average upstream flow rate by the average discharge flow rate. Enter the Actual Stream Dilution Ratio accurate to the nearest 0.1.
No. of Days the SDF > Stream Dilution Ratio: For each day of discharge, compare the minimum Stream Dilution Factor (SDF) from the permit to the calculated Stream Dilution Ratio. On Part B of the DMR, enter an asterisk (*) if the SDF is greater than the Stream Dilution Ratio on any day of discharge. On Part A of the DMR, add up the days with an "*" and record the total number of days the Stream Dilution Factor was greater than the Stream Dilution Ratio.
$CBOD_5$: Enter the average $CBOD_5$ of the reclaimed water discharged during the period shown in duration of discharge.
TKN: Enter the average TKN of the reclaimed water discharged during the period shown in duration of discharge.
Actual Rainfall: Enter the actual rainfall for each day on Part B. Enter the actual cumulative rainfall to date for this calendar year and the actual total monthly rainfall on Part A. The cumulative rainfall to date for this calendar year is the total amount of rain, in inches, that has been recorded since January 1 of the current year through the month for which this DMR contains data.
Rainfall During Average Rainfall Year: On Part A, enter the total monthly rainfall during the average rainfall year and the cumulative rainfall for the average rainfall year. The cumulative rainfall for the average rainfall year is the amount of rain, in inches, which fell during the average rainfall year from January through the month for which this DMR contains data.
No. of Days LWWD Activated During Calendar Year: Enter the cumulative number of days that the limited wet weather discharge was activated since January 1 of the current year.
Reason for Discharge: Attach to the DMR a brief explanation of the factors contributing to the need to activate the limited wet weather discharge.

STATEMENT OF BASIS
FOR
STATE OF FLORIDA DOMESTIC WASTEWATER FACILITY PERMIT

PERMIT NUMBER: FLA012617-026

FACILITY NAME: Manatee County North Regional WRF

FACILITY LOCATION: 8500 69th St E, Palmetto, FL 34221-9064
Manatee County

NAME OF PERMITTEE: Manatee County Utilities Department

PERMIT WRITER: Ryan Curll

1. SUMMARY OF APPLICATION

a. Chronology of Application

Application Number: FLA012617-026-DW1P/NRL

Application Submittal Date: August 21, 2015

b. Type of Facility

Domestic Wastewater Treatment Plant

Ownership Type: County

SIC Code: 4952

c. Facility Capacity

Existing Permitted Capacity:	7.5 mgd	Three Month Average Daily Flow
Proposed Increase in Permitted Capacity:	0.0 mgd	Three Month Average Daily Flow
Proposed Total Permitted Capacity:	7.5 mgd	Three Month Average Daily Flow

d. Description of Wastewater Treatment

Operation of an existing 7.5 Million Gallon per Day (MGD) Three-Month Rolling Average Daily Flow (TMRADF), Type I, oxidation ditch activated sludge domestic wastewater treatment facility consisting of: a head works with two automatic bar screens, one manual bar screen, and a forced flow vortex grit removal unit; two Carrousel oxidation ditches (each with a 0.6 Million Gallons [MG] anoxic basin and a 3.1 MG aeration basin, for a total oxidation ditch volume of 7.4 MG), three clarifiers (each with a volume of 1 MG and a surface area of 9,500 Square Feet [SF], for a total clarification volume of 3 MG and total surface area of 28,500 SF), a 32,000 gallon mixing/flow splitter basin, two automatic backwash traveling bridge filters (each with a surface area of 1,440 SF, for a total surface area of 2,880 SF), two automatic backwash cloth media disk filters (each rated at 3 MGD for a total disk filter capacity of 6 MGD), and two chlorine contact chambers each with two basins (one chlorine contact chamber with a volume of 144,000 gallons and one chlorine contact chamber with a volume of 168,000 gallons for total volume of 312,000 gallons). Disinfection is achieved using sodium hypochlorite. Waste activated sludge is directed from the clarifiers to three aerobic digesters (two digesters with a volume of 0.6 MG each and one digester with a volume of 1.05 MG, for a total digester volume of 2.25 MG), and four belt filter presses. The North Regional WRF is a source facility for residuals processing at the Manatee County Southeast Regional Water Reclamation Facility (Permit FLA012618).

During a site visit, it was noted that there are two automatic bar screens at this facility, as noted in the description above. Only one automatic bar screen was listed on the existing permit.

e. Description of Proposed Modifications (as reported by applicant)

Construction of a 3 MG equalization basin and installation of a forced flow vortex grit removal unit. The modification will include the construction and installation of a cover and odor control, a splitter box, a new electrical building, a pump-back station, a platform with stairway, as well as all of the necessary electrical, instrumentation and controls with SCADA modifications, and all necessary new piping and appurtenances.

The existing permit was modified to include the construction of a 3.7 MG Carrousel oxidation ditch and two 6.0 MG ground storage tanks. The County has notified the Department that these modifications will no longer be constructed, per an email from the County dated 9/23/2015, so the modification language was not retained.

g. Description of Effluent Disposal and Land Application Sites

Land Application R-001: An existing 7.5 MGD Annual Average Daily Flow (AADF) permitted capacity Part III slow-rate public access reuse (PAR) system (R-001). The MC North Regional WRF serves as a source plant for the Manatee County Master Reuse System (Permit FLA474029). A 49.0 MG PAR storage pond is located onsite. The Manatee County Master Reuse System Permit contains additional PAR storage information.

Land Application R-002: An existing Part IV rapid-rate land application system (R-002). R-002 consists of a single-cell Rapid Infiltration Basin (RIB). R-002 is used to store reject water until it is returned to the headworks for further treatment when no other discharge location is available. R-002's southwestern embankment is equipped with an overflow structure to the 49.0 MG PAR storage pond. An overflow from R-002 to the storage pond will require the water in the storage pond to be sent to the plant for retreatment. R-002 is located approximately at Latitude 27° 35' 04" N, Longitude 82° 28' 29" W.

2. SUMMARY OF SURFACE WATER DISCHARGE

This facility does not discharge to surface waters.

3. BASIS FOR PERMIT LIMITATIONS AND MONITORING REQUIREMENTS

This facility is authorized to direct reclaimed water to Reuse System R-001, a slow-rate public access system, based on the following:

Parameter	Units	Max/ Min	Limit	Statistical Basis	Rationale
Flow	MGD	Max	7.5	Annual Average	62-600.400(3)(b) & 62-610.810(5) FAC
		Max	Report	Monthly Average	62-600.400(3)(b) & 62-610.810(5) FAC
BOD, Carbonaceous 5 day, 20C	mg/L	Max	20.0	Annual Average	62-610.460 & 62-600.740(1)(b)1.a. FAC
		Max	30.0	Monthly Average	62-600.740(1)(b)1.b. FAC
		Max	45.0	Weekly Average	62-600.740(1)(b)1.c. FAC
		Max	60.0	Single Sample	62-600.740(1)(b)1.d. FAC
Solids, Total Suspended	mg/L	Max	5.0	Single Sample	62-610.460(1) & 62-600.440(5)(f)3. FAC

Parameter	Units	Max/ Min	Limit	Statistical Basis	Rationale
pH	s.u.	Min	6.0	Single Sample	62-600.445 FAC
		Max	8.5	Single Sample	62-600.445 FAC
Coliform, Fecal	#/100mL	Max	25	Single Sample	62-610.460 & 62-600.440(5)(f)2. FAC
Coliform, Fecal, % less than detection	percent	Min	75	Monthly Total	62-600.440(5)(f)1. FAC
Chlorine, Total Residual (For Disinfection)	mg/L	Min	1.0	Single Sample	62-600.440(5)(b), 62-610.460(2), & 62-610.463(2) FAC
Turbidity	NTU	Max	Report	Single Sample	62-610.463(2) FAC
Nitrogen, Total	mg/L	Max	Report	Single Sample	62-601.300(6) FAC
Phosphorus, Total (as P)	mg/L	Max	Report	Single Sample	62-601.300(6) FAC
Giardia	cysts/100L	Max	Report	Single Sample	62-610.463(4) FAC
Cryptosporidium	oocysts/100L	Max	Report	Single Sample	62-610.463(4) FAC

This facility is authorized to direct reclaimed water to Reuse System R-002, a rapid infiltration basin system, based on the following:

Parameter	Units	Max/ Min	Limit	Statistical Basis	Rationale
Flow	MGD	Max	Report	Annual Average	62-600.400(3)(b) & 62-610.810(5) FAC
		Max	Report	Monthly Average	62-600.400(3)(b) & 62-610.810(5) FAC
BOD, Carbonaceous 5 day, 20C	mg/L	Max	20.0	Annual Average	62-610.510 & 62-600.740(1)(b)1.a. FAC
		Max	30.0	Monthly Average	62-600.740(1)(b)1.b. FAC
		Max	45.0	Weekly Average	62-600.740(1)(b)1.c. FAC
		Max	60.0	Single Sample	62-600.740(1)(b)1.d. FAC
Solids, Total Suspended	mg/L	Max	20.0	Annual Average	62-610.510 & 62-600.740(1)(b)1.a. FAC
		Max	30.0	Monthly Average	62-600.740(1)(b)1.b. FAC
		Max	45.0	Weekly Average	62-600.740(1)(b)1.c. FAC
		Max	60.0	Single Sample	62-600.740(1)(b)1.d. FAC
pH	s.u.	Min	6.0	Single Sample	62-600.445 FAC
		Max	8.5	Single Sample	62-600.445 FAC
Coliform, Fecal	#/100mL	Max	200	Annual Average	62-610.510 & 62-600.440(4)(c)1. FAC
		Max	800	Single Sample	62-600.440(4)(c)4. FAC
Chlorine, Total Residual (For Disinfection)	mg/L	Min	0.5	Single Sample	62-610.510 & 62-600.440(4)(b) FAC
Nitrogen, Nitrate, Total (as N)	mg/L	Max	12.0	Single Sample	62-610.510(1) FAC

Other Limitations and Monitoring Requirements:

Parameter	Units	Max/ Min	Limit	Statistical Basis	Rationale
Flow	MGD	Max	7.5	3-Month Rolling Average	62-600.400(3)(b) FAC

Parameter	Units	Max/ Min	Limit	Statistical Basis	Rationale
		Max	Report	Monthly Average	62-600.400(3)(b) FAC
Percent Capacity, (TMADF/Permitted Capacity) x 100	percent	Max	Report	Monthly Average	62-600.405(4) FAC
BOD, Carbonaceous 5 day, 20C (Influent)	mg/L	Max	Report	Monthly Average	62-601.300(1) FAC
Solids, Total Suspended (Influent)	mg/L	Max	Report	Monthly Average	62-601.300(1) FAC
Monitoring Frequencies and Sample Types	-	-	-	All Parameters	62-601 FAC & 62-699 FAC and/or BPJ of permit writer
Sampling Locations	-	-	-	All Parameters	62-601, 62-610.412, 62-610.463(1), 62-610.568, 62-610.613 FAC and/or BPJ of permit writer

4. DISCUSSION OF CHANGES TO PERMIT LIMITATIONS
The current wastewater permit for this facility FLA012617-025-DW1P/NR expires on February 2, 2016.

There were no changes to permit limitations.

5. BIOSOLIDS MANAGEMENT REQUIREMENTS

Biosolids generated by this facility may be transferred to a Biosolids Treatment Facility (BTF) or disposed of in a Class I solid waste landfill.

See the table below for the rationale for the biosolids quantities monitoring requirements.

Parameter	Units	Max/ Min	Limit	Statistical Basis	Rationale
Biosolids Quantity (Transferred)	dry tons	Max	Report	Monthly Total	62-640.650(5)(a)1. FAC
Biosolids Quantity (Landfilled)	dry tons	Max	Report	Monthly Total	62-640.650(5)(a)1. FAC
Monitoring Frequency		All Parameters			62-640.650(5)(a) FAC

6. GROUND WATER MONITORING REQUIREMENTS

Ground water monitoring requirements are contained in the Manatee County Master Reuse System (MCMRS), Permit No. FLA474029.

7. PERMIT SCHEDULES

Implementation Step		Completion Date
a.	Submit an application for permit renewal.	At least 180 days before existing permit expiration date.
b.	Submit a revised Operating Protocol to the Department's Compliance Assurance Program for review and approval prior to placing the new facilities into operation.	Ninety (90) days prior to the completion of construction.
c.	Provide appropriate documentation as required in permit Conditions VII. 9 & 10 for any new facilities or unit processes.	As required by permit Conditions VII. 9 & 10

8. INDUSTRIAL PRETREATMENT REQUIREMENTS

The permittee has an active, approved industrial pretreatment program. The permit includes standard conditions requiring implementation and enforcement of the existing program.

9. ADMINISTRATIVE ORDERS (AO) AND CONSENT ORDERS (CO)

This permit is not accompanied by an AO and has not entered into a CO with the Department.

10. REQUESTED VARIANCES OR ALTERNATIVES TO REQUIRED STANDARDS

No variances were requested for this facility.

11. TERM OF THE PERMIT

The permittee requested a 10-year permit for this renewal. The treatment facility has generally met all water quality standards and has operated in conformance with the limits of permitted flows and other conditions specified in the existing permit. It is my best professional judgement that a 10-year permit be issued for this facility.

12. THE ADMINISTRATIVE RECORD

The administrative record including application, draft permit, fact sheet, public notice (after release), comments received and additional information is available for public inspection during normal business hours at the location specified in item 13. Copies will be provided at a minimal charge per page.

13. DEP CONTACT

Additional information concerning the permit and proposed schedule for permit issuance may be obtained during normal business hours from:

Ryan Curll
Engineer II
Southwest District Office
13051 N Telecom Pkwy
Temple Terrace, FL 33637-0926
Ryan.Curll@dep.state.fl.us
Telephone No.: (813) 470-5947

Butler, Linda

From: Brantley, Anna on behalf of SWD_Clerical (Shared Mailbox)
Sent: Tuesday, October 20, 2015 9:47 AM
To: Butler, Linda
Subject: FW: WF - Manatee County North Regional WRF (FLA012617-026-DW1P/NRL)

Follow Up Flag: Follow up
Flag Status: Completed

Please process

From: Thompson, Steve
Sent: Tuesday, October 20, 2015 9:30 AM
To: SWD_Clerical (Shared Mailbox) <SWD_Clerical@dep.state.fl.us>
Cc: Curll, Ryan <Ryan.Curll@dep.state.fl.us>
Subject: FW: WF - Manatee County North Regional WRF (FLA012617-026-DW1P/NRL)

Please process.
Thanks,
Steve

From: Curll, Ryan
Sent: Wednesday, October 14, 2015 3:16 PM
To: Thompson, Steve <Steve.Thompson@dep.state.fl.us>
Subject: RE: WF - Manatee County North Regional WRF (FLA012617-026-DW1P/NRL)

Steve – I have made the suggested edits from the County. In legal docs, there is only "bi-annually" for the "every two years" monitoring. Other than the bi-annual question, I believe the permit is ready for final approval.

From: Thompson, Steve
Sent: Thursday, September 24, 2015 11:08 AM
To: Curll, Ryan <Ryan.Curll@dep.state.fl.us>
Subject: RE: WF - Manatee County North Regional WRF (FLA012617-026-DW1P/NRL)

Acknowledged.
Thanks

From: Curll, Ryan
Sent: Wednesday, September 23, 2015 4:49 PM
To: Thompson, Steve <Steve.Thompson@dep.state.fl.us>
Subject: WF - Manatee County North Regional WRF (FLA012617-026-DW1P/NRL)

L:\all_common\Sites\Manatee\DW\Manatee County North Regional - FLA012617\Permit\026 NRL

Day 30 for this project is: September 20, 2015

Notes to Administrative Staff: DW 10-Year Permit

Send to SWD_Clerical for permit issuance.

For IW and DW individual permit, please indicate whether the permit is Non-NPDES

County: **Manatee**

<u>DW Permits</u>
Catalog: Wastewater
Profile: Permitting Authorization
Document: **Permit Final**
Permit Type: **DW Facility**
Facility Type: **Domestic Wastewater**
Application Number: FLA012617026
Document Subject: 026 DW1PNRL Final permit

Thanks!
Ryan Curll
Engineering Specialist II
Permitting & Waste Cleanup Program, Southwest District
Florida Department of Environmental Protection
Ryan.Curll@dep.state.fl.us
(813)470-5947

OCULUS

APPENDIX B:

VISUAL HYDRAULICS MODEL REPORT OUTPUT – 10 MGD WITH MLE, CLASS I RELIABILITY

Visual Hydraulics Summary Report - Hydraulic Analysis

Project: **NRWRF Expansion to 12.5 MGD_10 MLE Class I Adjusted 2023-02-27.vh**
Company: **McKim & Creed**
Date: **February 28, 2023**

Current flow conditions

Forward Flow =	25 mgd
Return I Flow =	12.5 mgd
Return II Flow =	12 mgd
Return III Flow =	-----

Section Description	Water Surface Elevation
CCC1 Train 2 Effluent Cipolletti Weir	**29.36**
CCC2 NORTH Effluent Cipolletti Weir	**25.21**
CCC1 Train 1 Effluent Cipolletti Weir	**28.75**
CCC1 Slide Gate #2	**29.38**

Opening type = rectangular gate
Opening diameter/width = 72 in
Gate height = 72 in
Invert = 25.75
Number of gates = 1
Flow through gate(s) = 4.168 mgd
Total area of opening(s) = 36 ft^2
Velocity through gate(s) = 0.18 ft/s

CCC2 Influent Slide Gate 1 — **29.38**

Opening type = rectangular gate
Opening diameter/width = 72 in
Gate height = 64 in
Invert = 25.81
Number of gates = 1
Flow through gate(s) = 4.168 mgd
Total area of opening(s) = 32 ft^2
Velocity through gate(s) = 0.2 ft/s

CCC2 Influent Chamber — **29.38**

User defined loss for flow split = 0 ft

Section Description	Water Surface Elevation

Total flow through flow split = 4.168 mgd

Pipe - tee to CCC2 **29.39**

Pipe shape = Circular
Diameter = 42 in
Length = 10 ft
Flow = 4.169 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 1.3
Pipe area = 9.62 ft²
Pipe hydraulic radius = 0.875
Age factor = 1
Solids factor = 1
Velocity = 0.67 ft/s
Friction loss = 0 ft
Fitting loss = 0.01 ft
Total loss = 0.01 ft

Tee connecting AquaDiamond Filters to Disk Filters Eff

CCC1 Slide Gate #1 **29.38**

Opening type = rectangular gate
Opening diameter/width = 72 in
Gate height = 72 in
Invert = 25.75
Number of gates = 1
Flow through gate(s) = 4.168 mgd
Total area of opening(s) = 36 ft^2
Velocity through gate(s) = 0.18 ft/s

CCC1 Influent Chamber **29.38**

User defined loss for flow split = 0 ft
Total flow through flow split = 8.337 mgd

Filters to CCC1 after Wye **29.46**

Pipe shape = Circular
Diameter = 42 in
Length = 60 ft
Flow = 8.337 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 2.65
Pipe area = 9.62 ft²
Pipe hydraulic radius = 0.875
Age factor = 1
Solids factor = 1
Velocity = 1.34 ft/s

Section Description	Water Surface Elevation
Friction loss = 0.01 ft Fitting loss = 0.07 ft Total loss = 0.08 ft	
Wye to CCCs	**29.46**
User defined loss for flow split = 0 ft Total flow through flow split = 8.337 mgd	
AquaDiamond Filters to CCC Pipe 1	**29.85**
Pipe shape = Circular Diameter = 36 in Length = 167 ft Flow = 12.5 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 2.18 Pipe area = 7.07 ft² Pipe hydraulic radius = 0.75 Age factor = 1 Solids factor = 1 Velocity = 2.74 ft/s Friction loss = 0.13 ft Fitting loss = 0.25 ft Total loss = 0.38 ft	
AquaDiamond Filters to Disk Filters Eff Pipe	**29.85**
User defined loss for flow split = 0 ft Total flow through flow split = 15.5 mgd	
AquaDiamond Filters Common Eff. Channel	**29.85**
Channel shape = Rectangular Manning's 'n' = 0.012 Channel length = 47 ft Channel width/diameter = 3 ft Flow = 9.25 mgd Downstream channel invert = 26 Channel slope = 0 ft/ft Channel side slope = not applicable Area of flow = 11.55 ft^2 Hydraulic radius = 1.079 Normal depth = infinite Critical depth = 0.89 ft Depth downstream = 3.85 ft Bend loss = 0 ft Depth upstream = 3.85 ft Velocity = 1.24 ft/s Flow profile = Horizontal	

Section Description	Water Surface Elevation
Disk Filters to CCCs	**29.6**

Pipe shape = Circular
Diameter = 42 in
Length = 132 ft
Flow = 12.5 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 2.66
Pipe area = 9.62 ft^2
Pipe hydraulic radius = 0.875
Age factor = 1
Solids factor = 1
Velocity = 2.01 ft/s
Friction loss = 0.05 ft
Fitting loss = 0.17 ft
Total loss = 0.21 ft

Pipe - Disk Filters to Wye	**29.39**

Pipe shape = Circular
Diameter = 36 in
Length = 30 ft
Flow = 0 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 0
Pipe area = 7.07 ft^2
Pipe hydraulic radius = 0.75
Age factor = 1
Solids factor = 1
Velocity = 0 ft/s
Friction loss = 0 ft
Fitting loss = 0 ft
Total loss = 0 ft

Disk Filters Effluent Pipe	**29.69**

Pipe shape = Circular
Diameter = 36 in
Length = 72 ft
Flow = 9.5 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 0.8
Pipe area = 7.07 ft^2
Pipe hydraulic radius = 0.75
Age factor = 1
Solids factor = 1

Section Description	Water Surface Elevation
Velocity = 2.08 ft/s Friction loss = 0.03 ft Fitting loss = 0.05 ft Total loss = 0.09 ft	
Pipe - AquaDiamond Filters to Disk Filters Eff Pipe	**29.61**
Pipe shape = Circular Diameter = 42 in Length = 35 ft Flow = 3 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 1.93 Pipe area = 9.62 ft² Pipe hydraulic radius = 0.875 Age factor = 1 Solids factor = 1 Velocity = 0.48 ft/s Friction loss = 0 ft Fitting loss = 0.01 ft Total loss = 0.01 ft	
Disk Filters Common Eff. Channel	
Disk Filters Eff. Weir - Contracted 1	**31.81**
Weir invert (top of weir) = 31.35 Number of contracted sides = 2 Weir length = 7.5 ft Flow over weir = 4.75 mgd Submergence = unsubmerged Head over weir = 0.46 ft	
Disk Filters Eff. Weir - Contracted 2	**31.81**
Weir invert (top of weir) = 31.35 Number of contracted sides = 2 Weir length = 7.5 ft Flow over weir = 4.75 mgd Submergence = unsubmerged Head over weir = 0.46 ft	
Disk Filters Inf. Weir 2	**33.29**
Weir invert (top of weir) = 32.9 Weir length = 9.17 ft Weir 'C' coefficient = 3.33 Flow over weir = 4.75 mgd Weir submergence = unsubmerged Head over weir = 0.39 ft	

Section Description	**Water Surface Elevation**
Disk Filters Inf. Slide Gate 2	**33.33**
Opening type = rectangular gate	
Opening diameter/width = 36 in	
Gate height = 30 in	
Invert = 30.41	
Number of gates = 1	
Flow through gate(s) = 4.75 mgd	
Total area of opening(s) = 7.5 ft^2	
Velocity through gate(s) = 0.98 ft/s	
Flow behavior = weir control	
Gate loss = 0.04 ft	
Downstream water level = 33.29	
Upstream water level = 33.33	
Disk Filters Inf. Weir 1	**33.29**
Weir invert (top of weir) = 32.9	
Weir length = 9.17 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 4.75 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.39 ft	
Disk Filters Inf. Slide Gate 1	**33.33**
Opening type = rectangular gate	
Opening diameter/width = 36 in	
Gate height = 30 in	
Invert = 30.41	
Number of gates = 1	
Flow through gate(s) = 4.75 mgd	
Total area of opening(s) = 7.5 ft^2	
Velocity through gate(s) = 0.98 ft/s	
Flow behavior = weir control	
Gate loss = 0.04 ft	
Downstream water level = 33.29	
Upstream water level = 33.33	
Disk Filters Common Inf. Channel Flow Split	**33.33**
User defined loss for flow split = 0 ft	
Total flow through flow split = 9.5 mgd	
Filter FSB to Disk Filters - Pipe	**33.46**
Pipe shape = Circular	
Diameter = 36 in	
Length = 19 ft	
Flow = 9.5 mgd	
Friction method = Hazen Williams	

Section Description	**Water Surface Elevation**
Friction factor = 120	
Total fitting K value = 1.8	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 2.08 ft/s	
Friction loss = 0.01 ft	
Fitting loss = 0.12 ft	
Total loss = 0.13 ft	
Filter FSB Eff. Weir to Disk Filters	**34.74**
Weir invert (top of weir) = 34	
Weir length = 7 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 9.5 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.74 ft	
AquaDiamond Filters Common Eff. Channel Flow Comb	
AquaDiamond Filters Eff. Weir 1	**30.94**
Weir invert (top of weir) = 30.58	
Weir length = 20 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 9.25 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.36 ft	
AquaDiamond Filters Inf. Weir 1	**32.01**
Weir invert (top of weir) = 31.58	
Weir length = 15 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 9.25 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.43 ft	
AquaDiamond Filters Inf. Slide Gate #1	**32.14**
Opening type = rectangular gate	
Opening diameter/width = 36 in	
Gate height = 45 in	
Invert = 29.58	
Number of gates = 1	
Flow through gate(s) = 9.25 mgd	
Total area of opening(s) = 11.25 ft^2	
Velocity through gate(s) = 1.27 ft/s	
AquaDiamond Filters Common Inf. Channel	**32.14**

Section Description	Water Surface Elevation
User defined loss for flow split = 0 ft	
Total flow through flow split = 9.25 mgd	
Filter FSB to AquaDiamond Filters - Pipe	**32.28**
Pipe shape = Circular	
Diameter = 36 in	
Length = 64 ft	
Flow = 9.25 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.75	
Pipe area = 7.07 ft^2	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 2.02 ft/s	
Friction loss = 0.03 ft	
Fitting loss = 0.11 ft	
Total loss = 0.14 ft	
Filter FSB Eff. Weir to AquaDiamond Filters	**34.72**
Weir invert (top of weir) = 34	
Weir length = 7 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 9.25 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.72 ft	
Filter FSB Eff. Flow Split	**34.74**
User defined loss for flow split = 0 ft	
Total flow through flow split = 18.75 mgd	
Filter FSB Influent Channel Approximation	**34.74**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 50 ft	
Channel width/diameter = 15 ft	
Flow = 25.001 mgd	
Downstream channel invert = 23.83	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 163.58 ft^2	
Hydraulic radius = 4.444	
Normal depth = infinite	
Critical depth = 0.59 ft	
Depth downstream = 10.91 ft	
Bend loss = 0 ft	

Section Description	Water Surface Elevation
Depth upstream = 10.91 ft	
Velocity = 0.24 ft/s	
Flow profile = Horizontal	
Filter FSB Slide Gate	**34.8**
Opening type = rectangular gate	
Opening diameter/width = 72 in	
Gate height = 60 in	
Invert = 26.58	
Number of gates = 1	
Flow through gate(s) = 25 mgd	
Total area of opening(s) = 30 ft^2	
Velocity through gate(s) = 1.29 ft/s	
Filter Flow Splitter Box Inf. Flow Combination	
Clarifiers #1 and #2 Eff. Pipe 2	**35.23**
Pipe shape = Circular	
Diameter = 36 in	
Length = 240 ft	
Flow = 12.5 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.05	
Pipe area = 7.07 ft^2	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 2.74 ft/s	
Friction loss = 0.18 ft	
Fitting loss = 0.24 ft	
Total loss = 0.42 ft	
Clarifier #3 Eff. Pipe 2	**34.94**
Pipe shape = Circular	
Diameter = 36 in	
Length = 170 ft	
Flow = 6.25 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 3.35	
Pipe area = 7.07 ft^2	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 1.37 ft/s	
Friction loss = 0.04 ft	

Section Description	Water Surface Elevation
Fitting loss = 0.1 ft Total loss = 0.13 ft	
Clarifier #3 Eff. Pipe 1	**35.16**
Pipe shape = Circular Diameter = 30 in Length = 30 ft Flow = 6.25 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 3.5 Pipe area = 4.91 ft^2 Pipe hydraulic radius = 0.625 Age factor = 1 Solids factor = 1 Velocity = 1.97 ft/s Friction loss = 0.02 ft Fitting loss = 0.21 ft Total loss = 0.23 ft	
Clarifier #3 Eff. Launder	**37.64**
Launder invert = 36.08 Launder length = 172.79 ft Launder width = 2 ft Launder slope = 0 ft/ft Flow through launder = 6.25 mgd Critical depth = 0.9 ft Downstream depth = 0.9 ft Upstream depth = 1.56 ft	
Clarifier #3 V-notch Weir	**38.3**
Invert of V notch = 38.17 Angle of V notch = 90 degrees Number of notches = 660 Total flow over weir = 6.25 mgd Weir submergence = unsubmerged Head over weir = 0.13 ft	
Clarifier FSB to Clarifier #3	**38.48**
Pipe shape = Circular Diameter = 36 in Length = 120 ft Flow = 10.417 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 1.48	

Section Description	Water Surface Elevation
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 2.28 ft/s	
Friction loss = 0.07 ft	
Fitting loss = 0.12 ft	
Total loss = 0.19 ft	
Clarifier FSB Weir Gate #3	**39.94**
Weir invert (top of weir) = 39.25	
Number of contracted sides = 2	
Weir length = 8 ft	
Flow over weir = 9.375 mgd	
Submergence = unsubmerged	
Head over weir = 0.69 ft	
Tee - Clarifiers #1 and #2 to Filter FSB	**35.45**
Main line diameter = 36 in	
Branch diameter = 30 in	
Main line flow = 6.25 mgd	
Branch flow = 6.25 mgd	
Tee head loss = 0.22 ft	
Tee - Eff. Pipes of Clarifiers #1 and #2	
Clarifier #1 Eff. Pipe 1	**35.67**
Pipe shape = Circular	
Diameter = 30 in	
Length = 164 ft	
Flow = 6.25 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.25	
Pipe area = 4.91 ft²	
Pipe hydraulic radius = 0.625	
Age factor = 1	
Solids factor = 1	
Velocity = 1.97 ft/s	
Friction loss = 0.09 ft	
Fitting loss = 0.14 ft	
Total loss = 0.22 ft	
Clarifier #2 Eff. Pipe 1	**35.56**
Pipe shape = Circular	
Diameter = 30 in	
Length = 18 ft	

Section Description	Water Surface Elevation
Flow = 6.25 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 1.75 Pipe area = 4.91 ft² Pipe hydraulic radius = 0.625 Age factor = 1 Solids factor = 1 Velocity = 1.97 ft/s Friction loss = 0.01 ft Fitting loss = 0.11 ft Total loss = 0.11 ft	
Clarifier #2 Eff. Launder	**37.64**
Launder invert = 36.08 Launder length = 172.79 ft Launder width = 2 ft Launder slope = 0 ft/ft Flow through launder = 6.25 mgd Critical depth = 0.9 ft Downstream depth = 0.9 ft Upstream depth = 1.56 ft	
Clarifier #2 V-notch Weir	**38.3**
Invert of V notch = 38.17 Angle of V notch = 90 degrees Number of notches = 660 Total flow over weir = 6.25 mgd Weir submergence = unsubmerged Head over weir = 0.13 ft	
Clarifier FSB to Clarifier #2	**38.48**
Pipe shape = Circular Diameter = 36 in Length = 120 ft Flow = 10.417 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 1.48 Pipe area = 7.07 ft² Pipe hydraulic radius = 0.75 Age factor = 1 Solids factor = 1 Velocity = 2.28 ft/s Friction loss = 0.07 ft Fitting loss = 0.12 ft Total loss = 0.19 ft	

Section Description	Water Surface Elevation
Clarifier FSB Weir Gate #2	**39.94**
Weir invert (top of weir) = 39.25	
Number of contracted sides = 2	
Weir length = 8 ft	
Flow over weir = 9.375 mgd	
Submergence = unsubmerged	
Head over weir = 0.69 ft	
Clarifier #1 Eff. Launder	**37.64**
Launder invert = 36.08	
Launder length = 172.79 ft	
Launder width = 2 ft	
Launder slope = 0 ft/ft	
Flow through launder = 6.25 mgd	
Critical depth = 0.9 ft	
Downstream depth = 0.9 ft	
Upstream depth = 1.56 ft	
Clarifier #1 V-notch Weir	**38.3**
Invert of V notch = 38.17	
Angle of V notch = 90 degrees	
Number of notches = 660	
Total flow over weir = 6.25 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.13 ft	
Clarifier FSB to Clarifier #1	**38.48**
Pipe shape = Circular	
Diameter = 36 in	
Length = 120 ft	
Flow = 10.416 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.48	
Pipe area = 7.07 ft^2	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 2.28 ft/s	
Friction loss = 0.07 ft	
Fitting loss = 0.12 ft	
Total loss = 0.19 ft	
Clarifier FSB Weir Gate #1	**39.94**
Weir invert (top of weir) = 39.25	
Number of contracted sides = 2	

Section Description	Water Surface Elevation
Weir length = 8 ft	
Flow over weir = 9.375 mgd	
Submergence = unsubmerged	
Head over weir = 0.69 ft	
Clarifier FSB Flow Split	**39.94**
User defined loss for flow split = 0 ft	
Total flow through flow split = 28.125 mgd	
Clarifier FSB Approximation	**39.94**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 16 ft	
Channel width/diameter = 5 ft	
Flow = 37.5 mgd	
Downstream channel invert = 23.25	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 83.45 ft^2	
Hydraulic radius = 2.174	
Normal depth = infinite	
Critical depth = 1.61 ft	
Depth downstream = 16.69 ft	
Bend loss = 0 ft	
Depth upstream = 16.69 ft	
Velocity = 0.7 ft/s	
Flow profile = Horizontal	
Pipe - Anx/Aer Basin 1 to Clarifier FSB	**40.38**
Pipe shape = Circular	
Diameter = 42 in	
Length = 440 ft	
Flow = 16.667 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.52	
Pipe area = 9.62 ft^2	
Pipe hydraulic radius = 0.875	
Age factor = 1	
Solids factor = 1	
Velocity = 2.68 ft/s	
Friction loss = 0.27 ft	
Fitting loss = 0.17 ft	
Total loss = 0.44 ft	
Anx/Aer Eff Sluice Gate #1	**40.7**
Opening type = circular gate	

Section Description	Water Surface Elevation
Opening diameter/width = 42 in	
Gate height = 42 in	
Invert = 24.08	
Number of gates = 1	
Flow through gate(s) = 16.667 mgd	
Total area of opening(s) = 9.62 ft^2	
Velocity through gate(s) = 2.68 ft/s	
Anx/Aer Basin 1 Eff. Box	**40.7**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 15 ft	
Channel width/diameter = 6 ft	
Flow = 16.667 mgd	
Downstream channel invert = 23.08	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 105.73 ft^2	
Hydraulic radius = 2.564	
Normal depth = infinite	
Critical depth = 0.83 ft	
Depth downstream = 17.62 ft	
Bend loss = 0 ft	
Depth upstream = 17.62 ft	
Velocity = 0.24 ft/s	
Flow profile = Horizontal	
Eff. Box flow combination	
Anx/Aer Basin 1 Eff. Weir Gate	**42.86**
Weir invert (top of weir) = 42.2	
Number of contracted sides = 2	
Weir length = 15 ft	
Flow over weir = 16.667 mgd	
Submergence = unsubmerged	
Head over weir = 0.66 ft	
Anx/Aer Basin 1 Port	**43.02**
Opening type = rectangular orifice	
Opening diameter/width = 57 in	
Opening height = 57 in	
Invert = 30.92	
Number of openings = 1	
Flow through opening(s) = 28.667 mgd	
Total area of opening(s) = 22.56 ft^2	
Velocity through opening(s) = 1.97 ft/s	

Section Description	Water Surface Elevation
Anx/Aer Basin 1 Inf. Sluice Gate	**43.6**
Opening type = circular gate	
Opening diameter/width = 36 in	
Gate height = 36 in	
Invert = 30.92	
Number of gates = 1	
Flow through gate(s) = 16.667 mgd	
Total area of opening(s) = 7.07 ft^2	
Velocity through gate(s) = 3.65 ft/s	
36-inch DI from Headworks to Anoxic/Aerobic Basin 1	**43.88**
Pipe shape = Circular	
Diameter = 36 in	
Length = 60 ft	
Flow = 16.667 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 0.95	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 3.65 ft/s	
Friction loss = 0.08 ft	
Fitting loss = 0.2 ft	
Total loss = 0.27 ft	
30-inch DI from Headworks to Anoxic/Aerobic Basin 1	**45.61**
Pipe shape = Circular	
Diameter = 30 in	
Length = 375 ft	
Flow = 16.667 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.25	
Pipe area = 4.91 ft²	
Pipe hydraulic radius = 0.625	
Age factor = 1	
Solids factor = 1	
Velocity = 5.25 ft/s	
Friction loss = 1.19 ft	
Fitting loss = 0.54 ft	
Total loss = 1.73 ft	
Headworks Eff. Weir Gate 1	**52.64**
Weir invert (top of weir) = 51.62	
Number of contracted sides = 2	

Section Description	Water Surface Elevation
Weir length = 6 ft	
Flow over weir = 12.501 mgd	
Submergence = unsubmerged	
Head over weir = 1.02 ft	
Pipe - connecting Anx/Aer Basins Eff. Boxes	**40.7**
Pipe shape = Circular	
Diameter = 48 in	
Length = 9.67 ft	
Flow = 0 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.23	
Pipe area = 12.57 ft^2	
Pipe hydraulic radius = 1	
Age factor = 1	
Solids factor = 1	
Velocity = 0 ft/s	
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
Pipe - Anx/Aer Basin 2 to Clarifier FSB	**40.38**
Pipe shape = Circular	
Diameter = 42 in	
Length = 440 ft	
Flow = 16.667 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.52	
Pipe area = 9.62 ft^2	
Pipe hydraulic radius = 0.875	
Age factor = 1	
Solids factor = 1	
Velocity = 2.68 ft/s	
Friction loss = 0.27 ft	
Fitting loss = 0.17 ft	
Total loss = 0.44 ft	
Anx/Aer Eff. Sluice Gate #2	**40.7**
Opening type = circular gate	
Opening diameter/width = 42 in	
Gate height = 42 in	
Invert = 24.08	
Number of gates = 1	
Flow through gate(s) = 16.667 mgd	
Total area of opening(s) = 9.62 ft^2	

Section Description	**Water Surface Elevation**
Velocity through gate(s) = 2.68 ft/s	
Anx/Aer Basin 2 Eff. Box	**40.7**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 15 ft	
Channel width/diameter = 6 ft	
Flow = 18.75 mgd	
Downstream channel invert = 23.08	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 105.73 ft^2	
Hydraulic radius = 2.564	
Normal depth = infinite	
Critical depth = 0.9 ft	
Depth downstream = 17.62 ft	
Bend loss = 0 ft	
Depth upstream = 17.62 ft	
Velocity = 0.27 ft/s	
Flow profile = Horizontal	
Anx/Aer Basin 2 Eff. Box Flow Split	**40.7**
User defined loss for flow split = 0 ft	
Total flow through flow split = 18.75 mgd	
Anx/Aer Basin 2 Eff. Weir Gate	**42.86**
Weir invert (top of weir) = 42.2	
Number of contracted sides = 2	
Weir length = 15 ft	
Flow over weir = 16.667 mgd	
Submergence = unsubmerged	
Head over weir = 0.66 ft	
Anx/Aer Basin 2 Port	**43.02**
Opening type = rectangular orifice	
Opening diameter/width = 57 in	
Opening height = 57 in	
Invert = 30.92	
Number of openings = 1	
Flow through opening(s) = 28.667 mgd	
Total area of opening(s) = 22.56 ft^2	
Velocity through opening(s) = 1.97 ft/s	
Anx/Aer Basin 2 Inf. Sluice Gate	**43.6**
Opening type = circular gate	
Opening diameter/width = 36 in	
Gate height = 36 in	

Section Description	Water Surface Elevation

Invert = 30.92
Number of gates = 1
Flow through gate(s) = 16.667 mgd
Total area of opening(s) = 7.07 ft^2
Velocity through gate(s) = 3.65 ft/s

36-inch DI from Headworks to Anoxic/Aerobic Basin 2 **43.87**

Pipe shape = Circular
Diameter = 36 in
Length = 55 ft
Flow = 16.667 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 0.95
Pipe area = 7.07 ft^2
Pipe hydraulic radius = 0.75
Age factor = 1
Solids factor = 1
Velocity = 3.65 ft/s
Friction loss = 0.07 ft
Fitting loss = 0.2 ft
Total loss = 0.27 ft

30-inch DI from Headworks to Anoxic/Aerobic Basin 2 **45.43**

Pipe shape = Circular
Diameter = 30 in
Length = 320 ft
Flow = 16.667 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 1.25
Pipe area = 4.91 ft^2
Pipe hydraulic radius = 0.625
Age factor = 1
Solids factor = 1
Velocity = 5.25 ft/s
Friction loss = 1.02 ft
Fitting loss = 0.54 ft
Total loss = 1.55 ft

Headworks Eff. Weir Gate 2 **52.85**

Weir invert (top of weir) = 51.62
Number of contracted sides = 2
Weir length = 6 ft
Flow over weir = 16.667 mgd
Submergence = unsubmerged
Head over weir = 1.23 ft

Section Description	Water Surface Elevation
Headworks Eff. Splitter Box Flow Split	**52.85**
User defined loss for flow split = 0 ft	
Total flow through flow split = 29.168 mgd	
Headcell Eff. Channel	**52.85**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 40 ft	
Channel width/diameter = 8 ft	
Flow = 37.5 mgd	
Downstream channel invert = 47.92	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 39.45 ft^2	
Hydraulic radius = 2.208	
Normal depth = infinite	
Critical depth = 1.18 ft	
Depth downstream = 4.93 ft	
Bend loss = 0 ft	
Depth upstream = 4.93 ft	
Velocity = 1.47 ft/s	
Flow profile = Horizontal	
Headworks Eff. Channel	
HeadCell Grit Unit 1 Effluent Weir	**53.93**
Weir invert (top of weir) = 53.42	
Weir length = 16 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 12.5 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.51 ft	
HeadCell Grit Unit 2 Effluent Weir	**53.93**
Weir invert (top of weir) = 53.42	
Weir length = 16 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 12.5 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.51 ft	
Headcell Grit Unit 2	**54.61**
2nd degree polynomial	
Flow = 12.5 mgd	
Overall head loss = 0.68 ft	
Headcell Grit Unit 1	**54.61**

Section Description	Water Surface Elevation
2nd degree polynomial	
Flow = 12.5 mgd	
Overall head loss = 0.68 ft	
Headworks Eff. Box Flow Split	**54.61**
User defined loss for flow split = 0 ft	
Total flow through flow split = 25 mgd	
Screen Eff, Channel	**54.61**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 31 ft	
Channel width/diameter = 6 ft	
Flow = 25 mgd	
Downstream channel invert = 47.92	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 40.11 ft^2	
Hydraulic radius = 2.071	
Normal depth = infinite	
Critical depth = 1.09 ft	
Depth downstream = 6.69 ft	
Bend loss = 0 ft	
Depth upstream = 6.69 ft	
Velocity = 0.96 ft/s	
Flow profile = Horizontal	
AFS Channel 1 Baffle	**57.45**
Weir invert (top of weir) = 56.17	
Weir length = 4 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 12.5 mgd	
Weir submergence = unsubmerged	
Head over weir = 1.28 ft	
AFS Channel 2 Baffle	**57.45**
Weir invert (top of weir) = 56.17	
Weir length = 4 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 12.5 mgd	
Weir submergence = unsubmerged	
Head over weir = 1.28 ft	
AFS Channel 2	**57.46**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 20 ft	

Section Description	Water Surface Elevation

Channel width/diameter = 4 ft
Flow = 12.5 mgd
Downstream channel invert = 55.5
Channel slope = 0 ft/ft
Channel side slope = not applicable
Area of flow = 7.83 ft^2
Hydraulic radius = 0.989
Normal depth = infinite
Critical depth = 0.9 ft
Depth downstream = 1.95 ft
Bend loss = 0 ft
Depth upstream = 1.96 ft
Velocity = 2.48 ft/s
Flow profile = Horizontal

AFS Channel 1 — **57.46**

Channel shape = Rectangular
Manning's 'n' = 0.012
Channel length = 20 ft
Channel width/diameter = 4 ft
Flow = 12.5 mgd
Downstream channel invert = 55.5
Channel slope = 0 ft/ft
Channel side slope = not applicable
Area of flow = 7.83 ft^2
Hydraulic radius = 0.989
Normal depth = infinite
Critical depth = 0.9 ft
Depth downstream = 1.95 ft
Bend loss = 0 ft
Depth upstream = 1.96 ft
Velocity = 2.48 ft/s
Flow profile = Horizontal

Automatic Fine Screen 2 — **58.45**

Linear
Flow = 12.5 mgd
Overall head loss = 0.99 ft

Automatic Fine Screen 1 — **58.45**

Linear
Flow = 12.5 mgd
Overall head loss = 0.99 ft

Headworks Influent Channel — **58.45**

User defined loss for flow split = 0 ft
Total flow through flow split = 25 mgd

Section Description **Water Surface Elevation**

APPENDIX C:

VISUAL HYDRAULICS MODEL REPORT OUTPUT – 12.5 MGD WITH MLE, CLASS I RELIABILITY

McKIM&CREED
ENGINEERS SURVEYORS PLANNERS

Visual Hydraulics Summary Report - Hydraulic Analysis

Project: **NRWRF Expansion to 12.5 MGD_12.5 MLE Class I Adjusted 2023-02-28.**
Company: **McKim & Creed**
Date: **February 28, 2023**

Current flow conditions

Forward Flow =	31.25 mgd
Return I Flow =	15.62 mgd
Return II Flow =	12 mgd
Return III Flow =	-----

Section Description | **Water Surface Elevation**

AquaDiamond Filters Common Eff. Channel **29.68**

Channel shape = Rectangular
Manning's 'n' = 0.012
Channel length = 47 ft
Channel width/diameter = 3 ft
Flow = 13.937 mgd
Downstream channel invert = 26
Channel slope = 0 ft/ft
Channel side slope = not applicable
Area of flow = 11.02 ft^2
Hydraulic radius = 1.065
Normal depth = infinite
Critical depth = 1.17 ft
Depth downstream = 3.67 ft
Bend loss = 0 ft
Depth upstream = 3.68 ft
Velocity = 1.96 ft/s
Flow profile = Horizontal

Disk Filters to CCCs **29.58**

Pipe shape = Circular
Diameter = 42 in
Length = 132 ft
Flow = 15.625 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 2.66
Pipe area = 9.62 ft²

Section Description	Water Surface Elevation
Pipe hydraulic radius = 0.875 Age factor = 1 Solids factor = 1 Velocity = 2.51 ft/s Friction loss = 0.07 ft Fitting loss = 0.26 ft Total loss = 0.33 ft	
Pipe - Disk Filters to Wye Pipe shape = Circular Diameter = 36 in Length = 30 ft Flow = 0 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 0 Pipe area = 7.07 ft² Pipe hydraulic radius = 0.75 Age factor = 1 Solids factor = 1 Velocity = 0 ft/s Friction loss = 0 ft Fitting loss = 0 ft Total loss = 0 ft	**29.24**
Disk Filters Effluent Pipe Pipe shape = Circular Diameter = 36 in Length = 72 ft Flow = 9.5 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 0.8 Pipe area = 7.07 ft² Pipe hydraulic radius = 0.75 Age factor = 1 Solids factor = 1 Velocity = 2.08 ft/s Friction loss = 0.03 ft Fitting loss = 0.05 ft Total loss = 0.09 ft	**29.67**
Pipe - AquaDiamond Filters to Disk Filters Eff Pipe Pipe shape = Circular Diameter = 42 in Length = 35 ft	**29.61**

Section Description	Water Surface Elevation
Flow = 6.125 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.93	
Pipe area = 9.62 ft²	
Pipe hydraulic radius = 0.875	
Age factor = 1	
Solids factor = 1	
Velocity = 0.98 ft/s	
Friction loss = 0 ft	
Fitting loss = 0.03 ft	
Total loss = 0.03 ft	
Disk Filters Common Eff. Channel	
Disk Filters Eff. Weir - Contracted 1	**31.81**
Weir invert (top of weir) = 31.35	
Number of contracted sides = 2	
Weir length = 7.5 ft	
Flow over weir = 4.75 mgd	
Submergence = unsubmerged	
Head over weir = 0.46 ft	
Disk Filters Eff. Weir - Contracted 2	**31.81**
Weir invert (top of weir) = 31.35	
Number of contracted sides = 2	
Weir length = 7.5 ft	
Flow over weir = 4.75 mgd	
Submergence = unsubmerged	
Head over weir = 0.46 ft	
Disk Filters Inf. Weir 2	**33.29**
Weir invert (top of weir) = 32.9	
Weir length = 9.17 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 4.75 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.39 ft	
Disk Filters Inf. Slide Gate 2	**33.33**
Opening type = rectangular gate	
Opening diameter/width = 36 in	
Gate height = 30 in	
Invert = 30.41	
Number of gates = 1	
Flow through gate(s) = 4.75 mgd	
Total area of opening(s) = 7.5 ft^2	

Section Description	Water Surface Elevation
Velocity through gate(s) = 0.98 ft/s Flow behavior = weir control Gate loss = 0.04 ft Downstream water level = 33.29 Upstream water level = 33.33	
Disk Filters Inf. Weir 1	**33.29**
Weir invert (top of weir) = 32.9 Weir length = 9.17 ft Weir 'C' coefficient = 3.33 Flow over weir = 4.75 mgd Weir submergence = unsubmerged Head over weir = 0.39 ft	
CCC1 Train 2 Effluent Cipolletti Weir	**29.21**
CCC2 NORTH Effluent Cipolletti Weir	**25.21**
CCC2 SOUTH Effluent Cipolletti Weir	**Off-line**
CCC1 Train 1 Effluent Cipolletti Weir	**28.75**
CCC1 Slide Gate #2	**29.23**
Opening type = rectangular gate Opening diameter/width = 72 in Gate height = 72 in Invert = 25.75 Number of gates = 1 Flow through gate(s) = 5.208 mgd Total area of opening(s) = 36 ft^2 Velocity through gate(s) = 0.22 ft/s	
CCC2 Influent Slide Gate 1	**29.23**
Opening type = rectangular gate Opening diameter/width = 72 in Gate height = 64 in Invert = 25.81 Number of gates = 1 Flow through gate(s) = 5.208 mgd Total area of opening(s) = 32 ft^2 Velocity through gate(s) = 0.25 ft/s	
CCC2 Influent Slide Gate 2	**Off-line**
CCC2 Influent Chamber	**29.23**
User defined loss for flow split = 0 ft Total flow through flow split = 5.208 mgd	

Section Description	Water Surface Elevation
Pipe - tee to CCC2	**29.24**
Pipe shape = Circular	
Diameter = 42 in	
Length = 10 ft	
Flow = 5.208 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.3	
Pipe area = 9.62 ft²	
Pipe hydraulic radius = 0.875	
Age factor = 1	
Solids factor = 1	
Velocity = 0.84 ft/s	
Friction loss = 0 ft	
Fitting loss = 0.01 ft	
Total loss = 0.01 ft	
Tee connecting AquaDiamond Filters to Disk Filters Eff	
CCC1 Slide Gate #1	**29.23**
Opening type = rectangular gate	
Opening diameter/width = 72 in	
Gate height = 72 in	
Invert = 25.75	
Number of gates = 1	
Flow through gate(s) = 5.208 mgd	
Total area of opening(s) = 36 ft^2	
Velocity through gate(s) = 0.22 ft/s	
CCC1 Influent Chamber	**29.23**
User defined loss for flow split = 0 ft	
Total flow through flow split = 10.417 mgd	
Filters to CCC1 after Wye	**29.36**
Pipe shape = Circular	
Diameter = 42 in	
Length = 60 ft	
Flow = 10.417 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.65	
Pipe area = 9.62 ft²	
Pipe hydraulic radius = 0.875	
Age factor = 1	
Solids factor = 1	
Velocity = 1.67 ft/s	
Friction loss = 0.02 ft	

Section Description	Water Surface Elevation
Fitting loss = 0.12 ft	
Total loss = 0.13 ft	
Wye to CCCs	**29.36**
User defined loss for flow split = 0 ft	
Total flow through flow split = 10.417 mgd	
AquaDiamond Filters to CCC Pipe 1	**29.67**
Pipe shape = Circular	
Diameter = 42 in	
Length = 167 ft	
Flow = 15.625 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.18	
Pipe area = 9.62 ft²	
Pipe hydraulic radius = 0.875	
Age factor = 1	
Solids factor = 1	
Velocity = 2.51 ft/s	
Friction loss = 0.09 ft	
Fitting loss = 0.21 ft	
Total loss = 0.31 ft	
AquaDiamond Filters to Disk Filters Eff Pipe	**29.67**
User defined loss for flow split = 0 ft	
Total flow through flow split = 21.75 mgd	
Disk Filters Inf. Slide Gate 1	**33.33**
Opening type = rectangular gate	
Opening diameter/width = 36 in	
Gate height = 30 in	
Invert = 30.41	
Number of gates = 1	
Flow through gate(s) = 4.75 mgd	
Total area of opening(s) = 7.5 ft^2	
Velocity through gate(s) = 0.98 ft/s	
Flow behavior = weir control	
Gate loss = 0.04 ft	
Downstream water level = 33.29	
Upstream water level = 33.33	
Disk Filters Common Inf. Channel Flow Split	**33.33**
User defined loss for flow split = 0 ft	
Total flow through flow split = 9.5 mgd	
Filter FSB to Disk Filters - Pipe	**33.46**
Pipe shape = Circular	

Section Description	Water Surface Elevation
Diameter = 36 in	
Length = 19 ft	
Flow = 9.5 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.8	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 2.08 ft/s	
Friction loss = 0.01 ft	
Fitting loss = 0.12 ft	
Total loss = 0.13 ft	
Filter FSB Eff. Weir to Disk Filters	**34.95**
Weir invert (top of weir) = 34.21	
Weir length = 7 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 9.5 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.74 ft	
AquaDiamond Filters Common Eff. Channel Flow Comb	
AquaDiamond Filters Eff. Weir 1	**31.05**
Weir invert (top of weir) = 30.58	
Weir length = 20 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 13.937 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.47 ft	
AquaDiamond Filters Inf. Weir 1	**32.15**
Weir invert (top of weir) = 31.58	
Weir length = 15 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 13.937 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.57 ft	
AquaDiamond Filters Inf. Slide Gate #1	**32.42**
Opening type = rectangular gate	
Opening diameter/width = 36 in	
Gate height = 45 in	
Invert = 29.58	
Number of gates = 1	

Section Description	Water Surface Elevation
Flow through gate(s) = 13.937 mgd	
Total area of opening(s) = 11.25 ft^2	
Velocity through gate(s) = 1.92 ft/s	
AquaDiamond Filters Common Inf. Channel	**32.42**
User defined loss for flow split = 0 ft	
Total flow through flow split = 13.937 mgd	
Filter FSB to AquaDiamond Filters - Pipe	**32.73**
Pipe shape = Circular	
Diameter = 36 in	
Length = 64 ft	
Flow = 13.937 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.75	
Pipe area = 7.07 ft^2	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 3.05 ft/s	
Friction loss = 0.06 ft	
Fitting loss = 0.25 ft	
Total loss = 0.31 ft	
Filter FSB Eff. Weir to AquaDiamond Filters	**34.95**
Weir invert (top of weir) = 34	
Weir length = 7 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 13.938 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.95 ft	
Filter FSB Eff. Flow Split	**34.95**
User defined loss for flow split = 0 ft	
Total flow through flow split = 23.438 mgd	
Filter FSB Influent Channel Approximation	**34.95**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 50 ft	
Channel width/diameter = 15 ft	
Flow = 31.251 mgd	
Downstream channel invert = 23.83	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 166.8 ft^2	
Hydraulic radius = 4.479	

Section Description	Water Surface Elevation

Normal depth = infinite
Critical depth = 0.69 ft
Depth downstream = 11.12 ft
Bend loss = 0 ft
Depth upstream = 11.12 ft
Velocity = 0.29 ft/s
Flow profile = Horizontal

Filter FSB Slide Gate **35.06**

Opening type = rectangular gate
Opening diameter/width = 72 in
Gate height = 60 in
Invert = 26.58
Number of gates = 1
Flow through gate(s) = 31.25 mgd
Total area of opening(s) = 30 ft^2
Velocity through gate(s) = 1.61 ft/s

Filter Flow Splitter Box Inf. Flow Combination

Clarifiers #1 and #2 Eff. Pipe 2 **35.71**

Pipe shape = Circular
Diameter = 36 in
Length = 240 ft
Flow = 15.625 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 2.05
Pipe area = 7.07 ft^2
Pipe hydraulic radius = 0.75
Age factor = 1
Solids factor = 1
Velocity = 3.42 ft/s
Friction loss = 0.28 ft
Fitting loss = 0.37 ft
Total loss = 0.65 ft

Clarifier #3 Eff. Pipe 2 **35.26**

Pipe shape = Circular
Diameter = 36 in
Length = 170 ft
Flow = 7.812 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 3.35
Pipe area = 7.07 ft^2
Pipe hydraulic radius = 0.75

Section Description	Water Surface Elevation
Age factor = 1	
Solids factor = 1	
Velocity = 1.71 ft/s	
Friction loss = 0.05 ft	
Fitting loss = 0.15 ft	
Total loss = 0.21 ft	
Clarifier #3 Eff. Pipe 1	**35.62**
Pipe shape = Circular	
Diameter = 30 in	
Length = 30 ft	
Flow = 7.812 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 3.5	
Pipe area = 4.91 ft²	
Pipe hydraulic radius = 0.625	
Age factor = 1	
Solids factor = 1	
Velocity = 2.46 ft/s	
Friction loss = 0.02 ft	
Fitting loss = 0.33 ft	
Total loss = 0.35 ft	
Clarifier #3 Eff. Launder	**37.89**
Launder invert = 36.08	
Launder length = 172.79 ft	
Launder width = 2 ft	
Launder slope = 0 ft/ft	
Flow through launder = 7.812 mgd	
Critical depth = 1.04 ft	
Downstream depth = 1.04 ft	
Upstream depth = 1.81 ft	
Clarifier #3 V-notch Weir	**38.31**
Invert of V notch = 38.17	
Angle of V notch = 90 degrees	
Number of notches = 660	
Total flow over weir = 7.812 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.14 ft	
Clarifier FSB to Clarifier #3	**38.6**
Pipe shape = Circular	
Diameter = 36 in	
Length = 120 ft	

Section Description	Water Surface Elevation
Flow = 13.021 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 1.48 Pipe area = 7.07 ft² Pipe hydraulic radius = 0.75 Age factor = 1 Solids factor = 1 Velocity = 2.85 ft/s Friction loss = 0.1 ft Fitting loss = 0.19 ft Total loss = 0.29 ft	
Clarifier FSB Weir Gate #3	**40.05**
Weir invert (top of weir) = 39.25 Number of contracted sides = 2 Weir length = 8 ft Flow over weir = 11.719 mgd Submergence = unsubmerged Head over weir = 0.8 ft	
Tee - Clarifiers #1 and #2 to Filter FSB	**36.05**
Main line diameter = 36 in Branch diameter = 30 in Main line flow = 7.81 mgd Branch flow = 7.81 mgd Tee head loss = 0.34 ft	
Tee - Eff. Pipes of Clarifiers #1 and #2	
Clarifier #1 Eff. Pipe 1	**36.39**
Pipe shape = Circular Diameter = 30 in Length = 164 ft Flow = 7.812 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 2.25 Pipe area = 4.91 ft² Pipe hydraulic radius = 0.625 Age factor = 1 Solids factor = 1 Velocity = 2.46 ft/s Friction loss = 0.13 ft Fitting loss = 0.21 ft Total loss = 0.34 ft	
Clarifier #2 Eff. Pipe 1	**36.23**

Section Description	Water Surface Elevation
Pipe shape = Circular	
Diameter = 30 in	
Length = 18 ft	
Flow = 7.812 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.75	
Pipe area = 4.91 ft²	
Pipe hydraulic radius = 0.625	
Age factor = 1	
Solids factor = 1	
Velocity = 2.46 ft/s	
Friction loss = 0.01 ft	
Fitting loss = 0.16 ft	
Total loss = 0.18 ft	
Clarifier #2 Eff. Launder	**37.89**
Launder invert = 36.08	
Launder length = 172.79 ft	
Launder width = 2 ft	
Launder slope = 0 ft/ft	
Flow through launder = 7.812 mgd	
Critical depth = 1.04 ft	
Downstream depth = 1.04 ft	
Upstream depth = 1.81 ft	
Clarifier #2 V-notch Weir	**38.31**
Invert of V notch = 38.17	
Angle of V notch = 90 degrees	
Number of notches = 660	
Total flow over weir = 7.812 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.14 ft	
Clarifier FSB to Clarifier #2	**38.6**
Pipe shape = Circular	
Diameter = 36 in	
Length = 120 ft	
Flow = 13.021 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.48	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 2.85 ft/s	

Section Description	**Water Surface Elevation**
Friction loss = 0.1 ft	
Fitting loss = 0.19 ft	
Total loss = 0.29 ft	
Clarifier FSB Weir Gate #2	**40.05**
Weir invert (top of weir) = 39.25	
Number of contracted sides = 2	
Weir length = 8 ft	
Flow over weir = 11.719 mgd	
Submergence = unsubmerged	
Head over weir = 0.8 ft	
Clarifier #1 Eff. Launder	**37.89**
Launder invert = 36.08	
Launder length = 172.79 ft	
Launder width = 2 ft	
Launder slope = 0 ft/ft	
Flow through launder = 7.812 mgd	
Critical depth = 1.04 ft	
Downstream depth = 1.04 ft	
Upstream depth = 1.81 ft	
Clarifier #1 V-notch Weir	**38.31**
Invert of V notch = 38.17	
Angle of V notch = 90 degrees	
Number of notches = 660	
Total flow over weir = 7.812 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.14 ft	
Clarifier FSB to Clarifier #1	**38.6**
Pipe shape = Circular	
Diameter = 36 in	
Length = 120 ft	
Flow = 13.021 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.48	
Pipe area = 7.07 ft^2	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 2.85 ft/s	
Friction loss = 0.1 ft	
Fitting loss = 0.19 ft	
Total loss = 0.29 ft	

Section Description	**Water Surface Elevation**
Clarifier FSB Weir Gate #1	**40.05**
Weir invert (top of weir) = 39.25	
Number of contracted sides = 2	
Weir length = 8 ft	
Flow over weir = 11.719 mgd	
Submergence = unsubmerged	
Head over weir = 0.8 ft	
Clarifier FSB Flow Split	**40.05**
User defined loss for flow split = 0 ft	
Total flow through flow split = 35.156 mgd	
Clarifier FSB Approximation	**40.05**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 16 ft	
Channel width/diameter = 5 ft	
Flow = 46.875 mgd	
Downstream channel invert = 23.25	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 84 ft^2	
Hydraulic radius = 2.176	
Normal depth = infinite	
Critical depth = 1.87 ft	
Depth downstream = 16.8 ft	
Bend loss = 0 ft	
Depth upstream = 16.8 ft	
Velocity = 0.86 ft/s	
Flow profile = Horizontal	
Pipe - Anx/Aer Basin 1 to Clarifier FSB	**40.44**
Pipe shape = Circular	
Diameter = 42 in	
Length = 440 ft	
Flow = 15.626 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.52	
Pipe area = 9.62 ft²	
Pipe hydraulic radius = 0.875	
Age factor = 1	
Solids factor = 1	
Velocity = 2.51 ft/s	
Friction loss = 0.24 ft	
Fitting loss = 0.15 ft	
Total loss = 0.39 ft	

Section Description	Water Surface Elevation
Anx/Aer Eff Sluice Gate #1	**40.72**

Opening type = circular gate
Opening diameter/width = 42 in
Gate height = 42 in
Invert = 24.08
Number of gates = 1
Flow through gate(s) = 15.626 mgd
Total area of opening(s) = 9.62 ft^2
Velocity through gate(s) = 2.51 ft/s

Anx/Aer Basin 1 Eff. Box — **40.72**

Channel shape = Rectangular
Manning's 'n' = 0.012
Channel length = 15 ft
Channel width/diameter = 6 ft
Flow = 15.626 mgd
Downstream channel invert = 23.08
Channel slope = 0 ft/ft
Channel side slope = not applicable
Area of flow = 105.85 ft^2
Hydraulic radius = 2.564
Normal depth = infinite
Critical depth = 0.8 ft
Depth downstream = 17.64 ft
Bend loss = 0 ft
Depth upstream = 17.64 ft
Velocity = 0.23 ft/s
Flow profile = Horizontal

Eff. Box flow combination

Anx/Aer Basin 1 Eff. Weir Gate — **42.83**

Weir invert (top of weir) = 42.2
Number of contracted sides = 2
Weir length = 15 ft
Flow over weir = 15.627 mgd
Submergence = unsubmerged
Head over weir = 0.63 ft

Anx/Aer Basin 1 Port — **42.97**

Opening type = rectangular orifice
Opening diameter/width = 57 in
Opening height = 57 in
Invert = 30.92
Number of openings = 1
Flow through opening(s) = 27.626 mgd

Section Description	Water Surface Elevation
Total area of opening(s) = 22.56 ft^2	
Velocity through opening(s) = 1.89 ft/s	
Anx/Aer Basin 1 Inf. Sluice Gate	**43.49**
Opening type = circular gate	
Opening diameter/width = 36 in	
Gate height = 36 in	
Invert = 30.92	
Number of gates = 1	
Flow through gate(s) = 15.626 mgd	
Total area of opening(s) = 7.07 ft^2	
Velocity through gate(s) = 3.42 ft/s	
36-inch DI from Headworks to Anoxic/Aerobic Basin 1	**43.73**
Pipe shape = Circular	
Diameter = 36 in	
Length = 60 ft	
Flow = 15.626 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 0.95	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 3.42 ft/s	
Friction loss = 0.07 ft	
Fitting loss = 0.17 ft	
Total loss = 0.24 ft	
30-inch DI from Headworks to Anoxic/Aerobic Basin 1	**45.26**
Pipe shape = Circular	
Diameter = 30 in	
Length = 375 ft	
Flow = 15.626 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.25	
Pipe area = 4.91 ft²	
Pipe hydraulic radius = 0.625	
Age factor = 1	
Solids factor = 1	
Velocity = 4.92 ft/s	
Friction loss = 1.06 ft	
Fitting loss = 0.47 ft	
Total loss = 1.53 ft	

Section Description	Water Surface Elevation
Headworks Eff. Weir Gate 1	**52.8**
Weir invert (top of weir) = 51.62	
Number of contracted sides = 2	
Weir length = 6 ft	
Flow over weir = 15.627 mgd	
Submergence = unsubmerged	
Head over weir = 1.18 ft	
Pipe - connecting Anx/Aer Basins Eff. Boxes	**40.72**
Pipe shape = Circular	
Diameter = 48 in	
Length = 9.67 ft	
Flow = 0 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.23	
Pipe area = 12.57 ft^2	
Pipe hydraulic radius = 1	
Age factor = 1	
Solids factor = 1	
Velocity = 0 ft/s	
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
Pipe - Anx/Aer Basin 2 to Clarifier FSB	**40.44**
Pipe shape = Circular	
Diameter = 42 in	
Length = 440 ft	
Flow = 15.626 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.52	
Pipe area = 9.62 ft^2	
Pipe hydraulic radius = 0.875	
Age factor = 1	
Solids factor = 1	
Velocity = 2.51 ft/s	
Friction loss = 0.24 ft	
Fitting loss = 0.15 ft	
Total loss = 0.39 ft	
Pipe - Anx/Aer Basin 3 to Clarifier FSB	**40.49**
Pipe shape = Circular	
Diameter = 42 in	
Length = 520 ft	
Flow = 15.626 mgd	

Section Description	Water Surface Elevation
Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 1.52 Pipe area = 9.62 ft² Pipe hydraulic radius = 0.875 Age factor = 1 Solids factor = 1 Velocity = 2.51 ft/s Friction loss = 0.29 ft Fitting loss = 0.15 ft Total loss = 0.43 ft	
Anx/Aer Eff. Sluice Gate #3	**40.77**
Opening type = circular gate Opening diameter/width = 42 in Gate height = 42 in Invert = 24.08 Number of gates = 1 Flow through gate(s) = 15.626 mgd Total area of opening(s) = 9.62 ft^2 Velocity through gate(s) = 2.51 ft/s	
Anx/Aer Basin 3 Eff. Box	**40.77**
Channel shape = Rectangular Manning's 'n' = 0.012 Channel length = 15 ft Channel width/diameter = 6 ft Flow = 15.626 mgd Downstream channel invert = 23.08 Channel slope = 0 ft/ft Channel side slope = not applicable Area of flow = 106.12 ft^2 Hydraulic radius = 2.565 Normal depth = infinite Critical depth = 0.8 ft Depth downstream = 17.69 ft Bend loss = 0 ft Depth upstream = 17.69 ft Velocity = 0.23 ft/s Flow profile = Horizontal	
Anx/Aer Basin 3 Eff. Weir Gate	**42.83**
Weir invert (top of weir) = 42.2 Number of contracted sides = 2 Weir length = 15 ft Flow over weir = 15.627 mgd Submergence = unsubmerged	

Section Description	Water Surface Elevation
Head over weir = 0.63 ft	
Anx/Aer Basin 3 Port	**42.97**
Opening type = rectangular orifice	
Opening diameter/width = 57 in	
Opening height = 57 in	
Invert = 30.92	
Number of openings = 1	
Flow through opening(s) = 27.626 mgd	
Total area of opening(s) = 22.56 ft^2	
Velocity through opening(s) = 1.89 ft/s	
Anx/Aer Basin 3 Inf. Sluice Gate	**43.49**
Opening type = circular gate	
Opening diameter/width = 36 in	
Gate height = 36 in	
Invert = 30.92	
Number of gates = 1	
Flow through gate(s) = 15.626 mgd	
Total area of opening(s) = 7.07 ft^2	
Velocity through gate(s) = 3.42 ft/s	
30-inch DI from Headworks to Anx/Aer Basin 3	**44.58**
Pipe shape = Circular	
Diameter = 30 in	
Length = 220 ft	
Flow = 15.626 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.25	
Pipe area = 4.91 ft²	
Pipe hydraulic radius = 0.625	
Age factor = 1	
Solids factor = 1	
Velocity = 4.92 ft/s	
Friction loss = 0.62 ft	
Fitting loss = 0.47 ft	
Total loss = 1.09 ft	
Headworks Eff. Weir Gate 3	**52.8**
Weir invert (top of weir) = 51.62	
Number of contracted sides = 2	
Weir length = 6 ft	
Flow over weir = 15.627 mgd	
Submergence = unsubmerged	
Head over weir = 1.18 ft	

Section Description	Water Surface Elevation
Anx/Aer Eff. Sluice Gate #2	**40.72**

Opening type = circular gate
Opening diameter/width = 42 in
Gate height = 42 in
Invert = 24.08
Number of gates = 1
Flow through gate(s) = 15.626 mgd
Total area of opening(s) = 9.62 ft^2
Velocity through gate(s) = 2.51 ft/s

Anx/Aer Basin 2 Eff. Box — **40.72**

Channel shape = Rectangular
Manning's 'n' = 0.012
Channel length = 15 ft
Channel width/diameter = 6 ft
Flow = 23.438 mgd
Downstream channel invert = 23.08
Channel slope = 0 ft/ft
Channel side slope = not applicable
Area of flow = 105.85 ft^2
Hydraulic radius = 2.564
Normal depth = infinite
Critical depth = 1.04 ft
Depth downstream = 17.64 ft
Bend loss = 0 ft
Depth upstream = 17.64 ft
Velocity = 0.34 ft/s
Flow profile = Horizontal

Anx/Aer Basin 2 Eff. Box Flow Split — **40.72**

User defined loss for flow split = 0 ft
Total flow through flow split = 23.438 mgd

Anx/Aer Basin 2 Eff. Weir Gate — **42.83**

Weir invert (top of weir) = 42.2
Number of contracted sides = 2
Weir length = 15 ft
Flow over weir = 15.627 mgd
Submergence = unsubmerged
Head over weir = 0.63 ft

Anx/Aer Basin 2 Port — **42.97**

Opening type = rectangular orifice
Opening diameter/width = 57 in
Opening height = 57 in
Invert = 30.92
Number of openings = 1

Section Description	Water Surface Elevation
Flow through opening(s) = 27.626 mgd Total area of opening(s) = 22.56 ft^2 Velocity through opening(s) = 1.89 ft/s	
Anx/Aer Basin 2 Inf. Sluice Gate	**43.49**
Opening type = circular gate Opening diameter/width = 36 in Gate height = 36 in Invert = 30.92 Number of gates = 1 Flow through gate(s) = 15.626 mgd Total area of opening(s) = 7.07 ft^2 Velocity through gate(s) = 3.42 ft/s	
36-inch DI from Headworks to Anoxic/Aerobic Basin 2	**43.73**
Pipe shape = Circular Diameter = 36 in Length = 55 ft Flow = 15.626 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 0.95 Pipe area = 7.07 ft² Pipe hydraulic radius = 0.75 Age factor = 1 Solids factor = 1 Velocity = 3.42 ft/s Friction loss = 0.06 ft Fitting loss = 0.17 ft Total loss = 0.24 ft	
30-inch DI from Headworks to Anoxic/Aerobic Basin 2	**45.1**
Pipe shape = Circular Diameter = 30 in Length = 320 ft Flow = 15.626 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 1.25 Pipe area = 4.91 ft² Pipe hydraulic radius = 0.625 Age factor = 1 Solids factor = 1 Velocity = 4.92 ft/s Friction loss = 0.9 ft Fitting loss = 0.47 ft Total loss = 1.37 ft	

Section Description	Water Surface Elevation
Headworks Eff. Weir Gate 2	**52.8**
Weir invert (top of weir) = 51.62	
Number of contracted sides = 2	
Weir length = 6 ft	
Flow over weir = 15.627 mgd	
Submergence = unsubmerged	
Head over weir = 1.18 ft	
Headworks Eff. Splitter Box Flow Split	**52.8**
User defined loss for flow split = 0 ft	
Total flow through flow split = 46.88 mgd	
Headcell Eff. Channel	**52.81**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 40 ft	
Channel width/diameter = 8 ft	
Flow = 46.875 mgd	
Downstream channel invert = 47.92	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 39.06 ft^2	
Hydraulic radius = 2.199	
Normal depth = infinite	
Critical depth = 1.37 ft	
Depth downstream = 4.88 ft	
Bend loss = 0 ft	
Depth upstream = 4.89 ft	
Velocity = 1.86 ft/s	
Flow profile = Horizontal	
Headworks Eff. Channel	
HeadCell Grit Unit 1 Effluent Weir	**54.01**
Weir invert (top of weir) = 53.42	
Weir length = 16 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 15.625 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.59 ft	
HeadCell Grit Unit 2 Effluent Weir	**54.01**
Weir invert (top of weir) = 53.42	
Weir length = 16 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 15.625 mgd	

Section Description	**Water Surface Elevation**
Weir submergence = unsubmerged	
Head over weir = 0.59 ft	
Headcell Grit Unit 2	**55.07**
2nd degree polynomial	
Flow = 15.625 mgd	
Overall head loss = 1.06 ft	
Headcell Grit Unit 1	**55.07**
2nd degree polynomial	
Flow = 15.625 mgd	
Overall head loss = 1.06 ft	
Headworks Eff. Box Flow Split	**55.07**
User defined loss for flow split = 0 ft	
Total flow through flow split = 31.25 mgd	
Screen Eff, Channel	**55.07**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 31 ft	
Channel width/diameter = 6 ft	
Flow = 31.25 mgd	
Downstream channel invert = 47.92	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 42.88 ft^2	
Hydraulic radius = 2.113	
Normal depth = infinite	
Critical depth = 1.26 ft	
Depth downstream = 7.15 ft	
Bend loss = 0 ft	
Depth upstream = 7.15 ft	
Velocity = 1.13 ft/s	
Flow profile = Horizontal	
AFS Channel 1 Baffle	**57.66**
Weir invert (top of weir) = 56.17	
Weir length = 4 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 15.625 mgd	
Weir submergence = unsubmerged	
Head over weir = 1.49 ft	
AFS Channel 2 Baffle	**57.66**
Weir invert (top of weir) = 56.17	
Weir length = 4 ft	

Section Description	Water Surface Elevation
Weir 'C' coefficient = 3.33	
Flow over weir = 15.625 mgd	
Weir submergence = unsubmerged	
Head over weir = 1.49 ft	
AFS Channel 2	**57.67**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 20 ft	
Channel width/diameter = 4 ft	
Flow = 15.625 mgd	
Downstream channel invert = 55.5	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 8.65 ft^2	
Hydraulic radius = 1.039	
Normal depth = infinite	
Critical depth = 1.04 ft	
Depth downstream = 2.16 ft	
Bend loss = 0 ft	
Depth upstream = 2.17 ft	
Velocity = 2.8 ft/s	
Flow profile = Horizontal	
AFS Channel 1	**57.67**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 20 ft	
Channel width/diameter = 4 ft	
Flow = 15.625 mgd	
Downstream channel invert = 55.5	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 8.65 ft^2	
Hydraulic radius = 1.039	
Normal depth = infinite	
Critical depth = 1.04 ft	
Depth downstream = 2.16 ft	
Bend loss = 0 ft	
Depth upstream = 2.17 ft	
Velocity = 2.8 ft/s	
Flow profile = Horizontal	
Automatic Fine Screen 2	**58.66**
Linear	
Flow = 15.625 mgd	
Overall head loss = 0.99 ft	

Section Description	Water Surface Elevation
Automatic Fine Screen 1	**58.66**
Linear	
Flow = 15.625 mgd	
Overall head loss = 0.99 ft	
Headworks Influent Channel	**58.66**
User defined loss for flow split = 0 ft	
Total flow through flow split = 31.25 mgd	

APPENDIX D:

VISUAL HYDRAULICS MODEL REPORT OUTPUT – 12.5 MGD WITH MLE AND AGS, CLASS I RELIABILITY

Visual Hydraulics Summary Report - Hydraulic Analysis

Project: **NRWRF Expansion to 12.5 MGD_12.5 MLE AGS Class I 2023-02-28.vhf**
Company: **McKim & Creed**
Date: **February 28, 2023**

Current flow conditions

Forward Flow =	31.25 mgd
Return I Flow =	9.38 mgd
Return II Flow =	12 mgd
Return III Flow =	-----

Section Description	Water Surface Elevation
CCC1 Train 2 Effluent Cipolletti Weir	**29.21**
CCC2 NORTH Effluent Cipolletti Weir	**25.21**
CCC2 SOUTH Effluent Cipolletti Weir	**Off-line**
CCC1 Train 1 Effluent Cipolletti Weir	**28.75**
CCC1 Slide Gate #2	**29.23**

Opening type = rectangular gate
Opening diameter/width = 72 in
Gate height = 72 in
Invert = 25.75
Number of gates = 1
Flow through gate(s) = 5.21 mgd
Total area of opening(s) = 36 ft^2
Velocity through gate(s) = 0.22 ft/s

CCC2 Influent Slide Gate 1 — **29.23**

Opening type = rectangular gate
Opening diameter/width = 72 in
Gate height = 64 in
Invert = 25.81
Number of gates = 1
Flow through gate(s) = 5.21 mgd
Total area of opening(s) = 32 ft^2
Velocity through gate(s) = 0.25 ft/s

CCC2 Influent Slide Gate 2 — **Off-line**

Section Description	Water Surface Elevation
CCC2 Influent Chamber	**29.23**
User defined loss for flow split = 0 ft	
Total flow through flow split = 5.21 mgd	
Pipe - tee to CCC2	**29.24**
Pipe shape = Circular	
Diameter = 42 in	
Length = 10 ft	
Flow = 5.21 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.3	
Pipe area = 9.62 ft^2	
Pipe hydraulic radius = 0.875	
Age factor = 1	
Solids factor = 1	
Velocity = 0.84 ft/s	
Friction loss = 0 ft	
Fitting loss = 0.01 ft	
Total loss = 0.01 ft	
Tee connecting AquaDiamond Filters to Disk Filters Eff	
CCC1 Slide Gate #1	**29.23**
Opening type = rectangular gate	
Opening diameter/width = 72 in	
Gate height = 72 in	
Invert = 25.75	
Number of gates = 1	
Flow through gate(s) = 5.21 mgd	
Total area of opening(s) = 36 ft^2	
Velocity through gate(s) = 0.22 ft/s	
CCC1 Influent Chamber	**29.23**
User defined loss for flow split = 0 ft	
Total flow through flow split = 10.42 mgd	
Filters to CCC1 after Wye	**29.36**
Pipe shape = Circular	
Diameter = 42 in	
Length = 60 ft	
Flow = 10.42 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.65	
Pipe area = 9.62 ft^2	
Pipe hydraulic radius = 0.875	

Section Description	Water Surface Elevation
Age factor = 1 Solids factor = 1 Velocity = 1.68 ft/s Friction loss = 0.02 ft Fitting loss = 0.12 ft Total loss = 0.13 ft	
Wye to CCCs	**29.36**
User defined loss for flow split = 0 ft Total flow through flow split = 10.42 mgd	
AquaDiamond Filters to CCC Pipe 1	**29.67**
Pipe shape = Circular Diameter = 42 in Length = 167 ft Flow = 15.625 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 2.18 Pipe area = 9.62 ft² Pipe hydraulic radius = 0.875 Age factor = 1 Solids factor = 1 Velocity = 2.51 ft/s Friction loss = 0.09 ft Fitting loss = 0.21 ft Total loss = 0.31 ft	
AquaDiamond Filters to Disk Filters Eff Pipe	**29.67**
User defined loss for flow split = 0 ft Total flow through flow split = 21.75 mgd	
AquaDiamond Filters Common Eff. Channel	**29.68**
Channel shape = Rectangular Manning's 'n' = 0.012 Channel length = 47 ft Channel width/diameter = 3 ft Flow = 13.94 mgd Downstream channel invert = 26 Channel slope = 0 ft/ft Channel side slope = not applicable Area of flow = 11.02 ft^2 Hydraulic radius = 1.065 Normal depth = infinite Critical depth = 1.17 ft Depth downstream = 3.67 ft Bend loss = 0 ft Depth upstream = 3.68 ft	

Section Description	**Water Surface Elevation**

Velocity = 1.96 ft/s
Flow profile = Horizontal

Disk Filters to CCCs **29.58**

Pipe shape = Circular
Diameter = 42 in
Length = 132 ft
Flow = 15.625 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 2.66
Pipe area = 9.62 ft²
Pipe hydraulic radius = 0.875
Age factor = 1
Solids factor = 1
Velocity = 2.51 ft/s
Friction loss = 0.07 ft
Fitting loss = 0.26 ft
Total loss = 0.33 ft

Pipe - Disk Filters to Wye **29.24**

Pipe shape = Circular
Diameter = 36 in
Length = 30 ft
Flow = 0 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 0
Pipe area = 7.07 ft²
Pipe hydraulic radius = 0.75
Age factor = 1
Solids factor = 1
Velocity = 0 ft/s
Friction loss = 0 ft
Fitting loss = 0 ft
Total loss = 0 ft

Disk Filters Effluent Pipe **29.67**

Pipe shape = Circular
Diameter = 36 in
Length = 72 ft
Flow = 9.5 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 0.8
Pipe area = 7.07 ft²
Pipe hydraulic radius = 0.75

Section Description	Water Surface Elevation
Age factor = 1 Solids factor = 1 Velocity = 2.08 ft/s Friction loss = 0.03 ft Fitting loss = 0.05 ft Total loss = 0.09 ft	
Pipe - AquaDiamond Filters to Disk Filters Eff Pipe	**29.61**
Pipe shape = Circular Diameter = 42 in Length = 35 ft Flow = 6.125 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 1.93 Pipe area = 9.62 ft² Pipe hydraulic radius = 0.875 Age factor = 1 Solids factor = 1 Velocity = 0.98 ft/s Friction loss = 0 ft Fitting loss = 0.03 ft Total loss = 0.03 ft	
Disk Filters Common Eff. Channel	
Disk Filters Eff. Weir - Contracted 1	**31.81**
Weir invert (top of weir) = 31.35 Number of contracted sides = 2 Weir length = 7.5 ft Flow over weir = 4.75 mgd Submergence = unsubmerged Head over weir = 0.46 ft	
Disk Filters Eff. Weir - Contracted 2	**31.81**
Weir invert (top of weir) = 31.35 Number of contracted sides = 2 Weir length = 7.5 ft Flow over weir = 4.75 mgd Submergence = unsubmerged Head over weir = 0.46 ft	
Disk Filters Inf. Weir 2	**33.29**
Weir invert (top of weir) = 32.9 Weir length = 9.17 ft Weir 'C' coefficient = 3.33 Flow over weir = 4.75 mgd	

Section Description	Water Surface Elevation
Weir submergence = unsubmerged	
Head over weir = 0.39 ft	
Disk Filters Inf. Slide Gate 2	**33.33**
Opening type = rectangular gate	
Opening diameter/width = 36 in	
Gate height = 30 in	
Invert = 30.41	
Number of gates = 1	
Flow through gate(s) = 4.75 mgd	
Total area of opening(s) = 7.5 ft^2	
Velocity through gate(s) = 0.98 ft/s	
Flow behavior = weir control	
Gate loss = 0.04 ft	
Downstream water level = 33.29	
Upstream water level = 33.33	
Disk Filters Inf. Weir 1	**33.29**
Weir invert (top of weir) = 32.9	
Weir length = 9.17 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 4.75 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.39 ft	
Disk Filters Inf. Slide Gate 1	**33.33**
Opening type = rectangular gate	
Opening diameter/width = 36 in	
Gate height = 30 in	
Invert = 30.41	
Number of gates = 1	
Flow through gate(s) = 4.75 mgd	
Total area of opening(s) = 7.5 ft^2	
Velocity through gate(s) = 0.98 ft/s	
Flow behavior = weir control	
Gate loss = 0.04 ft	
Downstream water level = 33.29	
Upstream water level = 33.33	
Disk Filters Common Inf. Channel Flow Split	**33.33**
User defined loss for flow split = 0 ft	
Total flow through flow split = 9.5 mgd	
Filter FSB to Disk Filters - Pipe	**33.46**
Pipe shape = Circular	
Diameter = 36 in	
Length = 19 ft	

Section Description	Water Surface Elevation
Flow = 9.75 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.8	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 2.13 ft/s	
Friction loss = 0.01 ft	
Fitting loss = 0.13 ft	
Total loss = 0.14 ft	
Filter FSB Eff. Weir to Disk Filters	**34.95**
Weir invert (top of weir) = 34.2	
Weir length = 7 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 9.75 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.75 ft	
AquaDiamond Filters Common Eff. Channel Flow Comb	
AquaDiamond Filters Eff. Weir 2	**Off-line**
AquaDiamond Filters Eff. Weir 1	**31.05**
Weir invert (top of weir) = 30.58	
Weir length = 20 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 13.94 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.47 ft	
AquaDiamond Filters Inf. Weir 1	**32.15**
Weir invert (top of weir) = 31.58	
Weir length = 15 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 13.94 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.57 ft	
AquaDiamond Filters Inf. Slide Gate #1	**32.42**
Opening type = rectangular gate	
Opening diameter/width = 36 in	
Gate height = 45 in	
Invert = 29.58	
Number of gates = 1	

Section Description	Water Surface Elevation
Flow through gate(s) = 13.94 mgd	
Total area of opening(s) = 11.25 ft^2	
Velocity through gate(s) = 1.92 ft/s	
AquaDiamond Filters Inf. Weir 2	**Off-line**
AquaDiamond Filters Inf. Slide Gate #2	**Off-line**
AquaDiamond Filters Common Inf. Channel	**32.42**
User defined loss for flow split = 0 ft	
Total flow through flow split = 13.94 mgd	
Filter FSB to AquaDiamond Filters - Pipe	**32.73**
Pipe shape = Circular	
Diameter = 36 in	
Length = 64 ft	
Flow = 13.94 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.75	
Pipe area = 7.07 ft^2	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 3.05 ft/s	
Friction loss = 0.06 ft	
Fitting loss = 0.25 ft	
Total loss = 0.31 ft	
Filter FSB Eff. Weir to AquaDiamond Filters	**34.95**
Weir invert (top of weir) = 34	
Weir length = 7 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 13.94 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.95 ft	
Filter FSB Eff. Flow Split	**34.95**
User defined loss for flow split = 0 ft	
Total flow through flow split = 23.69 mgd	
Filter FSB Influent Channel Approximation	**34.95**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 50 ft	
Channel width/diameter = 15 ft	
Flow = 23.44 mgd	
Downstream channel invert = 23.83	

Section Description	Water Surface Elevation
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 166.8 ft^2	
Hydraulic radius = 4.479	
Normal depth = infinite	
Critical depth = 0.57 ft	
Depth downstream = 11.12 ft	
Bend loss = 0 ft	
Depth upstream = 11.12 ft	
Velocity = 0.22 ft/s	
Flow profile = Horizontal	
Filter FSB Slide Gate	**35.01**
Opening type = rectangular gate	
Opening diameter/width = 72 in	
Gate height = 60 in	
Invert = 26.58	
Number of gates = 1	
Flow through gate(s) = 23.44 mgd	
Total area of opening(s) = 30 ft^2	
Velocity through gate(s) = 1.21 ft/s	
Filter Flow Splitter Box Inf. Flow Combination	
Clarifiers #1 and #2 Eff. Pipe 2	**35.54**
Pipe shape = Circular	
Diameter = 36 in	
Length = 240 ft	
Flow = 14.062 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.05	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 3.08 ft/s	
Friction loss = 0.23 ft	
Fitting loss = 0.3 ft	
Total loss = 0.53 ft	
Clarifier #3 Eff. Pipe 2	**Off-line**
AGS Reactors to Filter FSB - Pipe	**35.47**
Pipe shape = Circular	
Diameter = 36 in	
Length = 520 ft	
Flow = 9.5 mgd	

Section Description	Water Surface Elevation
Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 3.25 Pipe area = 7.07 ft² Pipe hydraulic radius = 0.75 Age factor = 1 Solids factor = 1 Velocity = 2.08 ft/s Friction loss = 0.24 ft Fitting loss = 0.22 ft Total loss = 0.46 ft	
Tee - AGS Reactors Eff Pipes Tee type = run of tee Diameter of pipe run past tee = 36 in Flow through tee = 9.5 mgd Velocity through tee = 2.08 ft/s Total tee K value = 0.6 Overall head loss = 0.04 ft	**35.51**
Tee - AGS 1 & 2 Eff Pipes Tee type = run of tee Diameter of pipe run past tee = 36 in Flow through tee = 0 mgd Velocity through tee = 0 ft/s Total tee K value = 0.6 Overall head loss = 0 ft	**35.51**
AGS Reactor 3 Eff. Pipe Pipe shape = Circular Diameter = 20 in Length = 60 ft Flow = 9.5 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 2.94 Pipe area = 2.18 ft² Pipe hydraulic radius = 0.417 Age factor = 1 Solids factor = 1 Velocity = 6.74 ft/s Friction loss = 0.49 ft Fitting loss = 2.07 ft Total loss = 2.56 ft	**38.07**
AGS Reactor 3 Eff Weir Weir invert (top of weir) = 42.2	**42.52**

Section Description	Water Surface Elevation
Weir length = 24 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 9.5 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.32 ft	
AGS Reactor 3	**43.78**
2nd degree polynomial	
Flow = 11.719 mgd	
Overall head loss = 1.25 ft	
Headworks to AGS Reactor 3	**48.45**
Pipe shape = Circular	
Diameter = 20 in	
Length = 360 ft	
Flow = 9.5 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.5	
Pipe area = 2.18 ft^2	
Pipe hydraulic radius = 0.417	
Age factor = 1	
Solids factor = 1	
Velocity = 6.74 ft/s	
Friction loss = 2.91 ft	
Fitting loss = 1.76 ft	
Total loss = 4.67 ft	
AGS 1 & 2 Eff. Pipe	**35.51**
Pipe shape = Circular	
Diameter = 36 in	
Length = 110 ft	
Flow = 0 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.94	
Pipe area = 7.07 ft^2	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 0 ft/s	
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
AGS Reactors 1 & 2 Eff. Pipes Flow	
AGS Reactor 1 Eff. Pipe	**35.51**

Section Description	Water Surface Elevation
Pipe shape = Circular Diameter = 20 in Length = 165 ft Flow = 0 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 2.94 Pipe area = 2.18 ft² Pipe hydraulic radius = 0.417 Age factor = 1 Solids factor = 1 Velocity = 0 ft/s Friction loss = 0 ft Fitting loss = 0 ft Total loss = 0 ft	
AGS Reactor 1 Eff Weir	**42.17**
Weir invert (top of weir) = 42.17 Weir length = 24 ft Weir 'C' coefficient = 3.33 Flow over weir = 0 mgd Weir submergence = unsubmerged Head over weir = 0 ft	
AGS Reactor 1	**42.64**
2nd degree polynomial Flow = 0 mgd Overall head loss = 0.47 ft	
Headworks to AGS Reactor 1	**42.64**
Pipe shape = Circular Diameter = 20 in Length = 235 ft Flow = 0 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 2.5 Pipe area = 2.18 ft² Pipe hydraulic radius = 0.417 Age factor = 1 Solids factor = 1 Velocity = 0 ft/s Friction loss = 0 ft Fitting loss = 0 ft Total loss = 0 ft	
AGS Reactor 2 Eff. Pipe	**35.51**

Section Description	Water Surface Elevation
Pipe shape = Circular	
Diameter = 20 in	
Length = 60 ft	
Flow = 0 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.94	
Pipe area = 2.18 ft²	
Pipe hydraulic radius = 0.417	
Age factor = 1	
Solids factor = 1	
Velocity = 0 ft/s	
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
AGS Reactor 2 Eff Weir	**42.17**
Weir invert (top of weir) = 42.17	
Weir length = 24 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 0 mgd	
Weir submergence = unsubmerged	
Head over weir = 0 ft	
AGS Reactor 2	**42.64**
2nd degree polynomial	
Flow = 0 mgd	
Overall head loss = 0.47 ft	
Headworks to AGS Reactor 2	**42.64**
Pipe shape = Circular	
Diameter = 20 in	
Length = 360 ft	
Flow = 0 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.5	
Pipe area = 2.18 ft²	
Pipe hydraulic radius = 0.417	
Age factor = 1	
Solids factor = 1	
Velocity = 0 ft/s	
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
Clarifier #3 Eff. Pipe 1	**Off-line**

Section Description	Water Surface Elevation
Clarifier #3 Eff. Launder	**Off-line**
Clarifier #3 V-notch Weir	**Off-line**
Clarifier FSB to Clarifier #3	**Off-line**
Clarifier FSB Weir Gate #3	**Off-line**
Tee - Clarifiers #1 and #2 to Filter FSB	**35.82**

Main line diameter = 36 in
Branch diameter = 30 in
Main line flow = 7.03 mgd
Branch flow = 7.03 mgd
Tee head loss = 0.28 ft

Tee - Eff. Pipes of Clarifiers #1 and #2

Clarifier #1 Eff. Pipe 1	**36.1**

Pipe shape = Circular
Diameter = 30 in
Length = 164 ft
Flow = 7.031 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 2.25
Pipe area = 4.91 ft^2
Pipe hydraulic radius = 0.625
Age factor = 1
Solids factor = 1
Velocity = 2.22 ft/s
Friction loss = 0.11 ft
Fitting loss = 0.17 ft
Total loss = 0.28 ft

Clarifier #2 Eff. Pipe 1	**35.96**

Pipe shape = Circular
Diameter = 30 in
Length = 18 ft
Flow = 7.031 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 1.75
Pipe area = 4.91 ft^2
Pipe hydraulic radius = 0.625
Age factor = 1
Solids factor = 1
Velocity = 2.22 ft/s

Section Description	Water Surface Elevation
Friction loss = 0.01 ft Fitting loss = 0.13 ft Total loss = 0.15 ft	
Clarifier #2 Eff. Launder	**37.76**
Launder invert = 36.08 Launder length = 172.79 ft Launder width = 2 ft Launder slope = 0 ft/ft Flow through launder = 7.031 mgd Critical depth = 0.97 ft Downstream depth = 0.97 ft Upstream depth = 1.68 ft	
Clarifier #2 V-notch Weir	**38.3**
Invert of V notch = 38.17 Angle of V notch = 90 degrees Number of notches = 660 Total flow over weir = 7.031 mgd Weir submergence = unsubmerged Head over weir = 0.13 ft	
Clarifier FSB to Clarifier #2	**38.54**
Pipe shape = Circular Diameter = 36 in Length = 120 ft Flow = 11.718 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 1.48 Pipe area = 7.07 ft^2 Pipe hydraulic radius = 0.75 Age factor = 1 Solids factor = 1 Velocity = 2.56 ft/s Friction loss = 0.08 ft Fitting loss = 0.15 ft Total loss = 0.23 ft	
Clarifier FSB Weir Gate #2	**40.05**
Weir invert (top of weir) = 39.25 Number of contracted sides = 2 Weir length = 8 ft Flow over weir = 11.718 mgd Submergence = unsubmerged Head over weir = 0.8 ft	

Section Description	**Water Surface Elevation**
Clarifier #1 Eff. Launder	**37.76**
Launder invert = 36.08	
Launder length = 172.79 ft	
Launder width = 2 ft	
Launder slope = 0 ft/ft	
Flow through launder = 7.031 mgd	
Critical depth = 0.97 ft	
Downstream depth = 0.97 ft	
Upstream depth = 1.68 ft	
Clarifier #1 V-notch Weir	**38.3**
Invert of V notch = 38.17	
Angle of V notch = 90 degrees	
Number of notches = 660	
Total flow over weir = 7.031 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.13 ft	
Clarifier FSB to Clarifier #1	**38.54**
Pipe shape = Circular	
Diameter = 36 in	
Length = 120 ft	
Flow = 11.718 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.48	
Pipe area = 7.07 ft^2	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 2.56 ft/s	
Friction loss = 0.08 ft	
Fitting loss = 0.15 ft	
Total loss = 0.23 ft	
Clarifier FSB Weir Gate #1	**40.05**
Weir invert (top of weir) = 39.25	
Number of contracted sides = 2	
Weir length = 8 ft	
Flow over weir = 11.718 mgd	
Submergence = unsubmerged	
Head over weir = 0.8 ft	
Clarifier FSB Flow Split	**40.05**
User defined loss for flow split = 0 ft	
Total flow through flow split = 23.436 mgd	

Section Description	**Water Surface Elevation**

Clarifier FSB Approximation 40.05

Channel shape = Rectangular
Manning's 'n' = 0.012
Channel length = 16 ft
Channel width/diameter = 5 ft
Flow = 23.435 mgd
Downstream channel invert = 23.25
Channel slope = 0 ft/ft
Channel side slope = not applicable
Area of flow = 84 ft^2
Hydraulic radius = 2.176
Normal depth = infinite
Critical depth = 1.18 ft
Depth downstream = 16.8 ft
Bend loss = 0 ft
Depth upstream = 16.8 ft
Velocity = 0.43 ft/s
Flow profile = Horizontal

Pipe - Anx/Aer Basin 1 to Clarifier FSB 40.37

Pipe shape = Circular
Diameter = 42 in
Length = 440 ft
Flow = 14.061 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 1.52
Pipe area = 9.62 ft^2
Pipe hydraulic radius = 0.875
Age factor = 1
Solids factor = 1
Velocity = 2.26 ft/s
Friction loss = 0.2 ft
Fitting loss = 0.12 ft
Total loss = 0.32 ft

Anx/Aer Eff Sluice Gate #1 40.6

Opening type = circular gate
Opening diameter/width = 42 in
Gate height = 42 in
Invert = 24.08
Number of gates = 1
Flow through gate(s) = 14.061 mgd
Total area of opening(s) = 9.62 ft^2
Velocity through gate(s) = 2.26 ft/s

Section Description	Water Surface Elevation
Anx/Aer Basin 1 Eff. Box	**40.6**

Channel shape = Rectangular
Manning's 'n' = 0.012
Channel length = 15 ft
Channel width/diameter = 6 ft
Flow = 14.061 mgd
Downstream channel invert = 23.08
Channel slope = 0 ft/ft
Channel side slope = not applicable
Area of flow = 105.11 ft^2
Hydraulic radius = 2.561
Normal depth = infinite
Critical depth = 0.74 ft
Depth downstream = 17.52 ft
Bend loss = 0 ft
Depth upstream = 17.52 ft
Velocity = 0.21 ft/s
Flow profile = Horizontal

Eff. Box flow combination

Anx/Aer Basin 1 Eff. Weir Gate — **42.79**

Weir invert (top of weir) = 42.2
Number of contracted sides = 2
Weir length = 15 ft
Flow over weir = 14.061 mgd
Submergence = unsubmerged
Head over weir = 0.59 ft

Anx/Aer Basin 1 Port — **42.92**

Opening type = rectangular orifice
Opening diameter/width = 57 in
Opening height = 57 in
Invert = 30.92
Number of openings = 1
Flow through opening(s) = 26.061 mgd
Total area of opening(s) = 22.56 ft^2
Velocity through opening(s) = 1.79 ft/s

Anx/Aer Basin 1 Inf. Sluice Gate — **43.34**

Opening type = circular gate
Opening diameter/width = 36 in
Gate height = 36 in
Invert = 30.92
Number of gates = 1
Flow through gate(s) = 14.061 mgd
Total area of opening(s) = 7.07 ft^2

Section Description	**Water Surface Elevation**
Velocity through gate(s) = 3.08 ft/s	
36-inch DI from Headworks to Anoxic/Aerobic Basin 1	**43.53**
Pipe shape = Circular	
Diameter = 36 in	
Length = 60 ft	
Flow = 14.061 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 0.95	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 3.08 ft/s	
Friction loss = 0.06 ft	
Fitting loss = 0.14 ft	
Total loss = 0.2 ft	
30-inch DI from Headworks to Anoxic/Aerobic Basin 1	**44.79**
Pipe shape = Circular	
Diameter = 30 in	
Length = 375 ft	
Flow = 14.061 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.25	
Pipe area = 4.91 ft²	
Pipe hydraulic radius = 0.625	
Age factor = 1	
Solids factor = 1	
Velocity = 4.43 ft/s	
Friction loss = 0.87 ft	
Fitting loss = 0.38 ft	
Total loss = 1.25 ft	
Headworks Eff. Weir Gate 1	**52.72**
Weir invert (top of weir) = 51.62	
Number of contracted sides = 2	
Weir length = 6 ft	
Flow over weir = 14.061 mgd	
Submergence = unsubmerged	
Head over weir = 1.1 ft	
Pipe - connecting Anx/Aer Basins Eff. Boxes	**40.6**
Pipe shape = Circular	
Diameter = 48 in	

Section Description	Water Surface Elevation
Length = 9.67 ft	
Flow = 0 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.23	
Pipe area = 12.57 ft²	
Pipe hydraulic radius = 1	
Age factor = 1	
Solids factor = 1	
Velocity = 0 ft/s	
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
Pipe - Anx/Aer Basin 2 to Clarifier FSB	**40.37**
Pipe shape = Circular	
Diameter = 42 in	
Length = 440 ft	
Flow = 14.061 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.52	
Pipe area = 9.62 ft²	
Pipe hydraulic radius = 0.875	
Age factor = 1	
Solids factor = 1	
Velocity = 2.26 ft/s	
Friction loss = 0.2 ft	
Fitting loss = 0.12 ft	
Total loss = 0.32 ft	
Anx/Aer Eff. Sluice Gate #2	**40.6**
Opening type = circular gate	
Opening diameter/width = 42 in	
Gate height = 42 in	
Invert = 24.08	
Number of gates = 1	
Flow through gate(s) = 14.061 mgd	
Total area of opening(s) = 9.62 ft^2	
Velocity through gate(s) = 2.26 ft/s	
Anx/Aer Basin 2 Eff. Box	**40.6**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 15 ft	
Channel width/diameter = 6 ft	
Flow = 14.063 mgd	

Section Description	Water Surface Elevation
Downstream channel invert = 23.08	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 105.11 ft^2	
Hydraulic radius = 2.561	
Normal depth = infinite	
Critical depth = 0.74 ft	
Depth downstream = 17.52 ft	
Bend loss = 0 ft	
Depth upstream = 17.52 ft	
Velocity = 0.21 ft/s	
Flow profile = Horizontal	
Anx/Aer Basin 2 Eff. Box Flow Split	**40.6**
User defined loss for flow split = 0 ft	
Total flow through flow split = 14.063 mgd	
Anx/Aer Basin 2 Eff. Weir Gate	**41.79**
Weir invert (top of weir) = 41.2	
Number of contracted sides = 2	
Weir length = 15 ft	
Flow over weir = 14.061 mgd	
Submergence = unsubmerged	
Head over weir = 0.59 ft	
Anx/Aer Basin 2 Port	**41.92**
Opening type = rectangular orifice	
Opening diameter/width = 57 in	
Opening height = 57 in	
Invert = 30.92	
Number of openings = 1	
Flow through opening(s) = 26.061 mgd	
Total area of opening(s) = 22.56 ft^2	
Velocity through opening(s) = 1.79 ft/s	
Anx/Aer Basin 2 Inf. Sluice Gate	**42.34**
Opening type = circular gate	
Opening diameter/width = 36 in	
Gate height = 36 in	
Invert = 30.92	
Number of gates = 1	
Flow through gate(s) = 14.061 mgd	
Total area of opening(s) = 7.07 ft^2	
Velocity through gate(s) = 3.08 ft/s	
36-inch DI from Headworks to Anoxic/Aerobic Basin 2	**42.53**
Pipe shape = Circular	

Section Description	Water Surface Elevation

Diameter = 36 in
Length = 55 ft
Flow = 14.061 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 0.95
Pipe area = 7.07 ft^2
Pipe hydraulic radius = 0.75
Age factor = 1
Solids factor = 1
Velocity = 3.08 ft/s
Friction loss = 0.05 ft
Fitting loss = 0.14 ft
Total loss = 0.19 ft

30-inch DI from Headworks to Anoxic/Aerobic Basin 2 — **43.65**

Pipe shape = Circular
Diameter = 30 in
Length = 320 ft
Flow = 14.061 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 1.25
Pipe area = 4.91 ft^2
Pipe hydraulic radius = 0.625
Age factor = 1
Solids factor = 1
Velocity = 4.43 ft/s
Friction loss = 0.74 ft
Fitting loss = 0.38 ft
Total loss = 1.12 ft

Headworks Eff. Weir Gate 2 — **52.72**

Weir invert (top of weir) = 51.62
Number of contracted sides = 2
Weir length = 6 ft
Flow over weir = 14.061 mgd
Submergence = unsubmerged
Head over weir = 1.1 ft

Headworks Eff. Splitter Box Flow Split — **52.72**

User defined loss for flow split = 0 ft
Total flow through flow split = 37.622 mgd

Headcell Eff. Channel — **52.72**

Channel shape = Rectangular
Manning's 'n' = 0.012

Section Description	Water Surface Elevation
Channel length = 40 ft	
Channel width/diameter = 8 ft	
Flow = 40.625 mgd	
Downstream channel invert = 47.92	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 38.41 ft^2	
Hydraulic radius = 2.182	
Normal depth = infinite	
Critical depth = 1.24 ft	
Depth downstream = 4.8 ft	
Bend loss = 0 ft	
Depth upstream = 4.8 ft	
Velocity = 1.64 ft/s	
Flow profile = Horizontal	
Headworks Eff. Channel	
HeadCell Grit Unit 1 Effluent Weir	**54.01**
Weir invert (top of weir) = 53.42	
Weir length = 16 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 15.625 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.59 ft	
HeadCell Grit Unit 2 Effluent Weir	**54.01**
Weir invert (top of weir) = 53.42	
Weir length = 16 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 15.625 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.59 ft	
Headcell Grit Unit 2	**55.07**
2nd degree polynomial	
Flow = 15.625 mgd	
Overall head loss = 1.06 ft	
Headcell Grit Unit 1	**55.07**
2nd degree polynomial	
Flow = 15.625 mgd	
Overall head loss = 1.06 ft	
Headworks Eff. Box Flow Split	**55.07**
User defined loss for flow split = 0 ft	
Total flow through flow split = 31.25 mgd	

Section Description	Water Surface Elevation
Screen Eff, Channel	**55.07**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 31 ft	
Channel width/diameter = 6 ft	
Flow = 31.25 mgd	
Downstream channel invert = 47.92	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 42.88 ft^2	
Hydraulic radius = 2.113	
Normal depth = infinite	
Critical depth = 1.26 ft	
Depth downstream = 7.15 ft	
Bend loss = 0 ft	
Depth upstream = 7.15 ft	
Velocity = 1.13 ft/s	
Flow profile = Horizontal	
AFS Channel 1 Baffle	**57.66**
Weir invert (top of weir) = 56.17	
Weir length = 4 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 15.625 mgd	
Weir submergence = unsubmerged	
Head over weir = 1.49 ft	
AFS Channel 2 Baffle	**57.66**
Weir invert (top of weir) = 56.17	
Weir length = 4 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 15.625 mgd	
Weir submergence = unsubmerged	
Head over weir = 1.49 ft	
AFS Channel 2	**57.67**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 20 ft	
Channel width/diameter = 4 ft	
Flow = 15.625 mgd	
Downstream channel invert = 55.5	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 8.65 ft^2	
Hydraulic radius = 1.039	

Section Description	**Water Surface Elevation**
Normal depth = infinite	
Critical depth = 1.04 ft	
Depth downstream = 2.16 ft	
Bend loss = 0 ft	
Depth upstream = 2.17 ft	
Velocity = 2.8 ft/s	
Flow profile = Horizontal	
AFS Channel 1	**57.67**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 20 ft	
Channel width/diameter = 4 ft	
Flow = 15.625 mgd	
Downstream channel invert = 55.5	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 8.65 ft^2	
Hydraulic radius = 1.039	
Normal depth = infinite	
Critical depth = 1.04 ft	
Depth downstream = 2.16 ft	
Bend loss = 0 ft	
Depth upstream = 2.17 ft	
Velocity = 2.8 ft/s	
Flow profile = Horizontal	
Automatic Fine Screen 2	**58.66**
Linear	
Flow = 15.625 mgd	
Overall head loss = 0.99 ft	
Automatic Fine Screen 1	**58.66**
Linear	
Flow = 15.625 mgd	
Overall head loss = 0.99 ft	
Headworks Influent Channel	**58.66**
User defined loss for flow split = 0 ft	
Total flow through flow split = 31.25 mgd	

APPENDIX E:

VISUAL HYDRAULICS MODEL REPORT OUTPUT – 12.5 MGD AWT WITH AGS, PHF

Visual Hydraulics Summary Report - Hydraulic Analysis

Project: **NRWRF Expansion to 12.5 MGD_12.5 AWT AGS PHF 2023-02-28.vhf**
Company: **McKim & Creed**
Date: **February 28, 2023**

Current flow conditions

Forward Flow =	31.25 mgd
Return I Flow =	15.62 mgd
Return II Flow =	12 mgd
Return III Flow =	-----

Section Description	Water Surface Elevation
AquaDiamond Filters Common Eff. Channel	**30.07**

Channel shape = Rectangular
Manning's 'n' = 0.012
Channel length = 47 ft
Channel width/diameter = 3 ft
Flow = 21.75 mgd
Downstream channel invert = 26
Channel slope = 0 ft/ft
Channel side slope = not applicable
Area of flow = 12.18 ft^2
Hydraulic radius = 1.095
Normal depth = infinite
Critical depth = 1.57 ft
Depth downstream = 4.05 ft
Bend loss = 0 ft
Depth upstream = 4.07 ft
Velocity = 2.77 ft/s
Flow profile = Horizontal

Disk Filters to CCCs **29.92**

Pipe shape = Circular
Diameter = 42 in
Length = 132 ft
Flow = 15.625 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 2.66
Pipe area = 9.62 ft²

Section Description	Water Surface Elevation

Pipe hydraulic radius = 0.875
Age factor = 1
Solids factor = 1
Velocity = 2.51 ft/s
Friction loss = 0.07 ft
Fitting loss = 0.26 ft
Total loss = 0.33 ft

Pipe - Disk Filters to Wye — **29.58**

Pipe shape = Circular
Diameter = 36 in
Length = 30 ft
Flow = 0 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 0
Pipe area = 7.07 ft²
Pipe hydraulic radius = 0.75
Age factor = 1
Solids factor = 1
Velocity = 0 ft/s
Friction loss = 0 ft
Fitting loss = 0 ft
Total loss = 0 ft

Disk Filters Effluent Pipe — **30**

Pipe shape = Circular
Diameter = 36 in
Length = 72 ft
Flow = 9.5 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 0.8
Pipe area = 7.07 ft²
Pipe hydraulic radius = 0.75
Age factor = 1
Solids factor = 1
Velocity = 2.08 ft/s
Friction loss = 0.03 ft
Fitting loss = 0.05 ft
Total loss = 0.09 ft

Pipe - AquaDiamond Filters to Disk Filters Eff Pipe — **29.95**

Pipe shape = Circular
Diameter = 42 in
Length = 35 ft

Section Description	Water Surface Elevation
Flow = 6.125 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.93	
Pipe area = 9.62 ft²	
Pipe hydraulic radius = 0.875	
Age factor = 1	
Solids factor = 1	
Velocity = 0.98 ft/s	
Friction loss = 0 ft	
Fitting loss = 0.03 ft	
Total loss = 0.03 ft	
Disk Filters Common Eff. Channel	
Disk Filters Eff. Weir - Contracted 1	**31.81**
Weir invert (top of weir) = 31.35	
Number of contracted sides = 2	
Weir length = 7.5 ft	
Flow over weir = 4.75 mgd	
Submergence = unsubmerged	
Head over weir = 0.46 ft	
Disk Filters Eff. Weir - Contracted 2	**31.81**
Weir invert (top of weir) = 31.35	
Number of contracted sides = 2	
Weir length = 7.5 ft	
Flow over weir = 4.75 mgd	
Submergence = unsubmerged	
Head over weir = 0.46 ft	
Disk Filters Inf. Weir 2	**33.29**
Weir invert (top of weir) = 32.9	
Weir length = 9.17 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 4.75 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.39 ft	
Disk Filters Inf. Slide Gate 2	**33.33**
Opening type = rectangular gate	
Opening diameter/width = 36 in	
Gate height = 30 in	
Invert = 30.41	
Number of gates = 1	
Flow through gate(s) = 4.75 mgd	
Total area of opening(s) = 7.5 ft^2	

Section Description	Water Surface Elevation
Velocity through gate(s) = 0.98 ft/s	
Flow behavior = weir control	
Gate loss = 0.04 ft	
Downstream water level = 33.29	
Upstream water level = 33.33	
Disk Filters Inf. Weir 1	**33.29**
Weir invert (top of weir) = 32.9	
Weir length = 9.17 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 4.75 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.39 ft	
CCC1 Train 2 Effluent Cipolletti Weir	**29.43**
CCC2 NORTH Effluent Cipolletti Weir	**25.21**
CCC2 SOUTH Effluent Cipolletti Weir	**25.22**
CCC1 Train 1 Effluent Cipolletti Weir	**28.75**
CCC1 Slide Gate #2	**29.45**
Opening type = rectangular gate	
Opening diameter/width = 72 in	
Gate height = 72 in	
Invert = 25.75	
Number of gates = 1	
Flow through gate(s) = 7.812 mgd	
Total area of opening(s) = 36 ft^2	
Velocity through gate(s) = 0.34 ft/s	
CCC2 Influent Slide Gate 1	**29.45**
Opening type = rectangular gate	
Opening diameter/width = 72 in	
Gate height = 64 in	
Invert = 25.81	
Number of gates = 1	
Flow through gate(s) = 7.812 mgd	
Total area of opening(s) = 32 ft^2	
Velocity through gate(s) = 0.38 ft/s	
CCC2 Influent Slide Gate 2	**29.45**
Opening type = rectangular gate	
Opening diameter/width = 72 in	
Gate height = 64 in	
Invert = 25.81	
Number of gates = 1	

Section Description	Water Surface Elevation
Flow through gate(s) = 7.812 mgd	
Total area of opening(s) = 32 ft^2	
Velocity through gate(s) = 0.38 ft/s	
CCC2 Influent Chamber	**29.45**
User defined loss for flow split = 0 ft	
Total flow through flow split = 15.625 mgd	
Pipe - tee to CCC2	**29.58**
Pipe shape = Circular	
Diameter = 42 in	
Length = 10 ft	
Flow = 15.625 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.3	
Pipe area = 9.62 ft²	
Pipe hydraulic radius = 0.875	
Age factor = 1	
Solids factor = 1	
Velocity = 2.51 ft/s	
Friction loss = 0.01 ft	
Fitting loss = 0.13 ft	
Total loss = 0.13 ft	
Tee connecting AquaDiamond Filters to Disk Filters Eff	
CCC1 Slide Gate #1	**29.45**
Opening type = rectangular gate	
Opening diameter/width = 72 in	
Gate height = 72 in	
Invert = 25.75	
Number of gates = 1	
Flow through gate(s) = 7.812 mgd	
Total area of opening(s) = 36 ft^2	
Velocity through gate(s) = 0.34 ft/s	
CCC1 Influent Chamber	**29.45**
User defined loss for flow split = 0 ft	
Total flow through flow split = 15.625 mgd	
Filters to CCC1 after Wye	**29.74**
Pipe shape = Circular	
Diameter = 42 in	
Length = 60 ft	
Flow = 15.625 mgd	
Friction method = Hazen Williams	
Friction factor = 120	

Section Description	Water Surface Elevation

Total fitting K value = 2.65
Pipe area = 9.62 ft^2
Pipe hydraulic radius = 0.875
Age factor = 1
Solids factor = 1
Velocity = 2.51 ft/s
Friction loss = 0.03 ft
Fitting loss = 0.26 ft
Total loss = 0.29 ft

Wye to CCCs — **29.74**

User defined loss for flow split = 0 ft
Total flow through flow split = 15.625 mgd

AquaDiamond Filters to CCC Pipe 1 — **30.05**

Pipe shape = Circular
Diameter = 42 in
Length = 167 ft
Flow = 15.625 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 2.18
Pipe area = 9.62 ft^2
Pipe hydraulic radius = 0.875
Age factor = 1
Solids factor = 1
Velocity = 2.51 ft/s
Friction loss = 0.09 ft
Fitting loss = 0.21 ft
Total loss = 0.31 ft

AquaDiamond Filters to Disk Filters Eff Pipe — **30.05**

User defined loss for flow split = 0 ft
Total flow through flow split = 21.75 mgd

Disk Filters Inf. Slide Gate 1 — **33.33**

Opening type = rectangular gate
Opening diameter/width = 36 in
Gate height = 30 in
Invert = 30.41
Number of gates = 1
Flow through gate(s) = 4.75 mgd
Total area of opening(s) = 7.5 ft^2
Velocity through gate(s) = 0.98 ft/s
Flow behavior = weir control
Gate loss = 0.04 ft
Downstream water level = 33.29
Upstream water level = 33.33

Section Description	**Water Surface Elevation**
Disk Filters Common Inf. Channel Flow Split	**33.33**
User defined loss for flow split = 0 ft	
Total flow through flow split = 9.5 mgd	
Filter FSB to Disk Filters - Pipe	**33.46**
Pipe shape = Circular	
Diameter = 36 in	
Length = 19 ft	
Flow = 9.5 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.8	
Pipe area = 7.07 ft^2	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 2.08 ft/s	
Friction loss = 0.01 ft	
Fitting loss = 0.12 ft	
Total loss = 0.13 ft	
Filter FSB Eff. Weir to Disk Filters	**35.28**
Weir invert (top of weir) = 34.54	
Weir length = 7 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 9.5 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.74 ft	
AquaDiamond Filters Common Eff. Channel Flow Comb	
AquaDiamond Filters Eff. Weir 2	**30.98**
Weir invert (top of weir) = 30.58	
Weir length = 20 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 10.875 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.4 ft	
AquaDiamond Filters Eff. Weir 1	**30.98**
Weir invert (top of weir) = 30.58	
Weir length = 20 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 10.875 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.4 ft	

Section Description	Water Surface Elevation
AquaDiamond Filters Inf. Weir 1	**32.06**
Weir invert (top of weir) = 31.58	
Weir length = 15 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 10.875 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.48 ft	
AquaDiamond Filters Inf. Slide Gate #1	**32.23**
Opening type = rectangular gate	
Opening diameter/width = 36 in	
Gate height = 45 in	
Invert = 29.58	
Number of gates = 1	
Flow through gate(s) = 10.875 mgd	
Total area of opening(s) = 11.25 ft^2	
Velocity through gate(s) = 1.5 ft/s	
AquaDiamond Filters Inf. Weir 2	**32.06**
Weir invert (top of weir) = 31.58	
Weir length = 15 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 10.875 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.48 ft	
AquaDiamond Filters Inf. Slide Gate #2	**32.23**
Opening type = rectangular gate	
Opening diameter/width = 36 in	
Gate height = 45 in	
Invert = 29.58	
Number of gates = 1	
Flow through gate(s) = 10.875 mgd	
Total area of opening(s) = 11.25 ft^2	
Velocity through gate(s) = 1.5 ft/s	
AquaDiamond Filters Common Inf. Channel	**32.23**
User defined loss for flow split = 0 ft	
Total flow through flow split = 21.75 mgd	
Filter FSB to AquaDiamond Filters - Pipe	**32.99**
Pipe shape = Circular	
Diameter = 36 in	
Length = 64 ft	
Flow = 21.75 mgd	
Friction method = Hazen Williams	

Section Description	Water Surface Elevation
Friction factor = 120	
Total fitting K value = 1.75	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 4.76 ft/s	
Friction loss = 0.14 ft	
Fitting loss = 0.62 ft	
Total loss = 0.75 ft	
Filter FSB Eff. Weir to AquaDiamond Filters	**35.28**
Weir invert (top of weir) = 34	
Weir length = 7 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 21.75 mgd	
Weir submergence = unsubmerged	
Head over weir = 1.28 ft	
Filter FSB Eff. Flow Split	**35.28**
User defined loss for flow split = 0 ft	
Total flow through flow split = 31.25 mgd	
Filter FSB Influent Channel Approximation	**35.28**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 50 ft	
Channel width/diameter = 15 ft	
Flow = 31.251 mgd	
Downstream channel invert = 23.83	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 171.72 ft^2	
Hydraulic radius = 4.531	
Normal depth = infinite	
Critical depth = 0.69 ft	
Depth downstream = 11.45 ft	
Bend loss = 0 ft	
Depth upstream = 11.45 ft	
Velocity = 0.28 ft/s	
Flow profile = Horizontal	
Filter FSB Slide Gate	**35.38**
Opening type = rectangular gate	
Opening diameter/width = 72 in	
Gate height = 60 in	
Invert = 26.58	

Section Description	Water Surface Elevation
Number of gates = 1 Flow through gate(s) = 31.25 mgd Total area of opening(s) = 30 ft^2 Velocity through gate(s) = 1.61 ft/s	
Filter Flow Splitter Box Inf. Flow Combination	
AGS 1-4 Comb. Eff. Pipe	**35.66**
Pipe shape = Circular Diameter = 36 in Length = 445 ft Flow = 7.92 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 2.75 Pipe area = 7.07 ft² Pipe hydraulic radius = 0.75 Age factor = 1 Solids factor = 1 Velocity = 1.73 ft/s Friction loss = 0.15 ft Fitting loss = 0.13 ft Total loss = 0.28 ft	
Tee - AGS 1-4 Effluent	**35.69**
Tee type = run of tee Diameter of pipe run past tee = 36 in Flow through tee = 7.92 mgd Velocity through tee = 1.73 ft/s Total tee K value = 0.6 Overall head loss = 0.03 ft Overall head loss = 0.73 ft	
AGS 4 Eff Pipe Flow	
AGS 1-3 Comb. Eff. Pipe	**35.69**
Pipe shape = Circular Diameter = 36 in Length = 110 ft Flow = 0 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 1.5 Pipe area = 7.07 ft² Pipe hydraulic radius = 0.75 Age factor = 1 Solids factor = 1 Velocity = 0 ft/s	

Section Description	Water Surface Elevation
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
Tee - AGS 1-3 Effluent	**35.69**
Tee type = run of tee	
Diameter of pipe run past tee = 36 in	
Flow through tee = 0 mgd	
Velocity through tee = 0 ft/s	
Total tee K value = 0.6	
Overall head loss = 0 ft	
Overall head loss = 0.73 ft	
AGS 3 Eff Pipe Flow	
AGS Reactors 1-2 to Filter FSB	**35.69**
Pipe shape = Circular	
Diameter = 36 in	
Length = 110 ft	
Flow = 0 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.5	
Pipe area = 7.07 ft^2	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 0 ft/s	
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
AGS Reactors 5-8 to Filter FSB - Pipe	**36.95**
Pipe shape = Circular	
Diameter = 36 in	
Length = 765 ft	
Flow = 15.625 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 3.75	
Pipe area = 7.07 ft^2	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 3.42 ft/s	
Friction loss = 0.89 ft	
Fitting loss = 0.68 ft	

Section Description	**Water Surface Elevation**
Total loss = 1.57 ft	
Tee - AGS 5-8 Effluent	**37.07**
Tee type = run of tee Diameter of pipe run past tee = 36 in Flow through tee = 15.83 mgd Velocity through tee = 3.46 ft/s Total tee K value = 0.6 Overall head loss = 0.11 ft	
AGS 8 Eff Pipe Flow	
Tee - AGS 5-7 Effluent	**37.2**
Tee type = run of tee Diameter of pipe run past tee = 36 in Flow through tee = 7.92 mgd Velocity through tee = 1.73 ft/s Total tee K value = 0.6 Overall head loss = 0.03 ft Overall head loss = 0.73 ft	
AGS 5-6 Comb. Eff. Pipe	**37.2**
Pipe shape = Circular Diameter = 36 in Length = 105 ft Flow = 0 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 1.5 Pipe area = 7.07 ft² Pipe hydraulic radius = 0.75 Age factor = 1 Solids factor = 1 Velocity = 0 ft/s Friction loss = 0 ft Fitting loss = 0 ft Total loss = 0 ft	
AGS Reactor 7 Eff. Pipe	**38.23**
Pipe shape = Circular Diameter = 20 in Length = 35 ft Flow = 7.92 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 1.69 Pipe area = 2.18 ft²	

Section Description	Water Surface Elevation
Pipe hydraulic radius = 0.417 Age factor = 1 Solids factor = 1 Velocity = 5.62 ft/s Friction loss = 0.2 ft Fitting loss = 0.83 ft Total loss = 1.03 ft	
AGS 7 Eff Weir	**42.49**
Weir invert (top of weir) = 42.2 Weir length = 24 ft Weir 'C' coefficient = 3.33 Flow over weir = 7.92 mgd Weir submergence = unsubmerged Head over weir = 0.29 ft	
AGS Reactor 7	**43.71**
2nd degree polynomial Flow = 7.92 mgd Overall head loss = 1.22 ft	
Headworks to AGS Reactor 7	**47.5**
Pipe shape = Circular Diameter = 20 in Length = 445 ft Flow = 7.92 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 2.5 Pipe area = 2.18 ft^2 Pipe hydraulic radius = 0.417 Age factor = 1 Solids factor = 1 Velocity = 5.62 ft/s Friction loss = 2.57 ft Fitting loss = 1.22 ft Total loss = 3.79 ft	
Tee - AGS 5 & 6 Eff. Pipes	**37.2**
Tee type = run of tee Diameter of pipe run past tee = 36 in Flow through tee = 0 mgd Velocity through tee = 0 ft/s Total tee K value = 0.6 Overall head loss = 0 ft Overall head loss = 0.73 ft	

Section Description	Water Surface Elevation

AGS 5 & 6 Eff. Pipes Flow Comb. at Tee

Headworks to AGS Reactor 3 — **42.64**

Pipe shape = Circular
Diameter = 20 in
Length = 460 ft
Flow = 0 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 2.5
Pipe area = 2.18 ft²
Pipe hydraulic radius = 0.417
Age factor = 1
Solids factor = 1
Velocity = 0 ft/s
Friction loss = 0 ft
Fitting loss = 0 ft
Total loss = 0 ft

AGS Reactor 3 Eff. Pipe — **35.69**

Pipe shape = Circular
Diameter = 20 in
Length = 30 ft
Flow = 0 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 2.94
Pipe area = 2.18 ft²
Pipe hydraulic radius = 0.417
Age factor = 1
Solids factor = 1
Velocity = 0 ft/s
Friction loss = 0 ft
Fitting loss = 0 ft
Total loss = 0 ft

AGS 3 Eff Weir — **42.17**

Weir invert (top of weir) = 42.17
Weir length = 24 ft
Weir 'C' coefficient = 3.33
Flow over weir = 0 mgd
Weir submergence = unsubmerged
Head over weir = 0 ft

AGS Reactor 3 — **42.64**

2nd degree polynomial
Flow = 0 mgd

Section Description	Water Surface Elevation
Overall head loss = 0.47 ft	
AGS Reactor 4 Eff. Pipe	**38.04**
Pipe shape = Circular	
Diameter = 20 in	
Length = 30 ft	
Flow = 7.92 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 4.44	
Pipe area = 2.18 ft²	
Pipe hydraulic radius = 0.417	
Age factor = 1	
Solids factor = 1	
Velocity = 5.62 ft/s	
Friction loss = 0.17 ft	
Fitting loss = 2.17 ft	
Total loss = 2.35 ft	
AGS 4 Eff Weir	**42.49**
Weir invert (top of weir) = 42.2	
Weir length = 24 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 7.92 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.29 ft	
AGS Reactor 4	**43.71**
2nd degree polynomial	
Flow = 7.92 mgd	
Overall head loss = 1.22 ft	
Headworks to AGS Reactor 4	**47.59**
Pipe shape = Circular	
Diameter = 20 in	
Length = 460 ft	
Flow = 7.92 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.5	
Pipe area = 2.18 ft²	
Pipe hydraulic radius = 0.417	
Age factor = 1	
Solids factor = 1	
Velocity = 5.62 ft/s	
Friction loss = 2.66 ft	
Fitting loss = 1.22 ft	

Section Description	Water Surface Elevation
Total loss = 3.88 ft	
AGS 5-7 Comb. Eff. Pipe	**37.17**
Pipe shape = Circular	
Diameter = 36 in	
Length = 105 ft	
Flow = 7.92 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.5	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 1.73 ft/s	
Friction loss = 0.03 ft	
Fitting loss = 0.07 ft	
Total loss = 0.1 ft	
AGS Reactor 8 Eff. Pipe	**38.1**
Pipe shape = Circular	
Diameter = 20 in	
Length = 35 ft	
Flow = 7.92 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.69	
Pipe area = 2.18 ft²	
Pipe hydraulic radius = 0.417	
Age factor = 1	
Solids factor = 1	
Velocity = 5.62 ft/s	
Friction loss = 0.2 ft	
Fitting loss = 0.83 ft	
Total loss = 1.03 ft	
AGS 8 Eff Weir	**42.49**
Weir invert (top of weir) = 42.2	
Weir length = 24 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 7.92 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.29 ft	
AGS Reactor 8	**43.71**
2nd degree polynomial	
Flow = 7.92 mgd	

Section Description	Water Surface Elevation
Overall head loss = 1.22 ft	
Headworks to AGS Reactor 8	**48.23**
Pipe shape = Circular	
Diameter = 20 in	
Length = 570 ft	
Flow = 7.92 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.5	
Pipe area = 2.18 ft²	
Pipe hydraulic radius = 0.417	
Age factor = 1	
Solids factor = 1	
Velocity = 5.62 ft/s	
Friction loss = 3.29 ft	
Fitting loss = 1.22 ft	
Total loss = 4.52 ft	
AGS Reactor 5 Eff. Pipe	**37.2**
Pipe shape = Circular	
Diameter = 20 in	
Length = 145 ft	
Flow = 0 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.19	
Pipe area = 2.18 ft²	
Pipe hydraulic radius = 0.417	
Age factor = 1	
Solids factor = 1	
Velocity = 0 ft/s	
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
AGS Reactor 6 Eff. Pipe	**37.2**
Pipe shape = Circular	
Diameter = 36 in	
Length = 35 ft	
Flow = 0 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.69	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	

Section Description	Water Surface Elevation
Solids factor = 1	
Velocity = 0 ft/s	
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
AGS 6 Eff Weir	**42.17**
Weir invert (top of weir) = 42.17	
Weir length = 24 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 0 mgd	
Weir submergence = unsubmerged	
Head over weir = 0 ft	
AGS Reactor 6	**42.64**
2nd degree polynomial	
Flow = 0 mgd	
Overall head loss = 0.47 ft	
Headworks to AGS Reactor 6	**42.64**
Pipe shape = Circular	
Diameter = 20 in	
Length = 345 ft	
Flow = 0 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.5	
Pipe area = 2.18 ft^2	
Pipe hydraulic radius = 0.417	
Age factor = 1	
Solids factor = 1	
Velocity = 0 ft/s	
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
AGS 5 Eff Weir	**42.17**
Weir invert (top of weir) = 42.17	
Weir length = 24 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 0 mgd	
Weir submergence = unsubmerged	
Head over weir = 0 ft	
AGS Reactor 5	**42.64**
2nd degree polynomial	
Flow = 0 mgd	

Section Description	Water Surface Elevation
Overall head loss = 0.47 ft	
Headworks to AGS Reactor 5	**42.64**
Pipe shape = Circular	
Diameter = 20 in	
Length = 230 ft	
Flow = 0 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.5	
Pipe area = 2.18 ft²	
Pipe hydraulic radius = 0.417	
Age factor = 1	
Solids factor = 1	
Velocity = 0 ft/s	
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
Tee - AGS 1 & 2 Eff. Pipes	**35.69**
Tee type = run of tee	
Diameter of pipe run past tee = 36 in	
Flow through tee = 0 mgd	
Velocity through tee = 0 ft/s	
Total tee K value = 0.6	
Overall head loss = 0 ft	
Overall head loss = 0.73 ft	
AGS 1 & 2 Eff. Pipes Flow Comb. at Tee	
AGS Reactor 1 Eff. Pipe	**35.69**
Pipe shape = Circular	
Diameter = 20 in	
Length = 135 ft	
Flow = 0 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 3.19	
Pipe area = 2.18 ft²	
Pipe hydraulic radius = 0.417	
Age factor = 1	
Solids factor = 1	
Velocity = 0 ft/s	
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
AGS 1 Eff Weir	**42.17**

Section Description	Water Surface Elevation
Weir invert (top of weir) = 42.17	
Weir length = 24 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 0 mgd	
Weir submergence = unsubmerged	
Head over weir = 0 ft	
AGS Reactor 1	**42.64**
2nd degree polynomial	
Flow = 0 mgd	
Overall head loss = 0.47 ft	
Headworks to AGS Reactor 1	**42.64**
Pipe shape = Circular	
Diameter = 20 in	
Length = 245 ft	
Flow = 0 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.5	
Pipe area = 2.18 ft²	
Pipe hydraulic radius = 0.417	
Age factor = 1	
Solids factor = 1	
Velocity = 0 ft/s	
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
AGS Reactor 2 Eff. Pipe	**35.69**
Pipe shape = Circular	
Diameter = 20 in	
Length = 30 ft	
Flow = 0 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 5.44	
Pipe area = 2.18 ft²	
Pipe hydraulic radius = 0.417	
Age factor = 1	
Solids factor = 1	
Velocity = 0 ft/s	
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
AGS 2 Eff Weir	**42.17**

Section Description	Water Surface Elevation
Weir invert (top of weir) = 42.17	
Weir length = 24 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 0 mgd	
Weir submergence = unsubmerged	
Head over weir = 0 ft	
AGS Reactor 2	**42.64**
2nd degree polynomial	
Flow = 0 mgd	
Overall head loss = 0.47 ft	
Headworks to AGS Reactor 2	**42.64**
Pipe shape = Circular	
Diameter = 20 in	
Length = 315 ft	
Flow = 0 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.5	
Pipe area = 2.18 ft^2	
Pipe hydraulic radius = 0.417	
Age factor = 1	
Solids factor = 1	
Velocity = 0 ft/s	
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
Headworks Eff. Splitter Box Flow Split	**48.23**
User defined loss for flow split = 0 ft	
Total flow through flow split = 23.76 mgd	
Headcell Eff. Channel	**49.23**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 40 ft	
Channel width/diameter = 8 ft	
Flow = 31.25 mgd	
Downstream channel invert = 47.92	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 9.42 ft^2	
Hydraulic radius = 0.91	
Normal depth = infinite	
Critical depth = 1.04 ft	
Depth downstream = 1.04 ft	

Section Description	Water Surface Elevation
Bend loss = 0 ft	
Depth upstream = 1.31 ft	
Velocity = 5.8 ft/s	
Flow profile = Horizontal	
Headworks Eff. Channel	
HeadCell Grit Unit 1 Effluent Weir	**54.01**
Weir invert (top of weir) = 53.42	
Weir length = 16 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 15.625 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.59 ft	
HeadCell Grit Unit 2 Effluent Weir	**54.01**
Weir invert (top of weir) = 53.42	
Weir length = 16 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 15.625 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.59 ft	
Headcell Grit Unit 2	**55.07**
2nd degree polynomial	
Flow = 15.625 mgd	
Overall head loss = 1.06 ft	
Headcell Grit Unit 1	**55.07**
2nd degree polynomial	
Flow = 15.625 mgd	
Overall head loss = 1.06 ft	
Headworks Eff. Box Flow Split	**55.07**
User defined loss for flow split = 0 ft	
Total flow through flow split = 31.25 mgd	
Screen Eff, Channel	**55.07**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 31 ft	
Channel width/diameter = 6 ft	
Flow = 31.25 mgd	
Downstream channel invert = 47.92	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 42.88 ft^2	
Hydraulic radius = 2.113	

Section Description	Water Surface Elevation

Normal depth = infinite
Critical depth = 1.26 ft
Depth downstream = 7.15 ft
Bend loss = 0 ft
Depth upstream = 7.15 ft
Velocity = 1.13 ft/s
Flow profile = Horizontal

AFS Channel 1 Baffle **57.66**

Weir invert (top of weir) = 56.17
Weir length = 4 ft
Weir 'C' coefficient = 3.33
Flow over weir = 15.625 mgd
Weir submergence = unsubmerged
Head over weir = 1.49 ft

AFS Channel 2 Baffle **57.66**

Weir invert (top of weir) = 56.17
Weir length = 4 ft
Weir 'C' coefficient = 3.33
Flow over weir = 15.625 mgd
Weir submergence = unsubmerged
Head over weir = 1.49 ft

AFS Channel 2 **57.67**

Channel shape = Rectangular
Manning's 'n' = 0.012
Channel length = 20 ft
Channel width/diameter = 4 ft
Flow = 15.625 mgd
Downstream channel invert = 55.5
Channel slope = 0 ft/ft
Channel side slope = not applicable
Area of flow = 8.65 ft^2
Hydraulic radius = 1.039
Normal depth = infinite
Critical depth = 1.04 ft
Depth downstream = 2.16 ft
Bend loss = 0 ft
Depth upstream = 2.17 ft
Velocity = 2.8 ft/s
Flow profile = Horizontal

AFS Channel 1 **57.67**

Channel shape = Rectangular
Manning's 'n' = 0.012

Section Description	Water Surface Elevation
Channel length = 20 ft	
Channel width/diameter = 4 ft	
Flow = 15.625 mgd	
Downstream channel invert = 55.5	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 8.65 ft^2	
Hydraulic radius = 1.039	
Normal depth = infinite	
Critical depth = 1.04 ft	
Depth downstream = 2.16 ft	
Bend loss = 0 ft	
Depth upstream = 2.17 ft	
Velocity = 2.8 ft/s	
Flow profile = Horizontal	
Automatic Fine Screen 2	**58.66**
Linear	
Flow = 15.625 mgd	
Overall head loss = 0.99 ft	
Automatic Fine Screen 1	**58.66**
Linear	
Flow = 15.625 mgd	
Overall head loss = 0.99 ft	
Headworks Influent Channel	**58.66**
User defined loss for flow split = 0 ft	
Total flow through flow split = 31.25 mgd	

APPENDIX F:

AQUANEREDA PRELIMINARY DESIGN REPORTS

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Process Design Report

MANATEE COUNTY FL WWTP (NORTH)

Design# 170622
Option: Preliminary Nereda Design (Phase 1)

AquaNereda®

Aerobic Granular Sludge Technology

February 21, 2023
Designed By: Takuya Sakomoto

6306 N. Alpine Rd Loves Park, IL 61111
(815) 654-2501 www.aqua-aerobic.com

Upstream Recommendations

- ¼ inch (6 mm) perforated plate-style screening and grit removal, consisting of 95% removal at 140 mesh, is required ahead of the AquaNereda system.

- Neutralization is required ahead of the biological system if the pH is expected to fall outside of 6.5-8.5 for significant durations.

- Elevated concentration of hydrogen sulfide can be detrimental to both civil and mechanical structures. If anaerobic conditions exist in the collection system, steps should be taken to eliminate hydrogen sulfide prior to the treatment system.

Flow Considerations

- The maximum flow, as shown on the design, has been assumed as an organic maximum that represents an increased organic load. An oxygen peaking factor of 1.08 has been included to accommodate this additional load.

- When flows are in excess of the maximum daily flow of 9.5 MGD, the biological system has been designed to modify cycles in order to process a peak hydraulic flow of 12.5 MGD.

- Depending upon the magnitude and duration of the peak flow, effluent quality may be degraded.

Aeration

- The aeration system has been designed to provide 1.25 lbs. O2/lb. BOD5 applied and 4.6 lbs. O2/lb. TKN applied at the design average loading conditions.

- A common standby blower will be shared among the biological reactor.

- Depending on the actual yard piping from the blowers to the diffuser system and the heat losses associated with the yard piping, additional provisions for cooling of the air (i.e. incorporating heat exchangers) and/or modification of in-basin piping and/or diffuser sleeve material may be required. Aqua-Aerobic Systems, Inc. may need to modify the following equipment offering to ensure compatibility of all in-basin components with actual air temperatures.

Process/Site

- The anticipated effluent nitrogen requirement is predicated upon an influent waste temperature of 15 °C or greater. While lower temperatures may be acceptable for a short-term duration, nitrification and (if required) denitrification below 10 °C can be unpredictable, requiring special operator attention.

- Provisions for a supplemental carbon source are required in order to facilitate and enhance denitrification.

- Sufficient alkalinity is required for nitrification, as approximately 7.1 mg alkalinity (as CaCO3) is required for every mg of NH3-N nitrified. If the raw water alkalinity cannot support this consumption, while maintaining a residual concentration of 50 mg/l, supplemental alkalinity shall be provided (by others).

- This system has been designed to be expandable from a Phase I average flow of 6.0 MGD to an ultimate, Phase II average flow of 15.0 MGD. Five (5) identical AGS reactors, two (2) SB tanks and one (1) WLC tank shall be added for the expansion.

- Phase I blowers may need to be re-belted and sheaved to meet phase II operating requirements (by others). The engineer should give thought to piping and site layout to facilitate the expansion.

- The average, maximum and peak design flow and loading conditions, shown within the report, are based on maximum month average, maximum day and peak hour conditions, respectively.

Post-Secondary Treatment

-The following processes follow the Biological process: Tertiary filtration.

Equipment

- Changes in basin geometry may require alterations in the equipment recommendation.

- The basins are not included and shall be provided by others.

- The influent enters the basin near the reactor floor. Adequate hydraulic capacity shall be made in the headworks to prevent backflow from one reactor to the other during transition of influent.

- Based on the process requirements and selected equipment, the reactor wall height should be at least 23.5 ft in the AGS reactors.

- Scope of supply includes freight, installation supervision and start-up services.

- Equipment selection is based upon the use of Aqua-Aerobic Systems' standard materials of construction and electrical components, suitable for non-classified electrical environments.

- The basin dimensions reported on the design have been assumed based upon the required volumes and assumed basin geometry. Actual basin geometry may be circular, square or rectangular with construction materials including concrete or steel.

- The control panel does not include motor starters or VFDs, which should be provided in a separate MCC (by others).

- Provisions should be made, by others, for overflows in each of the recommended basins.

- Aqua-Aerobic Systems, Inc. is familiar with various “Buy American” Acts (i.e. AIS, ARRA, Federal FAR 52.225, EXIM Bank, USAid, PA Steel Products Act, etc.). As the project develops Aqua-Aerobic Systems can work with you to ensure full compliance of our goods with various Buy American provisions if they are applicable/required for the project. When applicable, please provide us with the specifics of the project’s “Buy American” provisions.

AquaNereda® - Aerobic Granular Sludge Reactor - Design Summary

Design#: 170622

Project: MANATEE COUNTY FL WWTP (NORTH)

Option: Preliminary Nereda Design (Phase 1)

Designed by Takuya Sakomoto on Tuesday, February 21, 2023

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DESIGN INFLUENT CONDITIONS

Avg. Design Flow	= 6.00 MGD	= 22,712 m3/day
Max Design Flow	= 9.50 MGD	= 35,961 m3/day
Peak Hourly Flow	= 12.50 MGD	= 47,317 m3/day

DESIGN PARAMETERS

			Effluent (After Filtration)			
	Influent	**mg/l**	**Required**	**<= mg/l**	**Anticipated**	**<= mg/l**
Bio/Chem Oxygen Demand:	BOD5	204	BOD5	20	BOD5	20
Total Suspended Solids:	TSS	317	TSS	5	TSS	5
Total Kjeldahl Nitrogen:	TKN	46	TKN	--	TKN	--
Total Nitrogen:	--	--	TN	10.0	TN	10.0
Phosphorus:	Total P	6	--	--	--	--

SITE CONDITIONS

	Maximum		Minimum		Elevation (MSL)
Ambient Air Temperatures:	105 F	41.0 C	50 F	10.0 C	66 ft
Influent Waste Temperatures:	77 F	25.0 C	59 F	15.0 C	20.0 m

AGS BASIN DESIGN VALUES

			Water Depth			Basin Vol./Basin	
No./Basin Geometry:	3 Rectangular Basin(s)		**Process Level (PWL):**	21.0 ft	(6.4 m)	1.09 MG	(4,130 m³)
Freeboard (from PWL):	2.3 ft	(0.7 m)	**Discharge Level (DWL):**	21.8 ft	(6.7 m)		
Length of Basin:	88.5 ft	(27.0 m)	**Top of Wall (TOW):**	23.5 ft	(7.2 m)		
Width of Basin:	78.5 ft	(23.9 m)					

PROCESS DETAILS

Cycle Duration:	= 4.0 Hours/Cycle	
Food/Mass (F/M) ratio:	= 0.047 lbs. BOD5/lb. MLSS-Day	
MLSS Concentration:	= 8000 mg/l	
Hydraulic Retention Time:	= 0.55 Days	
Solids Retention Time:	= 19.10 Days	
Est. Net Sludge Yield:	= 1.07 Lbs. WAS/lb. BOD5	
Est. Dry Solids Produced:	= 10957.0 lbs. WAS/Day	= (4970.1 kg/Day)

AERATION DETAILS

Lbs. O2/lb. BOD5	= 1.25	
Lbs. O2/lb. TKN	= 4.60	
Peak O2 Factor:	= 1.08	
Actual Oxygen Required:	= 25217 lbs./Day	= (11438.4 kg/Day)
Max. Discharge Pressure:	= 10.89 PSIG	= (75 KPA)
Max. Air Flowrate/Basin:	= 3,243 SCFM	
Min. Air Flowrate/Basin:	= 811 SCFM	
Max. Simultaneous Air:	= 4,930 SCFM	
Min. Simultaneous Air:	= 1,317 SCFM	

RETURN FLOW ESTIMATES

Daily Estimated Return Flow:	= 1.43 MGD
Max. Instantaneous Return Flow:	= 1,553 GPM

POWER CONSUMPTION

Average Aeration Power Consumption: = 2367 kWh/day (at 77% design load)

WATER LEVEL CORRECTION TANK DESIGN VALUES

No./Basin Geometry:	= 1 Rectangular Basin(s)	
Minimum Level:	= 0.0 ft	= (0.0 m)
Max. Water Depth:	= 14.4 ft	= (4.4 m)
Max. Basin Volume (Total):	= 39,626 gallons	= (150 m^3)
Length of Basin:	= 14.1 ft	= (4.3 m.)
Width of Basin:	= 26.0 ft	= (7.9 m)

WATER LEVEL CORRECTION VOLUME DETERMINATION

The water correction tank volume has been determined based on the required level drop in the AquaNereda reactors. The water from this tank will be pumped back to the head of the plant.

WATER LEVEL CORRECTION EQUIPMENT CRITERIA

Max. Pump Flow Rate Required:	= 440.3gpm	= 100.0 m3/hr
Avg. Power Required:	= 83.6 kW-hr/day	

Sludge Buffer - Design Summary

Design#: 170622

Project: ***MANATEE COUNTY FL WWTP (NORTH)***

Option: ***Preliminary Nereda Design (Phase 1)***

Designed by Takuya Sakomoto on Tuesday, February 21, 2023

SLUDGE BUFFER DESIGN VALUES

No./Basins Geometry:	= 2 Rectangular Basin(s)	
Minimum Level:	= 1.0 ft	= (0.3 m)
Max. Level:	= 15.4 ft	= (4.7 m)
Max. Basin Volume:	= 79,017 gallons	= (299.0 m³)
Length of Basin:	= 26.3 ft	= (8.0 m)
Width of Basin:	= 26.0 ft	= (7.9 m)

SLUDGE BUFFER VOLUME DETERMINATION

The sludge buffer volume has been determined based on the sludge production and the concentration of sludge from the AquaNereda reactors. The Sludge from this basin will be pumped to the sludge handling system, and the supernatant back to the head of the plant.

SLUDGE BUFFER EQUIPMENT CRITERIA

Max. Sludge Flow Rate Required:	= 220 gpm	= (50 m³/hr)
Max. Supernatant Flow Rate Required:	= 881 gpm	= (200 m³/hr)
Average Power Consumption:	= 82 kWh/day (at 77% design load)	

AquaNereda

Influent Valves

3 Influent Valve(s) will be provided as follows:

- 30 inch Miliken electrically operated Plug Valve(s).

Influent Distribution System

3 Influent Distribution Assembly(ies) consisting of:

- Influent distribution system consisting of HDPE and PVC pipe with supports.

Effluent Weir Assembly

3 Effluent Weir Assembly(ies) consisting of:

- Concrete main effluent channel(s) provided by others.
- Stainless steel weir assembliy(ies) with supports.

Sludge Removal System

3 Solids Waste System(s) consisting of:

- HDPE or Stainless steel solids waste system(s).
- Pressure transmitter(s).

3 Sludge Decant/WLC Valve Set(s) consisting of:

- Each reactor includes two (2) of the following automatic control valves and two (2) of the following manual throttling valves:
- 24 inch electrically operated butterfly valve(s).
- 24 inch diameter Miliken manual plug valve(s).

3 Air Valve Set(s) consisting of:

- Each reactor includes two (2) of the following automatic valves and one (1) of the following manual valves:
- 4 inch manual butterfly valve(s).
- 4 inch electrically operated butterfly valve(s) with actuator.

Fixed Fine Bubble Diffusers

3 Fixed Fine Bubble Diffuser Assembly(ies) consisting of:

- 304 SS, 12 Ga. drop pipe(s).
- PVC, Sch 40 Manifold(s) with connection to drop pipe.
- PVC, Air distributor(s) with connection to the manifold and required PVC pipe joint connections.
- 304 Stainless steel piping supports with vertical supports, clamps, adjusting mechanism and anchor bolts.
- Fine bubble diffuser assemblies.
- Air muffler(s).
- 12" manual butterfly valve(s).

Positive Displacement Blowers

3 Positive Displacement Blower Package(s), with each package consisting of:

- 200HP Rotary Positive Displacement Blower(s).
- 10" manual butterfly valve(s).

Air Valves

3 Air Control Valve(s) will be provided as follows:

- 10 inch electrically operated butterfly valve(s).

- Auma actuator will be upgraded from open/close service to modulating service.
- Air flow meter(s).
- Flow conditioner(s).

Level Sensor Assemblies

3 Pressure Transducer Assembly(ies) each consisting of:

- Pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting pipe weldment(s).

3 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

Instrumentation

3 Dissolved Oxygen Assembly(ies) consisting of:

- DO probe(s).

3 TSS Sensor(s) will be provided as follows:

- TSS probe(s).

3 ORP Sensor(s) will be provided as follows:

- ORP sensor(s).

3 pH Sensor(s) will be provided as follows:

- pH probe(s).

3 NO3 Sensor(s) will be provided as follows:

- Nitrate sensor(s).

3 Process Controller(s) consisting of:

- Controller and display module(s).

3 Process Controller(s) consisting of:

- Controller(s).

2 Process Control System will be provided as follows:

- Hach SC1000 display module.
- FRP enclosure(s) for SC1000 Display.

AquaNereda: Water Level Correction Tank

Transfer Pumps/Valves

2 Submersible pump assembly(ies) consisting of the following items:

- 7.5 HP Submersible Pump(s) with painted cast iron pump housing, discharge elbow, and multi-conductor electrical cable.
- 6" Manual plug valve(s).
- 6 inch diameter swing check valve.
- Guide bar(s).

Level Sensor Assemblies

1 Sensor installation(s) consisting of:

- Pressure transducer(s).

- Stainless steel sensor guide rail weldment(s).
- PVC sensor mounting pipe(s).
- Top support(s).

1 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

AquaNereda: Sludge Buffer

Transfer Pumps/Valves

2 External Pump Assembly(ies) consisting of the following items:

- 15HP Pump assembly(ies).
- 6" Manual plug valve(s).

2 Sludge Valve(s) consisting of the following items:

- 6 inch electrically operated plug valve(s).

2 Supernatant Valve(s) consisting of the following items:

- 8 inch diameter Milliken 601 electrically operated eccentric plug valve(s) with 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated ductile iron plug, assembled and tested with an Auma, 115 VAC, 60 hertz, single phase open/close service electric actuator. Valve actuator includes compartment heater.

2 Sludge Buffer Inlet Valve(s) consisting of:

- 24 inch electrically operated butterfly valve(s).

Sludge Removal System

2 Solids Removal Assembly(ies) consisting of:

- Solids removal assembly(ies) consisting of PVC and/or HDPE pipe with supports.

Level Sensor Assemblies

2 Pressure Transducer Assembly(ies) each consisting of:

- Pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting pipe weldment(s).

2 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

Instrumentation

2 Hach TSS WAS Sensor(s) will be provided as follows:

- Hach Solitax Inline sc stainless steel pipe isertion probe with stainless steel wiper and 33 ft electric cable. One (1) probe per basin.

1 Process Controller(s) consisting of:

- Controller and display module(s).

AquaNereda: PLC Controls

Controls wo/Starters

1 Controls Package(s) will be provided as follows:

- NEMA 12 panel enclosure suitable for indoor installation and constructed of painted steel.
- Fuse(s) and fuse block(s).
- Compactlogix Processor.
- Operator interface(s).
- Remote access Ethernet modem(s).

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Design Calculations

Manatee County North FL
Design # 170622
Option: Preliminary Design

AquaNereda®
Aerobic Granular Sludge System

February 22, 2023
Designed by Takuya Sakomoto

6306 N. Alpine Rd. Loves Park, IL 61111
(815) 654-2501 www.aqua-aerobic.com

Project: Manatee County North FL
Option: Preliminary Design
Designed by Takuya Sakomoto
Wednesday, February 22, 2023

DESIGN INFLUENT CONDITIONS

Avg. Design Flow	= 6 MG/Day	= 22712 m3/Day
Max. Design Flow	= 9.5 MG/Day	= 35961 m3/Day

		Conc. mg/l	Mass lbs./Day	KG/Day
Bio/Chemical Oxygen Demand:	BOD5	204	10214.8	4633.3
Total Suspended Solids:	TSS	317	15872.9	7199.9
Total Kjeldahl Nitrogen:	TKN	46	2303.3	1044.8
Phosphorus:	Total-P	6	300.4342	136.3

SITE CONDITIONS

	Maximum		Minimum		Design	
Ambient Air Temperatures:	105.08 F	40.6 C	50 F	10 C	105.08 F	40.6 C
Influent Waste Temperatures:	77 F	25 C	59 F	15 C	59 F	15 C
Elevation (Mean Sea Level):	66 ft	20.1 m				

EFFLUENT OBJECTIVES

		Conc. mg/l	Mass lbs./Day	KG/Day
Bio/Chemical Oxygen Demand:	BOD5	20	1000.8	453.9
Total Suspended Solids:	TSS	10	500.4	226.9
Total Nitrogen	TN	10	500.4	226.9

EFFLUENT ANTICIPATED

		Conc. mg/l	Mass lbs./Day	KG/Day
Bio/Chemical Oxygen Demand:	BOD5	20	1000.8	453.9
Total Suspended Solids:	TSS	10	500.4	226.9
Total Nitrogen:	TN	10	500.4	226.9

BIOREACTOR OXYGEN REQUIREMENT

Oxygen Requirement

1. Oxygen Utilization Rates for Synthesis, Oxidation & Nitrification

Based upon a kinetic evaluation of the influent data with respect to the proposed design considerations, the estimated oxygen uptake rate (OUR) at average conditions is 47 mg/l/Hour.

The process oxygen required is:

OUR lbs./hour = OUR mg/l/hour x Vol/Basin x 8.34 = 427.3 lbs. O2/Hour/Basin = (193.8 KG/Hour/Basin)

2. Oxygen Required For Organic Reduction (Rb)

The aeration system shall be designed to provide 1.25 lbs. O2 for each lb. BOD5, as influent to the system. This oxygen provision shall account for the oxygen utilization for synthesis, as well as endogenous respiration.

Rb = lbs. O2/lb. BOD5 x lbs. BOD5 Applied/Day = 12768.5 lbs. O2/Day = (5790.7 KG/Day)

3. Oxygen Required For Nitrification (Rn)

Additional oxygen may be necessary for Nitrification of TKN to NO3-N. While an effluent requirement may or may not exist, it may be difficult to prevent Nitrification from exerting an oxygen demand (when nitrogen is present in the influent).

Nitrification requires 4.6 lbs. O2 to oxidize each lb. of TKN to NO3-N.

Rn = lbs. O2/lb. TKN x lbs. TKN Applied/Day = 10595.3 lbs. O2/Day = (4805.1 KG/Day)

4. Carbon Stabilized via Denitrification (Rd)

When complete mixing occurs in the absence of aeration and the presence of organic substrate (and NO3-N), denitrification of NO3-N to N2 (gas) can occur. Denitrification makes 2.86 lbs. O2 available from each lb. NO3-N that is converted.

Rd =lbs. NO3-N converted/Day x lbs. O2/lb. NO3-N converted/Day = 0 lbs O2/Day = (0 KG/Day)

5. Total Oxygen Requirement (ORt)

The total oxygen demand under process (field) conditions with a peaking factor of 1.08 is (refer to notes for explanation):

ORt = (Rb + Rn – Rd) x Peaking Factor = 25232.9 lbs. O2/Day (total) = (11443.5 KG/Day)

6. Hourly Oxygen Requirement (ORh)

Based on 1.93 hours of aeration per cycle, 6 Cycles/Day/Basin, and 3 Basin(s), the hourly ORh is:

ORh = 726.3 lbs. O2/Hour/Basin = (329.4 KG/Hour/Basin)

7. Actual Aeration Time Required To Meet Average Demand (At)

The aeration system has been designed to meet the design maximum oxygen requirement in 1.93 Hours/Cycle/Basin. Since average conditions will not require as much oxygen, the actual aeration time shall be adjusted to generate a power draw reflective of average conditions. The aeration time required at average conditions is:

At = OURh/ORh*Aerobic Hours/Cycle = 1.14 Hours/Basin/Cycle

<u>Process Wastewater Conditions - FIXED FINE BUBBLE DIFFUSERS</u>

1. **Field Oxygen Transfer Factor (FTF)**
   While the Oxygen Requirement quantifies the necessary oxygen to satisfy the biochemical reactions, the process water possesses inherent characteristics that typically inhibit oxygen transfer, as it compares to tap (clean) water. The FTF coefficient adjusts the oxygen transfer requirements in Field (dirty) conditions to Standard (clean) water conditions as follows:

   FTF = Alpha x Theta^(T-20) x [(Beta x Csm) – Cr]/Cstm = 0.611

   <u>Where:</u>
   Alpha = Ratio of mass transfer rate of O2 in process water to clean water = 0.7
   Beta = Ratio of saturation of O2 in process water to clean water = 0.95
   Theta = Temperature correction factor for O2 transfer = 1.024
   T = Design Reactor Temperature = 25 C

   Cstm = Saturation DO at Mid-Depth and Standard Conditions = 11.8 mg/l

   Csm = Cstm corrected for site Elevation and Temperature = 10.7 mg/l
   Cr = Residual Dissolved Oxygen concentration = 1.03333333333333 mg/l

<u>AERATION SYSTEM</u>

<u>Standard Conditions</u>

1. **Standard Oxygen Requirement (SORh)**
   The oxygen transferred at Standard conditions necessary to satisfy the required process oxygen demand at Field conditions is:

   SORh = ORh / FTF = 1189.7 lbs. O2/Hour/Basin = (539.5 KG/Hour/Basin)

2. **Standard Cubic Feet of Air per Minute (SCFM)**
   The ability to transfer oxygen into the water under standardized conditions is:

   SCFM = (SOR lbs./Hour/Basin)/(60 x 0.0175 x SOTE/FT x Dsub) = 3328 SCFM = (94.3 CMM)

   <u>Where:</u>
   0.0175 = lbs. O2 per cubic foot of air at standard conditions
   SOTE/FT = Standard Oxygen Transfer Efficiency per foot submergence = 1.66%/FT = (5.45%/M)
   Dsub= Average Diffuser Submergence = 20.5 FT = (6.3 M)

<u>Blower Inlet Conditions</u>

1. **Actual Inlet Pressure (Pa, due to elevation, and inlet filter/silencer/piping losses)**
   Note: An assumed inlet loss due to blower fittings/piping of 0.25 PSIG has been assumed.

   Pa = 14.696 – (Elevation_FT/2116.3) – 0.25 = 14.66 P.S.I.A. = (101.14 KPA)

2. **Blower Inlet Air Temperature in Degrees Rankine**
   Ta = Ambient Air Temp (Deg F) + 460 = 565.08 Degrees R = (313.9 K)

3. **Inlet Cubic Feet of Air per Minute (ICFM)**
   From the perfect gas law, the universal gas constant (MR) can relate standard conditions to inlet conditions, as:

   ICFM = SCFM x (14.696 x Ta)/(Pa x 528) = 3569.5 ICFM/Basin = (101.1 CMM/Basin)

Blower Discharge Conditions

1. Discharge Pressure (Pd)

The discharge pressure includes the static pressure above the diffusers and dynamic losses from the blower discharge, through the diffusers expressed by:

Pd = (0.4333 x Diffuser Submergence, ft) + System Losses, PSIG

Where the assumed system losses account for 0.20 PSIG blower discharge losses, 0.50 PSIG piping losses from blower to diffuser and 1.30 PSIG diffuser losses.

Discharge Pressure (Pda) = 10.89 PSIG = (75.1 KPA)

Average Blower Power Estimate

1. Estimated Average Power Draw (BHP)

The following is a general equation that estimates the power draw of the blower at the average oxygen demand, and average pressure. While the actual blower selection shall be made from manufacturer supplied curves, programs or recommendations at maximum conditions, this equation shall be used to estimate the annual average aeration power. Unless stated otherwise, the blower efficiency (e) of 0.70 shall be used (typical range 0.60 to 0.70).

BHP = 0.227 x ICFM x [((Pa + Pda)/Pa)^0.283 – 1]/e = 196.9 BHP** = (146.9 KW)

**Note: Power draw may differ from actual BHP installed as actual blowers are designed based on providing oxygen on an applied basis.

2. Estimated Daily Power Required for Blowers (Pwa)

Pwa = (BHP x 0.7457 x At x Ncdb x Nb) = 3001.4 KW-Hours/Day at Max Month Loading Conditions
Estimated power at annual average loading conditions = 2409.4 KW-Hours/Day

Blower Selection

1. Blower Recommendation

The actual blower and motor sizing must consider inlet conditions under operating temperature and pressure extremes. Motor size, for example, must be selected to handle inlet air at maximum density which occurs at lowest operating temperatures. Blower size must be selected to deliver the required air volume at minimum density (maximum operation temperature) throughout the range of pressures. The following has been recommended to meet the design extremes:

Header Configuration:	= Common Header	
Number of Total Blower Operating:	= 4	
Number Of Standby Units:	= 1	
Total Number Of Installed Units:	= 5	
Motor Size of Each Blower:	= 125 HP	= 93.2 kW
Airflow Capacity of Each Blower:	= 1255 SCFM	= 35.5 CMM
Maximum Design Discharge Pressure:	= 10.9 PSIG	= 75.1 KPA

20-YEAR O&M ESTIMATE

AQUA-AEROBIC SYSTEMS, INC.

A Metawater Company

MANATEE COUNTY FL WWTP (NORTH)

Design#: 170622

Option: Preliminary Nereda Design (Phase 1)

Designed By Takuya Sakomoto on Tuesday, February 21, 2023

Prepared By Yusuke Saito on Wednesday, February 22, 2023

The enclosed information is based on preliminary data which we have received from you. There may be factors unknown to us which would alter the enclosed recommendation. These recommendations are based on models and assumptions widely used in the industry. While we attempt to keep these current, Aqua-Aerobic Systems, Inc. assumes no responsibility for their validity or any risks associated with their use. Also, because of the various factors stated above, Aqua-Aerobic Systems, Inc. assumes no responsibility for any liability resulting from any use made by you of the enclosed recommendations.

O&M NOTES

* Stand-by blower unit included in estimate for budget purposes. Maintenance costs of stand-by unit may be reduced based upon the actual hours of operation.

** This is based upon operation at 100% of design conditions.

*** The values listed are for estimating purposes only. The actual amount of operator attention provided will be dependent upon local requirements and the size of the staff available for testing.

All estimates are based upon equipment maintenance and operation in accordance with the O & M instructions provided by Aqua-Aerobic Systems. They are based on typical AquaNereda installations with a normal preventative maintenance schedule for the equipment. The actual maintenance man hours required for each project will vary depending upon site and climate conditions, which may alter the frequency of the maintenance schedule.

Biological Estimated Operation & Maintenance Costs

Design#: 170622

Project: **MANATEE COUNTY FL WWTP (NORTH)**

Option: **Preliminary Nereda Design (Phase 1)**

Designed by Takuya Sakomoto on Tuesday, February 21, 2023

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

I. EQUIPMENT MAINTENANCE AND REPLACEMENT ESTIMATE

Qty	Unit	Service Required	Replacement Interval (Years)	Material Cost	20-Year Total
	Water Level Correction Tank				
2	Transfer Pump	Repair Kit	5	$567	$4,536
	Aerobic Granular Sludge Reactor				
3	Blower*	Oil Change	2	$315	$9,450
3	Blower*	Replace Inlet Air Filter Elements	1	$350	$21,000
3	Blower*	Replace Belt	2	$180	$5,400
3	D.O. Sensors	Replace Sensor Head	2	$224	$6,720
5	TSS Sensor	Replace Wiper (if available)	0.5	$16	$3,200
5	TSS Sensor	Seal Kit	2	$700	$35,000
3	pH Sensor	Replace Salt Bridge	1	$84	$5,040
3	ORP Sensor	Replace Salt Bridge	1	$84	$5,040
3	Nitrate Sensor	Seal Kit	2	$700	$21,000
3,168	FFB Disc Diff. Membranes	100% Diffuser Membrane Replacement	7	$5	$31,680
	Sludge Buffer				
2	Transfer Pump	Repair Kit	5	$2,068	$16,544
	Controls				
1	Controller	Replace Relays, Switches, Fuses	1	$50	$1,000
1	Controller	Replace Microprocessor Battery	3	$26	$156

INTERVAL TOTALS:

1-Year	2-Year	3-Year	5-Year	7-Year
$1,764	$7,757	$26	$5,270	$15,840

20-Year Estimated Total: **$165,766**

II. LABOR REQUIREMENTS ESTIMATE

Estimated General Operation & Maintenance ***

14.0 = Man Hours/week for Process Testing

8.0 = Man Hours/week for General Plant Cleanup and Routine Maintenance

III. POWER CONSUMPTION ESTIMATE

Power Costs of All Equipment as Proposed **

Water Level Correction Tank	84	(kWh/day)
Aerobic Granular Sludge Reactor	2,367	(kWh/day)
Sludge Buffer	82	(kWh/day)
Total:	2,533	(kWh/day)
Estimated $/kWh:	$0.08	
Total Annual Power Cost:	$73,964	

20-Year Estimated Power Cost: **$1,492,280**

Process Design Report

MANATEE COUNTY FL WWTP (NORTH)

Design# 170643
Option: Preliminary Nereda Design (Phase 2)

AquaNereda®
Aerobic Granular Sludge Technology

February 22, 2023
Designed By: Takuya Sakomoto

6306 N. Alpine Rd Loves Park, IL 61111
(815) 654-2501 www.aqua-aerobic.com

Upstream Recommendations

- ¼ inch (6 mm) perforated plate-style screening and grit removal, consisting of 95% removal at 140 mesh, is required ahead of the AquaNereda system.

- Neutralization is required ahead of the biological system if the pH is expected to fall outside of 6.5-8.5 for significant durations.

- Elevated concentration of hydrogen sulfide can be detrimental to both civil and mechanical structures. If anaerobic conditions exist in the collection system, steps should be taken to eliminate hydrogen sulfide prior to the treatment system.

Flow Considerations

- The maximum flow, as shown on the design, has been assumed as an organic maximum that represents an increased organic load. An oxygen peaking factor of 1.08 has been included to accommodate this additional load.

- When flows are in excess of the maximum daily flow of 23.75 MGD, the biological system has been designed to modify cycles in order to process a peak hydraulic flow of 31.25 MGD.

- Depending upon the magnitude and duration of the peak flow, effluent quality may be degraded.

Aeration

- The aeration system has been designed to provide 1.25 lbs. O2/lb. BOD5 applied and 4.6 lbs. O2/lb. TKN applied at the design average loading conditions.

- A common standby blower will be shared among the biological reactor.

- Depending on the actual yard piping from the blowers to the diffuser system and the heat losses associated with the yard piping, additional provisions for cooling of the air (i.e. incorporating heat exchangers) and/or modification of in-basin piping and/or diffuser sleeve material may be required. Aqua-Aerobic Systems, Inc. may need to modify the following equipment offering to ensure compatibility of all in-basin components with actual air temperatures.

Process/Site

- The anticipated effluent nitrogen requirement is predicated upon an influent waste temperature of 15 °C or greater. While lower temperatures may be acceptable for a short-term duration, nitrification and (if required) denitrification below 10 °C can be unpredictable, requiring special operator attention.

- Provisions for a supplemental carbon source are required in order to facilitate and enhance denitrification.

- Sufficient alkalinity is required for nitrification, as approximately 7.1 mg alkalinity (as CaCO3) is required for every mg of NH3-N nitrified. If the raw water alkalinity cannot support this consumption, while maintaining a residual concentration of 50 mg/l, supplemental alkalinity shall be provided (by others).

- The average, maximum and peak design flow and loading conditions, shown within the report, are based on maximum month average, maximum day and peak hour conditions, respectively.

Post-Secondary Treatment

-The following processes follow the Biological process: Tertiary filtration.

Equipment

- Changes in basin geometry may require alterations in the equipment recommendation.

- The basins are not included and shall be provided by others.

- The influent enters the basin near the reactor floor. Adequate hydraulic capacity shall be made in the headworks to prevent backflow from one reactor to the other during transition of influent.

- Based on the process requirements and selected equipment, the reactor wall height should be at least 23.5 ft in the AGS reactors.

- Scope of supply includes freight, installation supervision and start-up services.

- Equipment selection is based upon the use of Aqua-Aerobic Systems' standard materials of construction and electrical components, suitable for non-classified electrical environments.

- The basin dimensions reported on the design have been assumed based upon the required volumes and assumed basin geometry. Actual basin geometry may be circular, square or rectangular with construction materials including concrete or steel.

- The control panel does not include motor starters or VFDs, which should be provided in a separate MCC (by others).

- Provisions should be made, by others, for overflows in each of the recommended basins.

- Aqua-Aerobic Systems, Inc. is familiar with various “Buy American” Acts (i.e. AIS, ARRA, Federal FAR 52.225, EXIM Bank, USAid, PA Steel Products Act, etc.). As the project develops Aqua-Aerobic Systems can work with you to ensure full compliance of our goods with various Buy American provisions if they are applicable/required for the project. When applicable, please provide us with the specifics of the project’s “Buy American” provisions.

AquaNereda® - Aerobic Granular Sludge Reactor - Design Summary

DESIGN INFLUENT CONDITIONS

Avg. Design Flow	= 15.00 MGD	= 56,781 m3/day
Max Design Flow	= 23.75 MGD	= 89,904 m3/day
Peak Hourly Flow	= 31.25 MGD	= 118294 m3/day

DESIGN PARAMETERS			Effluent (After Filtration)			
	Influent	**mg/l**	**Required**	**<= mg/l**	**Anticipated**	**<= mg/l**
Bio/Chem Oxygen Demand:	BOD5	204	BOD5	20	BOD5	20
Total Suspended Solids:	TSS	317	TSS	5	TSS	5
Total Kjeldahl Nitrogen:	TKN	46	TKN	--	TKN	--
Total Nitrogen:	--	--	TN	3.0	TN	3.0
Phosphorus:	Total P	6	--	--	--	--

SITE CONDITIONS	Maximum		Minimum		Elevation (MSL)
Ambient Air Temperatures:	105 F	41.0 C	50 F	10.0 C	66 ft
Influent Waste Temperatures:	77 F	25.0 C	59 F	15.0 C	20.0 m

AGS BASIN DESIGN VALUES

No./Basin Geometry: 8 Rectangular Basin(s)(including 3 existing basins)

Freeboard (from PWL):	2.3 ft	(0.7 m)
Length of Basin:	88.5 ft	(27.0 m)
Width of Basin:	78.5 ft	(23.9 m)

	Water Depth		Basin Vol./Basin	
Process Level (PWL):	21.0 ft	(6.4 m)	1.09 MG	(4,130 m³)
Discharge Level (DWL):	21.8 ft	(6.7 m)		
Top of Wall (TOW):	23.5 ft	(7.2 m)		

PROCESS DETAILS

Cycle Duration:	= 4.0 Hours/Cycle	
Food/Mass (F/M) ratio:	= 0.044 lbs. BOD5/lb. MLSS-Day	
MLSS Concentration:	= 8000 mg/l	
Hydraulic Retention Time:	= 0.58 Days	
Solids Retention Time:	= 20.40 Days	
Est. Net Sludge Yield:	= 1.07 Lbs. WAS/lb. BOD5	
Est. Dry Solids Produced:	= 27394.0 lbs. WAS/Day	= (12425.8 kg/Day)

AERATION DETAILS

Lbs. O2/lb. BOD5	= 1.25	
Lbs. O2/lb. TKN	= 4.60	
Peak O2 Factor:	= 1.08	
Actual Oxygen Required:	= 63041 lbs./Day	= (28595.2 kg/Day)
Max. Discharge Pressure:	= 10.89 PSIG	= (75 KPA)
Max. Air Flowrate/Basin:	= 4,074 SCFM	
Min. Air Flowrate/Basin:	= 1,019 SCFM	
Max. Simultaneous Air:	= 16,858 SCFM	
Min. Simultaneous Air:	= 6,739 SCFM	

RETURN FLOW ESTIMATES

Daily Estimated Return Flow: = 1.80 MGD

Max. Instantaneous Return Flow: = 1,828 GPM

POWER CONSUMPTION

Average Aeration Power Consumption: = 6279 kWh/day (at 77% design load)

Water Level Correction Tank - Design Summary

WATER LEVEL CORRECTION TANK DESIGN VALUES

No./Basin Geometry:	= 2 Rectangular Basin(s) (including 1 existing basin)	
Minimum Level:	= 0.0 ft	= (0.0 m)
Max. Water Depth:	= 14.4 ft	= (4.4 m)
Max. Basin Volume per basin:	= 39,626 gallons	= (150m³)
Length of Basin:	= 14.1 ft	= (4.3 m.)
Width of Basin:	= 26.0 ft	= (7.9 m)

WATER LEVEL CORRECTION VOLUME DETERMINATION

The water correction tank volume has been determined based on the required level drop in the AquaNereda reactors. The water from this tank will be pumped back to the head of the plant.

WATER LEVEL CORRECTION EQUIPMENT CRITERIA

Max. Pump Flow Rate Required:	= 1320.9gpm	= 300.0 m3/hr
Avg. Power Required:	= 250.9 kW-hr/day	

Sludge Buffer - Design Summary

SLUDGE BUFFER DESIGN VALUES

No./Basins Geometry:	= 4 Rectangular Basin(s) (including 2 existing basins)	
Minimum Level:	= 1.0 ft	= (0.3 m)
Max. Level:	= 15.4 ft	= (4.7 m)
Max. Basin Volume:	= 79,017 gallons	= (299.0 m^3)
Length of Basin:	= 26.3 ft	= (8.0 m)
Width of Basin:	= 26.0 ft	= (7.9 m)

SLUDGE BUFFER VOLUME DETERMINATION

The sludge buffer volume has been determined based on the sludge production and the concentration of sludge from the AquaNereda reactors. The Sludge from this basin will be pumped to the sludge handling system, and the supernatant back to the head of the plant.

SLUDGE BUFFER EQUIPMENT CRITERIA

Max. Sludge Flow Rate Required:	= 220 gpm	= (50 m^3/hr)
Max. Supernatant Flow Rate Required:	= 881 gpm	= (200 m^3/hr)
Average Power Consumption:	= 99 kWh/day (at 77% design load)	

AquaNereda

Influent Valves

5 Influent Valve(s) will be provided as follows:

- 30 inch Miliken electrically operated Plug Valve(s).

Influent Distribution System

5 Influent Distribution Assembly(ies) consisting of:

- Influent distribution system consisting of HDPE and PVC pipe with supports.

Effluent Weir Assembly

5 Effluent Weir Assembly(ies) consisting of:

- Concrete main effluent channel(s) provided by others.
- Stainless steel weir assembliy(ies) with supports.

Sludge Removal System

5 Solids Waste System(s) consisting of:

- HDPE or Stainless steel solids waste system(s).
- Pressure transmitter(s).

5 Sludge Decant/WLC Valve Set(s) consisting of:

- Each reactor includes two (2) of the following automatic control valves and two (2) of the following manual throttling valves:
- 24 inch electrically operated butterfly valve(s).
- 24 inch diameter Miliken manual plug valve(s).

5 Air Valve Set(s) consisting of:

- Each reactor includes two (2) of the following automatic valves and one (1) of the following manual valves:
- 4 inch manual butterfly valve(s).
- 4 inch electrically operated butterfly valve(s) with actuator.

Fixed Fine Bubble Diffusers

5 Fixed Fine Bubble Diffuser Assembly(ies) consisting of:

- 304 SS, 12 Ga. drop pipe(s).
- PVC, Sch 40 Manifold(s) with connection to drop pipe.
- PVC, Air distributor(s) with connection to the manifold and required PVC pipe joint connections.
- 304 Stainless steel piping supports with vertical supports, clamps, adjusting mechanism and anchor bolts.
- Fine bubble diffuser assemblies.
- Air muffler(s).
- 12" manual butterfly valve(s).

Positive Displacement Blowers

7 Positive Displacement Blower Package(s), with each package consisting of:

- 200HP Rotary Positive Displacement Blower(s).
- 10" manual butterfly valve(s).

Air Valves

5 Air Control Valve(s) will be provided as follows:

- 10 inch electrically operated butterfly valve(s).
- Auma actuator will be upgraded from open/close service to modulating service.
- Air flow meter(s).
- Flow conditioner(s).

Level Sensor Assemblies

5 Pressure Transducer Assembly(ies) each consisting of:

- Pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting pipe weldment(s).

5 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

Instrumentation

5 Dissolved Oxygen Assembly(ies) consisting of:

- DO probe(s).

5 TSS Sensor(s) will be provided as follows:

- TSS probe(s).

5 ORP Sensor(s) will be provided as follows:

- ORP sensor(s).

5 pH Sensor(s) will be provided as follows:

- pH probe(s).

5 NO3 Sensor(s) will be provided as follows:

- Nitrate sensor(s).

5 Process Controller(s) consisting of:

- Controller and display module(s).

5 Process Controller(s) consisting of:

- Controller(s).

2 Process Control System will be provided as follows:

- Hach SC1000 display module.
- FRP enclosure(s) for SC1000 Display.

AquaNereda: Water Level Correction Tank

Transfer Pumps/Valves

2 Submersible pump assembly(ies) consisting of the following items:

- 7.5 HP Submersible Pump(s) with painted cast iron pump housing, discharge elbow, and multi-conductor electrical cable.
- 6" Manual plug valve(s).
- 6 inch diameter swing check valve.
- Guide bar(s).

Level Sensor Assemblies

1 Sensor installation(s) consisting of:

- Pressure transducer(s).
- Stainless steel sensor guide rail weldment(s).
- PVC sensor mounting pipe(s).
- Top support(s).

1 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

AquaNereda: Sludge Buffer

Transfer Pumps/Valves

2 External Pump Assembly(ies) consisting of the following items:

- 15HP Pump assembly(ies).
- 6" Manual plug valve(s).

2 Sludge Valve(s) consisting of the following items:

- 6 inch electrically operated plug valve(s).

2 Supernatant Valve(s) consisting of the following items:

- 8 inch diameter Milliken 601 electrically operated eccentric plug valve(s) with 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated ductile iron plug, assembled and tested with an Auma, 115 VAC, 60 hertz, single phase open/close service electric actuator. Valve actuator includes compartment heater.

2 Sludge Buffer Inlet Valve(s) consisting of:

- 24 inch electrically operated butterfly valve(s).

Sludge Removal System

2 Solids Removal Assembly(ies) consisting of:

- Solids removal assembly(ies) consisting of PVC and/or HDPE pipe with supports.

Level Sensor Assemblies

2 Pressure Transducer Assembly(ies) each consisting of:

- Pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting pipe weldment(s).

2 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

Instrumentation

2 Hach TSS WAS Sensor(s) will be provided as follows:

- Hach Solitax Inline sc stainless steel pipe isertion probe with stainless steel wiper and 33 ft electric cable. One (1) probe per basin.

1 Process Controller(s) consisting of:

- Controller and display module(s).

AquaNereda: PLC Controls

Controls wo/Starters

2 Controls Package(s) will be provided as follows:

- NEMA 12 panel enclosure suitable for indoor installation and constructed of painted steel.
- Fuse(s) and fuse block(s).
- Compactlogix Processor.
- Operator interface(s).
- Remote access Ethernet modem(s).

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Design Calculations

Manatee County North FL
Design # 170643
Option: Preliminary Design

AquaNereda®
Aerobic Granular Sludge System

February 22, 2023
Designed by Takuya Sakomoto

6306 N. Alpine Rd. Loves Park, IL 61111
(815) 654-2501 www.aqua-aerobic.com

AquaNereda - Aerobic Granular Sludge Technology   Design# 170643

Project: Manatee County North FL
Option: Preliminary Design
Designed by Takuya Sakomoto
Wednesday, February 22, 2023

DESIGN INFLUENT CONDITIONS

Avg. Design Flow	= 15 MG/Day	= 56781 m3/Day
Max. Design Flow	= 23.75 MG/Day	= 89904 m3/Day

		Conc. mg/l	Mass lbs./Day	KG/Day
Bio/Chemical Oxygen Demand:	BOD5	204	25536.9	11583.4
Total Suspended Solids:	TSS	317	39682.4	17999.6
Total Kjeldahl Nitrogen:	TKN	46	5758.3	2611.9
Phosphorus:	Total-P	6	751.0855	340.7

SITE CONDITIONS

	Maximum		Minimum		Design	
Ambient Air Temperatures:	105.08 F	40.6 C	50 F	10 C	105.08 F	40.6 C
Influent Waste Temperatures:	77 F	25 C	59 F	15 C	59 F	15 C
Elevation (Mean Sea Level):	66 ft	20.1 m				

EFFLUENT OBJECTIVES

		Conc. mg/l	Mass lbs./Day	KG/Day
Bio/Chemical Oxygen Demand:	BOD5	20	2502.0	1134.7
Total Suspended Solids:	TSS	10	1251.0	567.3
Total Nitrogen	TN	3	375.3	170.2

EFFLUENT ANTICIPATED

		Conc. mg/l	Mass lbs./Day	KG/Day
Bio/Chemical Oxygen Demand:	BOD5	20	2502.0	1134.7
Total Suspended Solids:	TSS	10	1251.0	567.3
Total Nitrogen:	TN	3	375.3	170.2

BIOREACTOR OXYGEN REQUIREMENT

Oxygen Requirement

1. Oxygen Utilization Rates for Synthesis, Oxidation & Nitrification

Based upon a kinetic evaluation of the influent data with respect to the proposed design considerations, the estimated oxygen uptake rate (OUR) at average conditions is 56.8 mg/l/Hour.

The process oxygen required is:

OUR lbs./hour = OUR mg/l/hour x Vol/Basin x 8.34 = 517 lbs. O2/Hour/Basin = (234.5 KG/Hour/Basin)

2. Oxygen Required For Organic Reduction (Rb)

The aeration system shall be designed to provide 1.25 lbs. O2 for each lb. BOD5, as influent to the system. This oxygen provision shall account for the oxygen utilization for synthesis, as well as endogenous respiration.

Rb = lbs. O2/lb. BOD5 x lbs. BOD5 Applied/Day = 31921.1 lbs. O2/Day = (14476.7 KG/Day)

3. Oxygen Required For Nitrification (Rn)

Additional oxygen may be necessary for Nitrification of TKN to NO3-N. While an effluent requirement may or may not exist, it may be difficult to prevent Nitrification from exerting an oxygen demand (when nitrogen is present in the influent).

Nitrification requires 4.6 lbs. O2 to oxidize each lb. of TKN to NO3-N.

Rn = lbs. O2/lb. TKN x lbs. TKN Applied/Day = 26488.3 lbs. O2/Day = (12012.8 KG/Day)

4. Carbon Stabilized via Denitrification (Rd)

When complete mixing occurs in the absence of aeration and the presence of organic substrate (and NO3-N), denitrification of NO3-N to N2 (gas) can occur. Denitrification makes 2.86 lbs. O2 available from each lb. NO3-N that is converted.

Rd =lbs. NO3-N converted/Day x lbs. O2/lb. NO3-N converted/Day = 0 lbs O2/Day = (0 KG/Day)

5. Total Oxygen Requirement (ORt)

The total oxygen demand under process (field) conditions with a peaking factor of 1.08 is (refer to notes for explanation):

ORt = (Rb + Rn – Rd) x Peaking Factor = 63082.2 lbs. O2/Day (total) = (28608.7 KG/Day)

6. Hourly Oxygen Requirement (ORh)

Based on 1.51 hours of aeration per cycle, 6 Cycles/Day/Basin, and 4 Basin(s), the hourly ORh is:

ORh = 870.3 lbs. O2/Hour/Basin = (394.7 KG/Hour/Basin)

7. Actual Aeration Time Required To Meet Average Demand (At)

The aeration system has been designed to meet the design maximum oxygen requirement in 1.51 Hours/Cycle/Basin. Since average conditions will not require as much oxygen, the actual aeration time shall be adjusted to generate a power draw reflective of average conditions. The aeration time required at average conditions is:

At = OURh/ORh*Aerobic Hours/Cycle = 0.9 Hours/Basin/Cycle

Process Wastewater Conditions - FIXED FINE BUBBLE DIFFUSERS

1. **Field Oxygen Transfer Factor (FTF)**

While the Oxygen Requirement quantifies the necessary oxygen to satisfy the biochemical reactions, the process water possesses inherent characteristics that typically inhibit oxygen transfer, as it compares to tap (clean) water. The FTF coefficient adjusts the oxygen transfer requirements in Field (dirty) conditions to Standard (clean) water conditions as follows:

FTF = Alpha x Theta^(T-20) x [(Beta x Csm) – Cr]/Cstm = 0.581
Where:
Alpha = Ratio of mass transfer rate of O2 in process water to clean water = 0.7
Beta = Ratio of saturation of O2 in process water to clean water = 0.95
Theta = Temperature correction factor for O2 transfer = 1.024
T = Design Reactor Temperature = 25 C

Cstm = Saturation DO at Mid-Depth and Standard Conditions = 11.8 mg/l

Csm = Cstm corrected for site Elevation and Temperature = 10.7mg/l
Cr = Residual Dissolved Oxygen concentration = 1.48 mg/l

AERATION SYSTEM

Standard Conditions

1. **Standard Oxygen Requirement (SORh)**

The oxygen transferred at Standard conditions necessary to satisfy the required process oxygen demand at Field conditions is:

SORh = ORh / FTF = 1498.2 lbs. O2/Hour/Basin = (679.4 KG/Hour/Basin)

2. **Standard Cubic Feet of Air per Minute (SCFM)**

The ability to transfer oxygen into the water under standardized conditions is:

SCFM = (SOR lbs./Hour/Basin)/(60 x 0.0175 x SOTE/FT x Dsub) = 4117 SCFM = (116.6 CMM)

Where:

0.0175 = lbs. O2 per cubic foot of air at standard conditions
SOTE/FT = Standard Oxygen Transfer Efficiency per foot submergence = 1.69%/FT = (5.54%/M)
Dsub= Average Diffuser Submergence = 20.5 FT = (6.3 M)

Blower Inlet Conditions

1. **Actual Inlet Pressure (Pa, due to elevation, and inlet filter/silencer/piping losses)**

Note: An assumed inlet loss due to blower fittings/piping of 0.25 PSIG has been assumed.

Pa = 14.696 – (Elevation_FT/2116.3) – 0.25 = 14.66 P.S.I.A. = (101.14 KPA)

2. **Blower Inlet Air Temperature in Degrees Rankine**

Ta = Ambient Air Temp (Deg F) + 460 = 565.08 Degrees R = (313.9 K)

3. **Inlet Cubic Feet of Air per Minute (ICFM)**

From the perfect gas law, the universal gas constant (MR) can relate standard conditions to inlet conditions, as:

ICFM = SCFM x (14.696 x Ta)/(Pa x 528) = 4415.4 ICFM/Basin = (125.1 CMM/Basin)

Blower Discharge Conditions

1. Discharge Pressure (Pd)

The discharge pressure includes the static pressure above the diffusers and dynamic losses from the blower discharge, through the diffusers expressed by:

Pd = (0.4333 x Diffuser Submergence, ft) + System Losses, PSIG

Where the assumed system losses account for 0.20 PSIG blower discharge losses, 0.50 PSIG piping losses from blower to diffuser and 1.30 PSIG diffuser losses.

Discharge Pressure (Pda) = 10.89 PSIG = (75.1 KPA)

Average Blower Power Estimate

1. Estimated Average Power Draw (BHP)

The following is a general equation that estimates the power draw of the blower at the average oxygen demand, and average pressure. While the actual blower selection shall be made from manufacturer supplied curves, programs or recommendations at maximum conditions, this equation shall be used to estimate the annual average aeration power. Unless stated otherwise, the blower efficiency (e) of 0.70 shall be used (typical range 0.60 to 0.70).

BHP = 0.227 x ICFM x [((Pa + Pda)/Pa)^0.283 – 1]/e = 243.6 BHP** = (181.7 KW)

**Note: Power draw may differ from actual BHP installed as actual blowers are designed based on providing oxygen on an applied basis.

2. Estimated Daily Power Required for Blowers (Pwa)

Pwa = (BHP x 0.7457 x At x Ncdb x Nb) = 7821.3 KW-Hours/Day at Max Month Loading Conditions
Estimated power at annual average loading conditions = 6278.7 KW-Hours/Day

Blower Selection

1. Blower Recommendation

The actual blower and motor sizing must consider inlet conditions under operating temperature and pressure extremes. Motor size, for example, must be selected to handle inlet air at maximum density which occurs at lowest operating temperatures. Blower size must be selected to deliver the required air volume at minimum density (maximum operation temperature) throughout the range of pressures. The following has been recommended to meet the design extremes:

Header Configuration:	= Common Header	
Number of Total Blower Operating:	= 8	
Number Of Standby Units:	= 2	
Total Number Of Installed Units:	= 10	
Motor Size of Each Blower:	= 200 HP	= 149.1 kW
Airflow Capacity of Each Blower:	= 2107 SCFM	= 59.6 CMM
Maximum Design Discharge Pressure:	= 10.9 PSIG	= 75.1 KPA

20-YEAR O&M ESTIMATE

AQUA-AEROBIC SYSTEMS, INC.

A Metawater Company

MANATEE COUNTY FL WWTP (NORTH)

Design#: 170643

Option: Preliminary Nereda Design (Phase 2)

Designed By Takuya Sakomoto on Wednesday, February 22, 2023

Prepared By Takuya Sakomoto on Wednesday, February 22, 2023

O&M NOTES

* Stand-by blower unit included in estimate for budget purposes. Maintenance costs of stand-by unit may be reduced based upon the actual hours of operation.

** This is based upon operation at 100% of design conditions.

*** The values listed are for estimating purposes only. The actual amount of operator attention provided will be dependent upon local requirements and the size of the staff available for testing.

All estimates are based upon equipment maintenance and operation in accordance with the O & M instructions provided by Aqua-Aerobic Systems. They are based on typical AquaNereda installations with a normal preventative maintenance schedule for the equipment. The actual maintenance man hours required for each project will vary depending upon site and climate conditions, which may alter the frequency of the maintenance schedule.

Project: MANATEE COUNTY FL WWTP (NORTH)

Option: Preliminary Nereda Design (Phase 2)

Designed by Takuya Sakomoto on Wednesday, February 22, 2023

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

I. EQUIPMENT MAINTENANCE AND REPLACEMENT ESTIMATE

Qty	Unit	Service Required	Replacement Interval (Years)	Material Cost	20-Year Total
	Water Level Correction Tank				
4	Transfer Pump	Repair Kit	5	$567	$9,072
	Aerobic Granular Sludge Reactor				
10	Blower*	Oil Change	2	$315	$31,500
10	Blower*	Replace Inlet Air Filter Elements	1	$350	$70,000
10	Blower*	Replace Belt	2	$180	$18,000
8	D.O. Sensors	Replace Sensor Head	2	$224	$17,920
12	TSS Sensor	Replace Wiper (if available)	0.5	$16	$7,680
12	TSS Sensor	Seal Kit	2	$700	$84,000
8	pH Sensor	Replace Salt Bridge	1	$84	$13,440
8	ORP Sensor	Replace Salt Bridge	1	$84	$13,440
8	Nitrate Sensor	Seal Kit	2	$700	$56,000
8,448	FFB Disc Diff. Membranes	100% Diffuser Membrane Replacement	7	$5	$84,480
	Sludge Buffer				
4	Transfer Pump	Repair Kit	5	$229	$3,664
	Controls				
2	Controller	Replace Relays, Switches, Fuses	1	$50	$2,000
2	Controller	Replace Microprocessor Battery	3	$26	$312

INTERVAL TOTALS:

1-Year	2-Year	3-Year	5-Year	7-Year
$5,328	$20,742	$52	$3,184	$42,240

20-Year Estimated Total: $411,508

II. LABOR REQUIREMENTS ESTIMATE

Estimated General Operation & Maintenance ***

14.0 = Man Hours/week for Process Testing

8.0 = Man Hours/week for General Plant Cleanup and Routine Maintenance

III. POWER CONSUMPTION ESTIMATE

Power Costs of All Equipment as Proposed **

Water Level Correction Tank	251	(kWh/day)
Aerobic Granular Sludge Reactor	6,279	(kWh/day)
Sludge Buffer	198	(kWh/day)
Total:	6,728	(kWh/day)
Estimated $/kWh:	$0.08	
Total Annual Power Cost:	$196,458	

20-Year Estimated Power Cost: $3,929,160

APPENDIX G:

EXAMPLE BIOWIN REPORT FOR 12.5 MGD MLE

BioWin user and configuration data

Project details

Project name: Manatee NWRF Expansion CER   Project ref.: Future Max Month for 12.5 MGD TMRADF (1 Train) Variable Aerators

Plant name: NWRF   User name: M. Nixon

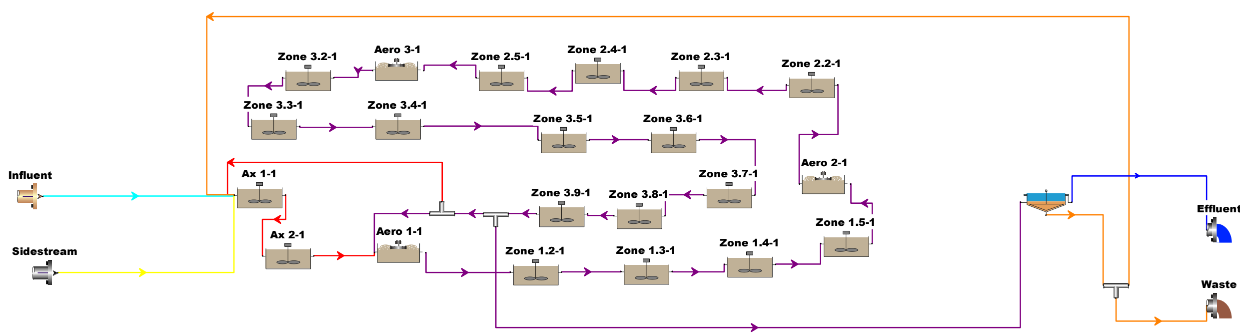
Created: 10/31/2022   Saved: 2/20/2023

Steady state solution

SRT: 6.96 days

Temperature: 20.0°C

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Ax 1-1	0.2900	2,584.4909	15.000	Un-aerated
Zone 1.2-1	0.1600	1,584.3622	13.500	Un-aerated
Zone 1.3-1	0.1600	1,584.3622	13.500	Un-aerated
Zone 2.2-1	0.1600	1,584.3622	13.500	Un-aerated
Zone 2.3-1	0.1600	1,584.3622	13.500	Un-aerated
Zone 3.2-1	0.1674	1,657.6390	13.500	Un-aerated
Zone 3.3-1	0.1674	1,657.6390	13.500	Un-aerated
Zone 3.9-1	0.1674	1,657.6390	13.500	Un-aerated
Ax 2-1	0.2900	2,584.4909	15.000	Un-aerated
Zone 1.4-1	0.1600	1,584.3622	13.500	Un-aerated
Zone 1.5-1	0.1600	1,584.3622	13.500	Un-aerated
Zone 2.4-1	0.1600	1,584.3622	13.500	Un-aerated
Zone 2.5-1	0.1600	1,584.3622	13.500	Un-aerated
Zone 3.8-1	0.1674	1,657.6390	13.500	Un-aerated
Zone 3.7-1	0.1674	1,657.6390	13.500	Un-aerated
Zone 3.6-1	0.1674	1,657.6390	13.500	Un-aerated
Zone 3.5-1	0.1674	1,657.6390	13.500	Un-aerated
Zone 3.4-1	0.1674	1,657.6390	13.500	Un-aerated

Configuration information for all Influent - BOD units

Operating data Average (flow/time weighted as required)

Element name	Influent
Flow	5
BOD - Total Carbonaceous mgBOD/L	204.17
Volatile suspended solids mg/L	175.00
Total suspended solids mg/L	316.67
N - Total Kjeldahl Nitrogen mgN/L	46.00
P - Total P mgP/L	6.00
S - Total S mgS/L	10.00
N - Nitrate mgN/L	0
pH	7.50
Alkalinity mmol/L	6.00
Metal soluble - Calcium mg/L	160.00
Metal soluble - Magnesium mg/L	25.00
Gas - Dissolved oxygen mg/L	0

Element name	Influent
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.8137
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.1300
Fcel - Cellulose fraction of unbiodegradable particulate [gCOD/gCOD]	0.5000
Fna - Ammonia [gNH3-N/gTKN]	0.8913
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200

FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	**0.0350**
Fpo4 - Phosphate [gPO4-P/gTP]	**0.5000**
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	**0.0110**
Fsr - Reduced sulfur [H2S] [gS/gS]	**0.1500**
FZbh - Ordinary heterotrophic COD fraction [gCOD/g of total COD]	**0.0200**
FZbm - Methylotrophic COD fraction [gCOD/g of total COD]	**1.000E-4**
FZao - Ammonia oxidizing COD fraction [gCOD/g of total COD]	**1.000E-4**
FZno - Nitrite oxidizing COD fraction [gCOD/g of total COD]	**1.000E-4**
FZaao - Anaerobic ammonia oxidizing COD fraction [gCOD/g of total COD]	**1.000E-4**
FZppa - Phosphorus accumulating COD fraction [gCOD/g of total COD]	**1.000E-4**
FZpa - Propionic acetogenic COD fraction [gCOD/g of total COD]	**1.000E-4**
FZam - Acetoclastic methanogenic COD fraction [gCOD/g of total COD]	**1.000E-4**
FZhm - Hydrogenotrophic methanogenic COD fraction [gCOD/g of total COD]	**1.000E-4**
FZso - Sulfur oxidizing COD fraction [gCOD/g of total COD]	**1.000E-4**
FZsrpa - Sulfur reducing propionic acetogenic COD fraction [gCOD/g of total COD]	**1.000E-4**
FZsra - Sulfur reducing acetotrophic COD fraction [gCOD/g of total COD]	**1.000E-4**
FZsrh - Sulfur reducing hydrogenotrophic COD fraction [gCOD/g of total COD]	**1.000E-4**
FZe - Endogenous products COD fraction [gCOD/g of total COD]	**0**

Configuration information for all Clarifier - Ideal units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]
SC 1	1.3270	1.267E+4	14.000

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
SC 1	Ratio	1.00

Element name	Average Temperature	Reactive	Percent removal	Blanket fraction
SC 1	Uses global setting	No	99.90	0.10

Configuration information for all Influent - COD units

Operating data Average (flow/time weighted as required)

Element name	Sidestream
Flow	0.15
COD - Total mgCOD/L	400.00
N - Total Kjeldahl Nitrogen mgN/L	10.00
P - Total P mgP/L	5.00
S - Total S mgS/L	10.00
N - Nitrate mgN/L	0
pH	7.30
Alkalinity mmol/L	6.00
ISS Total mgISS/L	300.00
Metal soluble - Calcium mg/L	0
Metal soluble - Magnesium mg/L	15.00
Gas - Dissolved oxygen mg/L	0

Element name	Sidestream
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.7500
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.1300
Fcel - Cellulose fraction of unbiodegradable particulate [gCOD/gCOD]	0.5000
Fna - Ammonia [gNH3-N/gTKN]	0.6600
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0700
Fpo4 - Phosphate [gPO4-P/gTP]	0.5000
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0220
Fsr - Reduced sulfur [H2S] [gS/gS]	0.1500
FZbh - Ordinary heterotrophic COD fraction [gCOD/g of total COD]	0.0200
FZbm - Methylotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZao - Ammonia oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZno - Nitrite oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZaao - Anaerobic ammonia oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZppa - Phosphorus accumulating COD fraction [gCOD/g of total COD]	1.000E-4
FZpa - Propionic acetogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZam - Acetoclastic methanogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZhm - Hydrogenotrophic methanogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZso - Sulfur oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZsrpa - Sulfur reducing propionic acetogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZsra - Sulfur reducing acetotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZsrh - Sulfur reducing hydrogenotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZe - Endogenous products COD fraction [gCOD/g of total COD]	0

Configuration information for all Splitter units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Ditch Flow Velocity	Flowrate [Main]	226
WAS/RAS split	Flowrate [Side]	0.218
Anoxic Recycle Gate	Flowrate [Side]	12

Configuration information for all Bioreactor - Surface aeration units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]
Aero 1-1	0.1600	1,584.3622	13.500
Aero 3-1	0.1600	1,584.3622	13.500
Aero 2-1	0.1600	1,584.3622	13.500

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint
Aero 1-1	1.2
Aero 2-1	2.0

Element name	Average Power supply rate [hp]
Aero 3-1	125.0

Aeration equipment parameters

Element name	Surface aerator Std. oxygen transfer rate [lb O /(hp hr)]
Aero 1-1	3.6500
Aero 3-1	3.6500
Aero 2-1	3.6500

BioWin Album

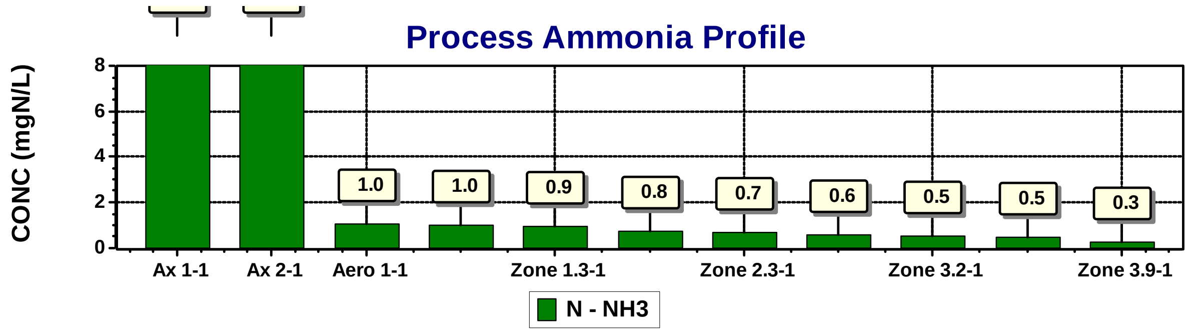
Album page - Influent

Influent			
Parameters	**Conc. (mg/L)**	**Mass rate (lb/d)**	**Notes**
Alkalinity	6.00	113.56	mmol/L and kmol/d
BOD - Filtered Carbonaceous	75.64	3,156.20	
BOD - Total Carbonaceous	204.17	8,519.41	
COD - Filtered	136.98	5,715.58	
COD - Particulate	279.35	11,656.42	
COD - Total	416.33	17,372.00	
COD - Volatile fatty acids	9.99	416.93	
Influent inorganic suspended solids	140.00	5,841.66	
ISS cellular	0.75	31.14	
ISS precipitate	0	0	
ISS Total	141.67	5,911.47	

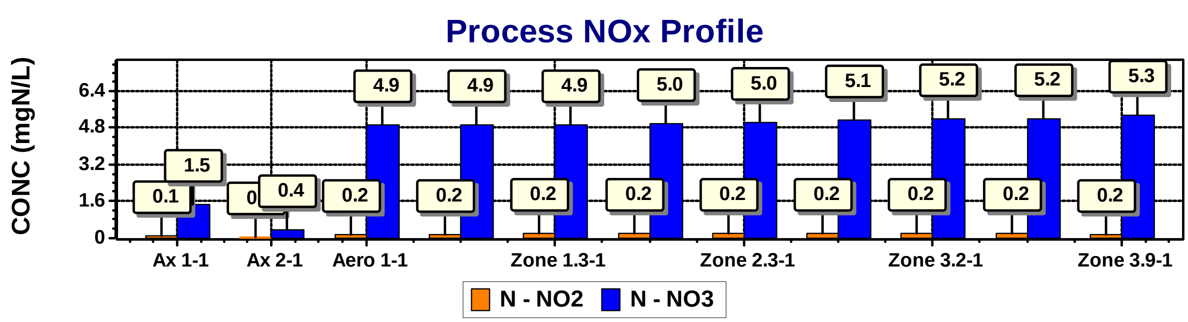
N - Ammonia	**41.00**	**1,710.80**
N - Filtered TKN	**43.18**	**1,801.67**
N - Nitrate	**0**	**0**
N - Nitrite + Nitrate	**0**	**0**
N - Particulate TKN	**2.82**	**117.78**
N - Total inorganic N	**41.00**	**1,710.80**
N - Total Kjeldahl Nitrogen	**46.00**	**1,919.44**
N - Total N	**46.00**	**1,919.44**
P - Phosphorus in HMO	**0**	**0**
P - Soluble PO4-P	**3.00**	**125.18**
P - Total P	**6.00**	**250.36**
pH	**7.00**	
S - Total S	**10.00**	**417.27**
Total aluminium (all forms)	**0**	**0**
Total Calcium (all forms)	**161.08**	**6,721.19**
Total iron (all forms)	**0**	**0**
Total Magnesium (all forms)	**25.13**	**1,048.76**
Total suspended solids	**316.67**	**13,213.70**
Volatile suspended solids	**175.00**	**7,302.23**

Parameter	**Value**	**Units**

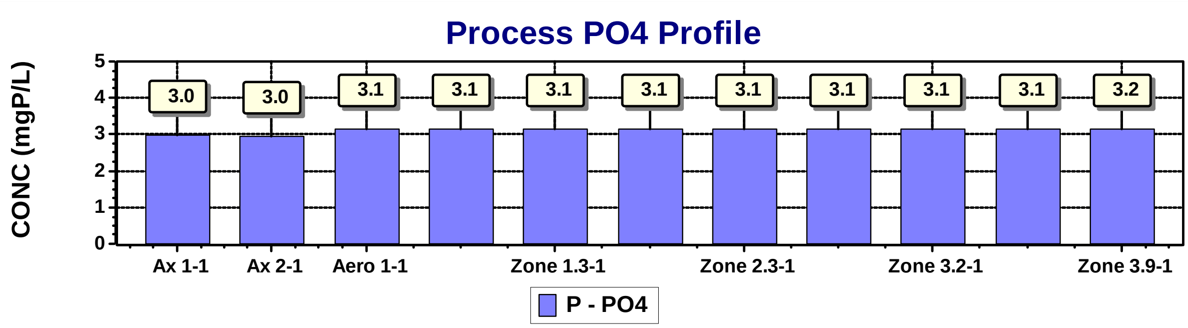
Album page - N- Species



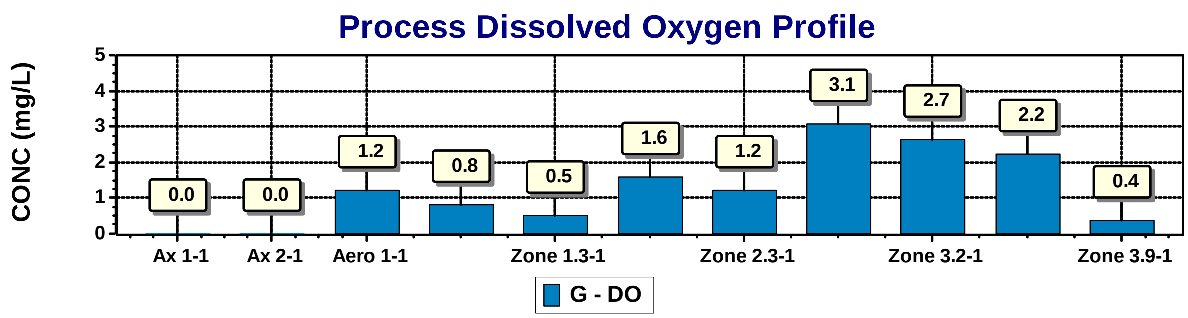
Album page - N- Species



Album page - PO4 and DO



Album page - PO4 and DO



Album page - Effluent

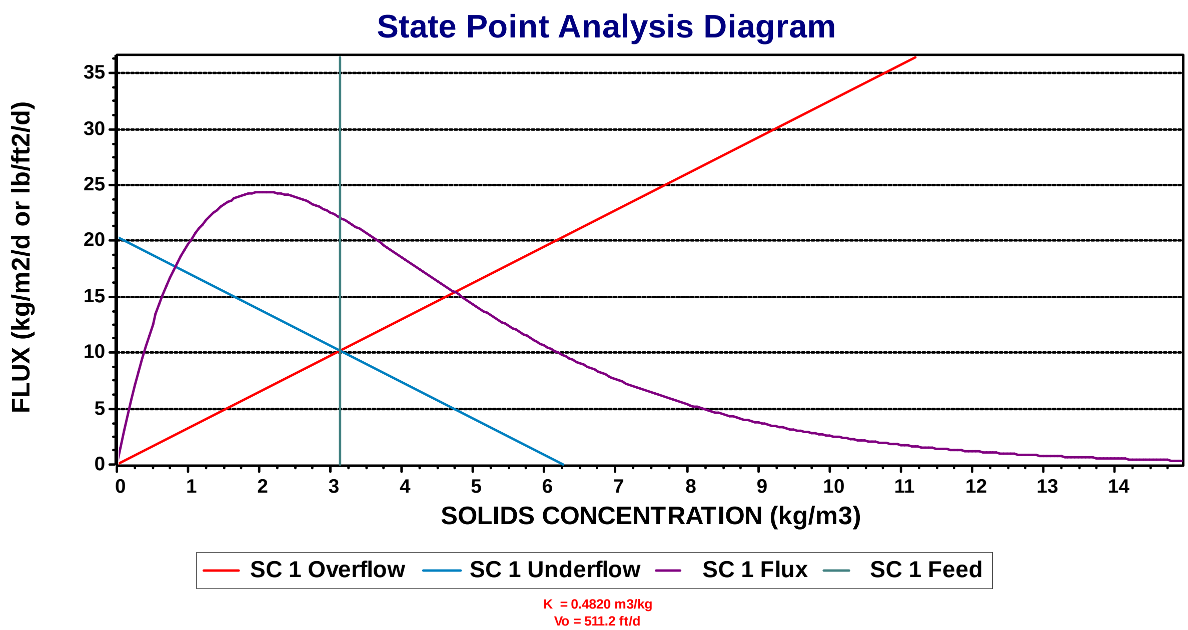
Effluent

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Alkalinity	2.70	50.35	mmol/L and kmol/d
BOD - Filtered Carbonaceous	1.00	41.05	
BOD - Total Carbonaceous	2.15	88.34	
COD - Filtered	22.27	916.46	
COD - Particulate	3.92	161.39	
COD - Total	26.19	1,077.85	
COD - Volatile fatty acids	0.00	0.20	
Influent inorganic suspended solids	3.34	137.64	
ISS cellular	0.21	8.74	
ISS precipitate	0	0	
ISS Total	3.56	146.40	
N - Ammonia	0.26	10.73	
N - Filtered TKN	1.62	66.50	
N - Nitrate	5.34	219.75	
N - Nitrite + Nitrate	5.50	226.35	
N - Particulate TKN	0.21	8.47	
N - Total inorganic N	5.76	237.08	

N - Total Kjeldahl Nitrogen	**1.82**	**74.97**
N - Total N	**7.32**	**301.32**
P - Phosphorus in HMO	**0**	**0**
P - Soluble PO4-P	**3.15**	**129.67**
P - Total P	**3.22**	**132.36**
pH	**7.00**	
S - Total S	**9.97**	**410.36**
Total aluminium (all forms)	**0**	**0**
Total Calcium (all forms)	**155.97**	**6,419.74**
Total iron (all forms)	**0**	**0**
Total Magnesium (all forms)	**24.42**	**1,005.06**
Total suspended solids	**6.26**	**257.81**
Volatile suspended solids	**2.71**	**111.41**

Parameter	**Value**	**Units**
Cost (Chemicals)	**0**	**$/hour**
Power	**0**	**kW**
Power cost (Excl. heating)	**0**	**$/hour**

Album page - SPA



Album page - Last Zone

Zone 3.9-1			
Parameters	**Conc. (mg/L)**	**Mass rate (lb/d)**	**Notes**
Alkalinity	**2.70**	**2,407.84**	**mmol/L and kmol/d**
BOD - Filtered Carbonaceous	**1.00**	**1,962.93**	
BOD - Total Carbonaceous	**575.57**	**1,132,948.48**	
COD - Filtered	**22.27**	**43,828.03**	
COD - Particulate	**1,960.52**	**3,859,040.07**	
COD - Total	**1,982.78**	**3,902,868.09**	
COD - Volatile fatty acids	**0.00**	**9.73**	
Influent inorganic suspended solids	**1,672.00**	**3,291,129.32**	
ISS cellular	**106.16**	**208,959.63**	
ISS precipitate	**0**	**0**	

ISS Total	**1,778.42**	**3,500,607.60**
N - Ammonia	**0.26**	**513.27**
N - Filtered TKN	**1.62**	**3,180.04**
N - Nitrate	**5.34**	**10,509.10**
N - Nitrite + Nitrate	**5.50**	**10,824.74**
N - Particulate TKN	**102.94**	**202,627.41**
N - Total inorganic N	**5.76**	**11,338.00**
N - Total Kjeldahl Nitrogen	**104.56**	**205,807.44**
N - Total N	**110.06**	**216,632.18**
P - Phosphorus in HMO	**0**	**0**
P - Soluble PO4-P	**3.15**	**6,201.35**
P - Total P	**35.76**	**70,388.52**
pH	**7.00**	
S - Total S	**10.33**	**20,326.81**
Total aluminium (all forms)	**0**	**0**
Total Calcium (all forms)	**161.19**	**317,280.83**
Total iron (all forms)	**0**	**0**
Total Magnesium (all forms)	**29.42**	**57,919.58**
Total suspended solids	**3,131.80**	**6,164,581.58**
Volatile suspended solids	**1,353.38**	**2,663,973.98**

Parameter	**Value**	**Units**
# of diffusers	**0**	
Actual DO sat. conc.	**8.89**	**mg/L**
Air flow rate	**0**	**ft3/min (20C, 1 atm)**
Air flow rate / diffuser	**0**	**ft3/min (20C, 1 atm)**
Alpha	**0.85**	**[]**
Beta	**0.95**	**[]**
Deamm - Ammonia removal rate	**0.00**	**mgN/L/hr**
Deamm - N2 production rate	**0.00**	**mgN/L/hr**

Deamm - Nitrate production rate	**0.00**	**mgN/L/hr**
Deamm - Nitrite removal rate	**0.00**	**mgN/L/hr**
Denit - N2 production rate	**1.52**	**mgN/L/hr**
Denit - Nitrate removal rate	**1.53**	**mgN/L/hr**
Denit - Nitrite removal rate	**0.74**	**mgN/L/hr**
Denit Auto - N2 production rate	**0.00**	**mgN/L/hr**
Denit Hetero - N2 production rate	**1.52**	**mgN/L/hr**
Denit Methylo - N2 production rate	**0.00**	**mgN/L/hr**
Element HRT	**0.0**	**hours**
Liquid depth	**13.50**	**ft**
Nit - Ammonia removal rate	**1.13**	**mgN/L/hr**
Nit - Nitrate production rate	**1.39**	**mgN/L/hr**
Nit - Nitrite production rate	**1.12**	**mgN/L/hr**
Nit - Nitrous oxide production rate	**0**	**mgN/L/hr**
Off gas Ammonia	**0**	**%**
Off gas Carbon dioxide	**91.83**	**%**
Off gas flow rate (dry)	**0.52**	**ft3/min (field)**
Off gas Hydrogen	**1.54**	**%**
Off gas Hydrogen sulfide	**0**	**%**
Off gas Ind #1	**0**	**%**
Off gas Ind #2	**0**	**%**
Off gas Ind #3	**0**	**%**
Off gas Methane	**0.00**	**%**
Off gas Nitrous oxide	**0**	**%**
Off gas Oxygen	**0**	**%**
OTE	**100.00**	**%**
OTR	**0**	**lb/hr**
OUR - Carbonaceous	**7.50**	**mgO/L/hr**
OUR - Nitrification	**5.13**	**mgO/L/hr**
OUR - Sulfur	**0.21**	**mgO/L/hr**
OUR - Total	**12.84**	**mgO/L/hr**

Power	**0.00**	**kW**
Power cost (Excl. heating)	**0.00**	**$/hour**
SOTE	**100.00**	**%**
SOTR	**0**	**lb/hr**
Sulfate production rate	**0.06**	**mgS/L/hr**
Sulfate removal rate	**0.00**	**mgS/L/hr**
Total readily biodegradable COD	**1.37**	**mg/L**
Total solids mass	**4,375.19**	**lb**
Velocity gradient	**87.37**	**1/s**
VSS destruction	**0.01**	**%**

Album page - WAS

Waste

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Alkalinity	**2.70**	**2.23**	**mmol/L and kmol/d**
BOD - Filtered Carbonaceous	**1.00**	**1.81**	
BOD - Total Carbonaceous	**1,149.00**	**2,090.38**	
COD - Filtered	**22.27**	**40.51**	
COD - Particulate	**3,917.11**	**7,126.39**	
COD - Total	**3,939.38**	**7,166.90**	
COD - Volatile fatty acids	**0.00**	**0.01**	
Influent inorganic suspended solids	**3,340.65**	**6,077.64**	
ISS cellular	**212.10**	**385.88**	
ISS precipitate	**0**	**0**	
ISS Total	**3,553.28**	**6,464.48**	
N - Ammonia	**0.26**	**0.47**	
N - Filtered TKN	**1.62**	**2.94**	
N - Nitrate	**5.34**	**9.71**	
N - Nitrite + Nitrate	**5.50**	**10.00**	

N - Particulate TKN	**205.68**	**374.19**
N - Total inorganic N	**5.76**	**10.48**
N - Total Kjeldahl Nitrogen	**207.29**	**377.13**
N - Total N	**212.79**	**387.13**
P - Phosphorus in HMO	**0**	**0**
P - Soluble PO4-P	**3.15**	**5.73**
P - Total P	**68.30**	**124.26**
pH	**7.00**	
S - Total S	**10.68**	**19.44**
Total aluminium (all forms)	**0**	**0**
Total Calcium (all forms)	**166.41**	**302.74**
Total iron (all forms)	**0**	**0**
Total Magnesium (all forms)	**34.43**	**62.64**
Total suspended solids	**6,257.34**	**11,383.97**
Volatile suspended solids	**2,704.06**	**4,919.49**

Parameter	**Value**	**Units**
Cost (Sludge)	**0**	**$/hour**
Power	**0**	**kW**
Power cost (Excl. heating)	**0**	**$/hour**

Global Parameters

Common

Name	**Default**	**Value**	
Hydrolysis rate [1/d]	**2.1000**	**2.1000**	**1.0290**
Hydrolysis half sat. [-]	**0.0600**	**0.0600**	**1.0000**

External organics hydrolysis rate [1/d]	**2.1000**	**2.1000**	**1.0290**
External organics hydrolysis half sat. [-]	**0.0600**	**0.0600**	**1.0000**
Anoxic hydrolysis factor [-]	**0.2800**	**0.2800**	**1.0000**
Anaerobic hydrolysis factor (AS) [-]	**0.0400**	**0.0400**	**1.0000**
Anaerobic hydrolysis factor (AD) [-]	**0.5000**	**0.5000**	**1.0000**
Adsorption rate of colloids [L/(mgCOD d)]	**0.1500**	**0.1500**	**1.0290**
Ammonification rate [L/(mgCOD d)]	**0.0800**	**0.0800**	**1.0290**
Assimilative nitrate/nitrite reduction rate [1/d]	**0.5000**	**0.5000**	**1.0000**
Endogenous products decay rate [1/d]	**0**	**0**	**1.0000**

Ammonia oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	**0.9000**	**0.9000**	**1.0720**
Substrate (NH4) half sat. [mgN/L]	**0.7000**	**0.7000**	**1.0000**
Byproduct NH4 logistic slope [-]	**50.0000**	**50.0000**	**1.0000**
Byproduct NH4 inflection point [mgN/L]	**1.4000**	**1.4000**	**1.0000**
Denite DO half sat. [mg/L]	**0.1000**	**0.1000**	**1.0000**
Denite HNO2 half sat. [mgN/L]	**5.000E-6**	**5.000E-6**	**1.0000**
Aerobic decay rate [1/d]	**0.1700**	**0.1700**	**1.0290**
Anoxic/anaerobic decay rate [1/d]	**0.0800**	**0.0800**	**1.0290**
KiHNO2 [mmol/L]	**5.000E-3**	**5.000E-3**	**1.0000**

Nitrite oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	**0.7000**	**0.7000**	**1.0600**
Substrate (NO2) half sat. [mgN/L]	**0.1000**	**0.1000**	**1.0000**

Aerobic decay rate [1/d]	**0.1700**	**0.1700**	**1.0290**
Anoxic/anaerobic decay rate [1/d]	**0.0800**	**0.0800**	**1.0290**
KiNH3 [mmol/L]	**0.0750**	**0.0750**	**1.0000**

Anaerobic ammonia oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	**0.2000**	**0.2000**	**1.1000**
Substrate (NH4) half sat. [mgN/L]	**2.0000**	**2.0000**	**1.0000**
Substrate (NO2) half sat. [mgN/L]	**1.0000**	**1.0000**	**1.0000**
Aerobic decay rate [1/d]	**0.0190**	**0.0190**	**1.0290**
Anoxic/anaerobic decay rate [1/d]	**9.500E-3**	**9.500E-3**	**1.0290**
Ki Nitrite [mgN/L]	**1,000.0000**	**1,000.0000**	**1.0000**
Nitrite sensitivity constant [L / (d mgN)]	**0.0160**	**0.0160**	**1.0000**

Ordinary heterotrophic

Name	Default	Value	
Max. spec. growth rate [1/d]	**3.2000**	**3.2000**	**1.0290**
Substrate half sat. [mgCOD/L]	**5.0000**	**5.0000**	**1.0000**
Anoxic growth factor [-]	**0.5000**	**0.5000**	**1.0000**
Denite N2 producers (NO3 or NO2) [-]	**0.5000**	**0.5000**	**1.0000**
Aerobic decay rate [1/d]	**0.6200**	**0.6200**	**1.0290**
Anoxic decay rate [1/d]	**0.2330**	**0.2330**	**1.0290**
Anaerobic decay rate [1/d]	**0.1310**	**0.1310**	**1.0290**
Fermentation rate [1/d]	**1.6000**	**1.6000**	**1.0290**
Fermentation half sat. [mgCOD/L]	**5.0000**	**5.0000**	**1.0000**
Fermentation growth factor (AS) [-]	**0.2500**	**0.2500**	**1.0000**

Free nitrous acid inhibition [mol/L]	**1.000E-7**	**1.000E-7**	**1.0000**

Heterotrophic on industrial COD

Name	Default	Value	
Maximum specific growth rate on Ind #1 COD [1/d]	4.3000	4.3000	1.0290
Substrate (Ind #1) half sat. [mgCOD/L]	1.0000	1.0000	1.0000
Inhibition coefficient for Ind #1 [mgCOD/L]	60.0000	60.0000	1.0000
Anaerobic growth factor for Ind #1 [mgCOD/L]	0.0500	0.0500	1.0000
Maximum specific growth rate on Ind #2 COD [1/d]	1.5000	1.5000	1.0290
Substrate (Ind #2) half sat. [mgCOD/L]	30.0000	30.0000	1.0000
Inhibition coefficient for Ind #2 [mgCOD/L]	3,000.0000	3,000.0000	1.0000
Anaerobic growth factor for Ind #2 [mgCOD/L]	0.0500	0.0500	1.0000
Maximum specific growth rate on Ind #3 COD [1/d]	4.3000	4.3000	1.0290
Substrate (Ind #3) half sat. [mgCOD/L]	1.0000	1.0000	1.0000
Inhibition coefficient for Ind #3 COD [mgCOD/L]	60.0000	60.0000	1.0000
Anaerobic growth factor for Ind #3 [mgCOD/L]	0.0500	0.0500	1.0000
Maximum specific growth rate on adsorbed hydrocarbon COD [1/d]	2.0000	2.0000	1.0290
Substrate (adsorbed hydrocarbon) half sat. [-]	0.1500	0.1500	1.0000
Anaerobic growth factor for adsorbed hydrocarbons [mgCOD/L]	0.0100	0.0100	1.0000
Adsorption rate of soluble hydrocarbons [l/(mgCOD d)]	0.2000	0.2000	1.0000

Methylotrophic

Name	Default	Value	
Max. spec. growth rate [1/d]	1.3000	1.3000	1.0720
Methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000

Denite N2 producers (NO3 or NO2) [-]	**0.5000**	**0.5000**	**1.0000**
Aerobic decay rate [1/d]	**0.0400**	**0.0400**	**1.0290**
Anoxic/anaerobic decay rate [1/d]	**0.0300**	**0.0300**	**1.0290**
Free nitrous acid inhibition [mmol/L]	**1.000E-7**	**1.000E-7**	**1.0000**

Phosphorus accumulating

Name	Default	Value	
Max. spec. growth rate [1/d]	**0.9500**	**0.9500**	**1.0000**
Max. spec. growth rate, P-limited [1/d]	**0.4200**	**0.4200**	**1.0000**
Substrate half sat. [mgCOD(PHA)/mgCOD(Zbp)]	**0.1000**	**0.1000**	**1.0000**
Substrate half sat., P-limited [mgCOD(PHA)/mgCOD(Zbp)]	**0.0500**	**0.0500**	**1.0000**
Magnesium half sat. [mgMg/L]	**0.1000**	**0.1000**	**1.0000**
Cation half sat. [mmol/L]	**0.1000**	**0.1000**	**1.0000**
Calcium half sat. [mgCa/L]	**0.1000**	**0.1000**	**1.0000**
Aerobic/anoxic decay rate [1/d]	**0.1000**	**0.1000**	**1.0000**
Aerobic/anoxic maintenance rate [1/d]	**0**	**0**	**1.0000**
Anaerobic decay rate [1/d]	**0.0400**	**0.0400**	**1.0000**
Anaerobic maintenance rate [1/d]	**0**	**0**	**1.0000**
Sequestration rate [1/d]	**4.5000**	**4.5000**	**1.0000**
Anoxic growth factor [-]	**0.3300**	**0.3300**	**1.0000**

Propionic acetogenic

Name	Default	Value	
Max. spec. growth rate [1/d]	**0.2500**	**0.2500**	**1.0290**
Substrate half sat. [mgCOD/L]	**10.0000**	**10.0000**	**1.0000**
Acetate inhibition [mgCOD/L]	**10,000.0000**	**10,000.0000**	**1.0000**

Anaerobic decay rate [1/d]	**0.0500**	**0.0500**	**1.0290**
Aerobic/anoxic decay rate [1/d]	**0.5200**	**0.5200**	**1.0290**

Methanogenic

Name	**Default**	**Value**	
Acetoclastic max. spec. growth rate [1/d]	**0.3000**	**0.3000**	**1.0290**
H2-utilizing max. spec. growth rate [1/d]	**1.4000**	**1.4000**	**1.0290**
Acetoclastic substrate half sat. [mgCOD/L]	**100.0000**	**100.0000**	**1.0000**
Acetoclastic methanol half sat. [mgCOD/L]	**0.5000**	**0.5000**	**1.0000**
H2-utilizing CO2 half sat. [mmol/L]	**0.1000**	**0.1000**	**1.0000**
H2-utilizing substrate half sat. [mgCOD/L]	**1.0000**	**1.0000**	**1.0000**
H2-utilizing methanol half sat. [mgCOD/L]	**0.5000**	**0.5000**	**1.0000**
Acetoclastic propionic inhibition [mgCOD/L]	**10,000.0000**	**10,000.0000**	**1.0000**
Acetoclastic anaerobic decay rate [1/d]	**0.1300**	**0.1300**	**1.0290**
Acetoclastic aerobic/anoxic decay rate [1/d]	**0.6000**	**0.6000**	**1.0290**
H2-utilizing anaerobic decay rate [1/d]	**0.1300**	**0.1300**	**1.0290**
H2-utilizing aerobic/anoxic decay rate [1/d]	**2.8000**	**2.8000**	**1.0290**

Sulfur oxidizing

Name	**Default**	**Value**	
Maximum specific growth rate (sulfide) [1/d]	**0.7500**	**0.7500**	**1.0290**
Maximum specific growth rate (sulfur) [1/d]	**0.1000**	**0.1000**	**1.0290**
Substrate (H2S) half sat. [mgS/L]	**1.0000**	**1.0000**	**1.0000**
Substrate (sulfur) half sat. [mgS/L]	**1.0000**	**1.0000**	**1.0000**
Anoxic growth factor [-]	**0.5000**	**0.5000**	**1.0000**
Decay rate [1/d]	**0.0400**	**0.0400**	**1.0290**

Sulfur reducing

Name	Default	Value	
Propionic max. spec. growth rate [1/d]	0.5830	0.5830	1.0350
Propionic acid half sat. [mgCOD/L]	295.0000	295.0000	1.0000
Hydrogen sulfide inhibition coefficient [mgS/L]	185.0000	185.0000	1.0000
Sulfate (SO4=) half sat. [mgS/L]	2.4700	2.4700	1.0000
Decay rate [1/d]	0.0185	0.0185	1.0350
Acetotrophic max. spec. growth rate [1/d]	0.6120	0.6120	1.0350
Acetic acid half sat. [mgCOD/L]	24.0000	24.0000	1.0000
Hydrogen sulfide inhibition coefficient [mgS/L]	164.0000	164.0000	1.0000
Sulfate (SO4=) half sat. [mgS/L]	6.4100	6.4100	1.0000
Decay rate [1/d]	0.0275	0.0275	1.0350
Hydrogenotrophic max. spec. growth rate with SO4= [1/d]	2.8000	2.8000	1.0350
Hydrogenotrophic max. spec. growth rate with S [1/d]	0.1000	0.1000	1.0350
Hydrogen half sat. [mgCOD/L]	0.0700	0.0700	1.0000
Hydrogen sulfide inhibition coefficient [mgS/L]	550.0000	550.0000	1.0000
Sulfate (SO4=) half sat. [mgS/L]	6.4100	6.4100	1.0000
Sulfur (S) half sat. [mgS/L]	50.0000	50.0000	1.0000
Decay rate [1/d]	0.0600	0.0600	1.0350

pH

Name	Default	Value
Ordinary heterotrophic low pH limit [-]	4.0000	4.0000
Ordinary heterotrophic high pH limit [-]	10.0000	10.0000
Methylotrophic low pH limit [-]	4.0000	4.0000

Methylotrophic high pH limit [-]	**10.0000**	**10.0000**
Autotrophic low pH limit [-]	**5.5000**	**5.5000**
Autotrophic high pH limit [-]	**9.5000**	**9.5000**
Phosphorus accumulating low pH limit [-]	**4.0000**	**4.0000**
Phosphorus accumulating high pH limit [-]	**10.0000**	**10.0000**
Ordinary heterotrophic low pH limit (anaerobic) [-]	**5.5000**	**5.5000**
Ordinary heterotrophic high pH limit (anaerobic) [-]	**8.5000**	**8.5000**
Propionic acetogenic low pH limit [-]	**4.0000**	**4.0000**
Propionic acetogenic high pH limit [-]	**10.0000**	**10.0000**
Acetoclastic methanogenic low pH limit [-]	**5.0000**	**5.0000**
Acetoclastic methanogenic high pH limit [-]	**9.0000**	**9.0000**
H2-utilizing methanogenic low pH limit [-]	**5.0000**	**5.0000**
H2-utilizing methanogenic high pH limit [-]	**9.0000**	**9.0000**

Switches

Name	Default	Value
Ordinary heterotrophic DO half sat. [mgO2/L]	**0.1500**	**0.2500**
Phosphorus accumulating DO half sat. [mgO2/L]	**0.0500**	**0.0500**
Anoxic/anaerobic NOx half sat. [mgN/L]	**0.1500**	**0.1500**
Ammonia oxidizing DO half sat. [mgO2/L]	**0.2500**	**0.2500**
Nitrite oxidizing DO half sat. [mgO2/L]	**0.5000**	**0.5000**
Anaerobic ammonia oxidizing DO half sat. [mgO2/L]	**0.0100**	**0.0100**
Sulfur oxidizing sulfate pathway DO half sat. [mgO2/L]	**0.2500**	**0.2500**
Sulfur oxidizing sulfur pathway DO half sat. [mgO2/L]	**0.0500**	**0.0500**
Anoxic NO3(->NO2) half sat. [mgN/L]	**0.1000**	**0.1000**
Anoxic NO3(->N2) half sat. [mgN/L]	**0.0500**	**0.0500**
Anoxic NO2(->N2) half sat. (mgN/L)	**0.0100**	**0.0100**
NH3 nutrient half sat. [mgN/L]	**5.000E-3**	**5.000E-3**
PolyP half sat. [mgP/mgCOD]	**0.0100**	**0.0100**

VFA sequestration half sat. [mgCOD/L]	**5.0000**	**5.0000**
P uptake half sat. [mgP/L]	**0.1500**	**0.1500**
P nutrient half sat. [mgP/L]	**1.000E-3**	**1.000E-3**
Autotrophic CO2 half sat. [mmol/L]	**0.1000**	**0.1000**
H2 low/high half sat. [mgCOD/L]	**1.0000**	**1.0000**
Propionic acetogenic H2 inhibition [mgCOD/L]	**5.0000**	**5.0000**
Synthesis anion/cation half sat. [meq/L]	**0.0100**	**0.0100**

Common

Name	**Default**	**Value**
Biomass/Endog Ca content (gCa/gCOD)	**3.912E-3**	**3.912E-3**
Biomass/Endog Mg content (gMg/gCOD)	**3.912E-3**	**3.912E-3**
Biomass/Endog other cations content (mol/gCOD)	**5.115E-4**	**5.115E-4**
Biomass/Endog other Anions content (mol/gCOD)	**1.410E-4**	**1.410E-4**
N in endogenous residue [mgN/mgCOD]	**0.0700**	**0.0700**
P in endogenous residue [mgP/mgCOD]	**0.0220**	**0.0220**
Ca content of slowly biodegradabe (gCa/gCOD)	**3.912E-3**	**3.912E-3**
Mg content of slowly biodegradabe (gMg/gCOD)	**3.700E-4**	**3.700E-4**
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	**1.4200**	**1.4200**
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	**1.6327**	**1.6327**
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	**1.6000**	**1.6000**
Cellulose COD:VSS ratio [mgCOD/mgVSS]	**1.4000**	**1.4000**
External organic COD:VSS ratio [mgCOD/mgVSS]	**1.6000**	**1.6000**
Molecular weight of other anions [mg/mmol]	**35.5000**	**35.5000**
Molecular weight of other cations [mg/mmol]	**39.0983**	**39.0983**

Ammonia oxidizing

Name	Default	Value
Yield [mgCOD/mgN]	0.1500	0.1500
Denite NO2 fraction as TEA [-]	0.5000	0.5000
Byproduct NH4 fraction to N2O [-]	2.500E-3	2.500E-3
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Nitrite oxidizing

Name	Default	Value
Yield [mgCOD/mgN]	0.0900	0.0900
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Anaerobic ammonia oxidizing

Name	Default	Value
Yield [mgCOD/mgN]	0.1140	0.1140
Nitrate production [mgN/mgBiomassCOD]	2.2800	2.2800
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Ordinary heterotrophic

Name	Default	Value
Yield (aerobic) [-]	0.6660	0.6660
Yield (fermentation, low H2) [-]	0.1000	0.1000
Yield (fermentation, high H2) [-]	0.1000	0.1000
H2 yield (fermentation low H2) [-]	0.3500	0.3500
H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.7000	0.7000
CO2 yield (fermentation, low H2) [-]	0.7000	0.7000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Endogenous fraction - aerobic [-]	0.0800	0.0800
Endogenous fraction - anoxic [-]	0.1030	0.1030
Endogenous fraction - anaerobic [-]	0.1840	0.1840
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield (anoxic) [-]	0.5400	0.5400
Yield propionic (aerobic) [-]	0.6400	0.6400
Yield propionic (anoxic) [-]	0.4600	0.4600
Yield acetic (aerobic) [-]	0.6000	0.6000
Yield acetic (anoxic) [-]	0.4300	0.4300
Yield methanol (aerobic) [-]	0.5000	0.5000
Adsorp. max. [-]	1.0000	1.0000
Max fraction to N2O at high FNA over nitrate [-]	0.0500	0.0500
Max fraction to N2O at high FNA over nitrite [-]	0.1000	0.1000

Ordinary heterotrophic on industrial COD

Name	Default	Value
Yield Ind #1 COD (Aerobic) [-]	0.5000	0.5000
Yield Ind #1 COD (Anoxic) [-]	0.4000	0.4000
Yield Ind #1 COD (Anaerobic) [-]	0.0400	0.0400
COD:Mole ratio - Ind #1 COD [gCOD/Mol]	224.0000	224.0000
Yield Ind #2 COD (Aerobic) [-]	0.5000	0.5000
Yield Ind #2 COD (Anoxic) [-]	0.4000	0.4000
Yield Ind #2 COD (Anaerobic) [-]	0.0500	0.0500
COD:Mole ratio - Ind #2 COD [gCOD/Mol]	240.0000	240.0000
Yield on Ind #3 COD (Aerobic) [-]	0.5000	0.5000
Yield on Ind #3 COD (Anoxic) [-]	0.4000	0.4000
Yield on Ind #3 COD (Anaerobic) [-]	0.0400	0.0400
COD:Mole ratio - Ind #3 COD [gCOD/Mol]	288.0000	288.0000
Yield enmeshed hydrocarbons (Aerobic) [-]	0.5000	0.5000
Yield enmeshed hydrocarbons (Anoxic) [-]	0.4000	0.4000
Yield enmeshed hydrocarbons (Anaerobic) [-]	0.0400	0.0400
COD:Mole ratio - Hydrocarbon COD [gCOD/Mol]	336.0000	336.0000
Hydrocarbon COD:VSS ratio [mgCOD/mgVSS]	3.2000	3.2000
Max. hydrocarbon adsorp. ratio [-]	1.0000	1.0000
Yield of Ind #1 on Ind #3 COD (Aerobic) [-]	0	0
Yield of Ind #1 on Ind #3 COD (Anoxic) [-]	0	0
Hydrocarbon Yield on Ind #3 COD (Aerobic) [-]	0	0
Hydrocarbon Yield on Ind #3 COD (Anoxic) [-]	0	0

Methylotrophic

Name	Default	Value

Yield (anoxic) [-]	**0.4000**	**0.4000**
N in biomass [mgN/mgCOD]	**0.0700**	**0.0700**
P in biomass [mgP/mgCOD]	**0.0220**	**0.0220**
Fraction to endogenous residue [-]	**0.0800**	**0.0800**
COD:VSS ratio [mgCOD/mgVSS]	**1.4200**	**1.4200**
Max fraction to N2O at high FNA over nitrate [-]	**0.1000**	**0.1000**
Max fraction to N2O at high FNA over nitrite [-]	**0.1500**	**0.1500**

Phosphorus accumulating

Name	Default	Value
Yield (aerobic) [-]	**0.6390**	**0.6390**
Yield (anoxic) [-]	**0.5200**	**0.5200**
Aerobic P/PHA uptake [mgP/mgCOD]	**0.9300**	**0.9300**
Anoxic P/PHA uptake [mgP/mgCOD]	**0.3500**	**0.3500**
Yield of PHA on Ac sequestration [-]	**0.8890**	**0.8890**
N in biomass [mgN/mgCOD]	**0.0700**	**0.0700**
N in sol. inert [mgN/mgCOD]	**0.0700**	**0.0700**
P in biomass [mgP/mgCOD]	**0.0220**	**0.0220**
Fraction to endogenous part. [-]	**0.2500**	**0.2500**
Inert fraction of endogenous sol. [-]	**0.2000**	**0.2000**
P/Ac release ratio [mgP/mgCOD]	**0.5100**	**0.5100**
COD:VSS ratio [mgCOD/mgVSS]	**1.4200**	**1.4200**
Yield of low PP [-]	**0.9400**	**0.9400**
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	**0.3000**	**0.3000**
Cation to P mole ratio in polyphosphate [meq/mmolP]	**0.1500**	**0.1500**
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	**0.0500**	**0.0500**

Propionic acetogenic

Name	Default	Value
Yield [-]	0.1000	0.1000
H2 yield [-]	0.4000	0.4000
CO2 yield [-]	1.0000	1.0000
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Methanogenic

Name	Default	Value
Acetoclastic yield [-]	0.1000	0.1000
Acetoclastic yield on methanol[-]	0.1000	0.1000
H2-utilizing yield [-]	0.1000	0.1000
H2-utilizing yield on methanol [-]	0.1000	0.1000
N in acetoclastic biomass [mgN/mgCOD]	0.0700	0.0700
N in H2-utilizing biomass [mgN/mgCOD]	0.0700	0.0700
P in acetoclastic biomass [mgP/mgCOD]	0.0220	0.0220
P in H2-utilizing biomass [mgP/mgCOD]	0.0220	0.0220
Acetoclastic fraction to endog. residue [-]	0.0800	0.0800
H2-utilizing fraction to endog. residue [-]	0.0800	0.0800
Acetoclastic COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
H2-utilizing COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Sulfur oxidizing

Name	Default	Value
Yield (aerobic) [mgCOD/mgS]	0.5000	0.5000
Yield (Anoxic) [mgCOD/mgS]	0.3500	0.3500
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Sulfur reducing

Name	Default	Value
Yield [mgCOD/mg H2 COD]	0.0712	0.0712
Yield [mgCOD/mg Ac COD]	0.0470	0.0470
Yield [mgCOD/mg Pr COD]	0.0384	0.0384
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

General

Name	Default	Value
Tank head loss per metre of length (from flow) [m/m]	2.500E-3	2.500E-3
BOD calculation rate constant for Xsc degradation [/d]	0.5000	0.5000
BOD calculation rate constant for Xsp (and hydrocarbon) degradation [/d]	0.5000	0.5000
BOD calculation rate constant for Xeo degradation [/d]	0.5000	0.5000

Heating fuel/Chemical Costs

Name	Default	Value
Methanol [$/gal]	1.6656	1.6656
Ferric chloride [$/lb Fe]	0.5307	0.5307
Ferric sulfate [$/lb Fe]	0.3583	0.3583
Ferrous chloride [$/lb Fe]	0.2767	0.2767
Ferrous sulfate [$/lb Fe]	1.0750	1.0750
Aluminum sulfate [$/lb Al]	0.7666	0.7666
Aluminum chloride [$/lb Al]	0.8981	0.8981
Poly Aluminum Chloride (PAC) [$/lb Al]	0.5307	0.5307
Natural gas [$/MMBTU]	3.1652	3.1652
Heating oil [$/gal]	1.8927	1.8927
Diesel [$/gal]	2.6498	2.6498
Custom fuel [$/gal]	3.7854	3.7854
Biogas sale price [$/MMBTU]	2.1101	2.1101

Anaerobic digester

Name	Default	Value
Bubble rise velocity (anaerobic digester) [cm/s]	23.9000	23.9000
Bubble Sauter mean diameter (anaerobic digester) [cm]	0.3500	0.3500
Anaerobic digester gas hold-up factor []	1.0000	1.0000

Combined Heat and Power (CHP) engine

Name	Default	Value

Methane heat of combustion [kJ/mole]	**800.0000**	**800.0000**
Hydrogen heat of combustion [kJ/mole]	**240.0000**	**240.0000**
CHP engine heat price [$/kWh]	**0**	**0**
CHP engine power price [$/kWh]	**0.1500**	**0.1500**

Calorific values of heating fuels

Name	Default	Value
Calorific value of natural gas [BTU/lb]	**20,636**	**20,636**
Calorific value of heating fuel oil [BTU/lb]	**18,057**	**18,057**
Calorific value of diesel [BTU/lb]	**19,776**	**19,776**
Calorific value of custom fuel [BTU/lb]	**13,758**	**13,758**

Density of liquid heating fuels

Name	Default	Value
Density of heating fuel oil [lb/ft3]	**56**	**56**
Density of diesel [lb/ft3]	**55**	**55**
Density of custom fuel [lb/ft3]	**49**	**49**

Mass transfer

Name	Default	Value	
Kl for H2 [m/d]	**17.0000**	**17.0000**	**1.0240**
Kl for CO2 [m/d]	**10.0000**	**10.0000**	**1.0240**
Kl for NH3 [m/d]	**1.0000**	**1.0000**	**1.0240**

KI for CH4 [m/d]	**8.0000**	**8.0000**	**1.0240**
KI for N2 [m/d]	**15.0000**	**15.0000**	**1.0240**
KI for N2O [m/d]	**8.0000**	**8.0000**	**1.0240**
KI for H2S [m/d]	**1.0000**	**1.0000**	**1.0240**
KI for Ind #1 COD [m/d]	**0**	**0**	**1.0240**
KI for Ind #2 COD [m/d]	**0.5000**	**0.5000**	**1.0240**
KI for Ind #3 COD [m/d]	**0**	**0**	**1.0240**
KI for O2 [m/d]	**13.0000**	**13.0000**	**1.0240**

Henry's law constants

Name	**Default**	**Value**	
CO2 [M/atm]	**3.4000E-2**	**3.4000E-2**	**2,400.0000**
O2 [M/atm]	**1.3000E-3**	**1.3000E-3**	**1,500.0000**
N2 [M/atm]	**6.5000E-4**	**6.5000E-4**	**1,300.0000**
N2O [M/atm]	**2.5000E-2**	**2.5000E-2**	**2,600.0000**
NH3 [M/atm]	**5.8000E+1**	**5.8000E+1**	**4,100.0000**
CH4 [M/atm]	**1.4000E-3**	**1.4000E-3**	**1,600.0000**
H2 [M/atm]	**7.8000E-4**	**7.8000E-4**	**500.0000**
H2S [M/Atm]	**1.0000E-1**	**1.0000E-1**	**2,200.0000**
Ind 1 [M/Atm]	**1.9000E+3**	**1.9000E+3**	**7,300.0000**
Ind 2 [M/Atm]	**1.8000E-1**	**1.8000E-1**	**2,200.0000**
Ind 3 [M/Atm]	**1.5000E-1**	**1.5000E-1**	**1,900.0000**

Properties constants

Name	**Default**	**Value**
K in Viscosity = K e ^(Ea/RT) [Pa s]	**6.849E-7**	**6.849E-7**

Ea in Viscosity = K e ^(Ea/RT) [j/mol]	1.780E+4	1.780E+4
Y in ML Viscosity = H2O viscosity * (1+A*MLSS^Y) [-]	1.0000	1.0000
A in ML Viscosity = H2O viscosity * (1+A*MLSS^Y) [m3/g]	1.000E-7	1.000E-7
A in ML Density = H2O density + A*MLSS [(kg/m3)/(g/m3)]	3.248E-4	3.248E-4
A in Antoine equn. [T in K, P in Bar {NIST}]	5.2000	5.2000
B in Antoine equn. [T in K, P in Bar {NIST}]	1,734.0000	1,734.0000
C in Antoine equn. [T in K, P in Bar {NIST}]	-39.5000	-39.5000

Metal salt solution densities

Name	Default	Value
Ferric chloride solution density [kg/m3]	3,820.0000	3,820.0000
Ferric sulfate solution density [kg/m3]	4,800.0000	4,800.0000
Ferrous chloride solution density [kg/m3]	3,160.0000	3,160.0000
Ferrous sulfate solution density [kg/m3]	1,150.0000	1,150.0000
Aluminum sulfate solution density [kg/m3]	1,950.0000	1,950.0000
Aluminum chloride solution density [kg/m3]	2,480.0000	2,480.0000

Mineral precipitation rates

Name	Default	Value	
Vivianite precipitation rate [L/(mol d)]	1.000E+5	1.000E+5	1.0240
Vivianite redissolution rate [L/(mol d)]	1.000E+5	1.000E+5	1.0240
Vivianite half sat. [mgTSS/L]	0.0100	0.0100	1.0000
FeS precipitation rate [L/(mol d)]	1,000.0000	1,000.0000	1.0240
FeS redissolution rate [L/(mol d)]	10.0000	10.0000	1.0240
FeS half sat. [mgTSS/L]	0.1000	0.1000	1.0000
Struvite precipitation rate [L^2/(mol^2 d)]	3.000E+10	3.000E+10	1.0240

Struvite redissolution rate [L^2/(mol^2 d)]	**3.000E+11**	**3.000E+11**	**1.0240**
Struvite half sat. [mgTSS/L]	**1.0000**	**1.0000**	**1.0000**
Brushite precipitation rate [L/(mol d)]	**1.000E+6**	**1.000E+6**	**1.0000**
Brushite redissolution rate [L/(mol d)]	**10,000.0000**	**10,000.0000**	**1.0000**
Brushite half sat. [mgTSS/L]	**1.0000**	**1.0000**	**1.0000**
HAP precipitation rate [g/d]	**5.000E-4**	**5.000E-4**	**1.0000**

Mineral precipitation constants

Name	Default	Value
Vivianite solubility product [mol/L]^5	**1.710E-36**	**1.710E-36**
FeS solubility product [mol/L]^2	**4.258E-4**	**4.258E-4**
Struvite solubility product [mol/L]^3	**6.918E-14**	**6.918E-14**
Brushite solubility product [mol/L]^2	**2.490E-7**	**2.490E-7**

Fe rates

Name	Default	Value	
A in aging rate = A * exp(-G/B) [1/d)]	**16.1550**	**16.1550**	**1.0000**
B in aging rate = A * exp(-G/B) [1/s)]	**57.3000**	**57.3000**	**1.0000**
HFO(L) aging rate factor	**2.500E-4**	**2.500E-4**	**1.0000**
HFO(H) with H2PO4- bound aging factor []	**1.000E-5**	**1.000E-5**	**1.0000**
HFO(L) with H2PO4- bound aging factor []	**0.4000**	**0.4000**	**1.0000**
H2PO4- coprecipitation rate [mol/(L d)]	**1.500E-9**	**1.500E-9**	**1.0000**
H2PO4- Adsorption rate [mol /(L d)]	**2.000E-11**	**2.000E-11**	**1.0000**
H+ competition for HFO(H) protonation sites [L/(mmol . d)]	**1,000.0000**	**1,000.0000**	**1.0000**
H+ competition for HFO(L) protonation sites [L/(mmol . d)]	**100.0000**	**100.0000**	**1.0000**

Fe constants

Name	Default	Value
Ferric active site factor(high) [{mol Sites}/{mol HFO(H)}]	4.0000	4.0000
Ferric active site factor(low) [{mol Sites}/{mol HFO(L)}]	2.4000	2.4000
H+ competition level for Fe(OH)3 [mol/L]	7.000E-7	7.000E-7
Equilibrium constant for FeOH3-H2PO4- [{mf HFO(H).H2PO4}/({mol H2PO4-}{mf HFO(H)}^2)]	2.000E-9	2.000E-9
Colloidal COD removed with Ferric [gCOD/Fe active site]	80.0000	80.0000
Minimum residual P level with iron addition [mgP/L]	0.0150	0.0150
HFO(H) with H2PO4- P release factor	10,000.0000	10,000.0000
HFO(L) with H2PO4- P release factor	10,000.0000	10,000.0000

Fe RedOx rates

Name	Default	Value	
Iron reduction using acetic acid	1.000E-7	1.000E-7	1.0000
Half Sat. acetic acid	0.5000	0.5000	1.0000
Iron reduction using propionic acid	1.000E-7	1.000E-7	1.0000
Half Sat. propionic acid	0.5000	0.5000	1.0000
Iron reduction using dissolved hydrogen gas	1.000E-7	1.000E-7	1.0000
Half Sat. dissolved hydrogen gas	0.5000	0.5000	1.0000
Iron reduction using hydrogen sulfide	5.000E-5	5.000E-5	1.0000
Half Sat. hydrogen sulfide	0.5000	0.5000	1.0000
Iron oxidation rate (aerobic)	1.000E-3	1.000E-3	1.0000
Abiotic iron reduction using acetic acid	2.000E-5	2.000E-5	1.0000
Abiotic iron reduction using propionic acid	2.000E-5	2.000E-5	1.0000
Abiotic iron reduction using dissolved hydrogen gas	2.000E-5	2.000E-5	1.0000

Abiotic iron reduction using hydrogen sulfide	**2.000E-5**	**2.000E-5**	**1.0000**
Abiotic iron oxidation rate (aerobic)	**1.0000**	**1.0000**	**1.0000**

CEPT rates

Name	Default	Value	
HFO colloidal adsorption rate	**1.0000**	**1.0000**	**1.0000**
Residual Xsc for adsorption to HFO	**5.0000**	**5.0000**	**1.0000**
Slope for Xsc residual	**1.0000**	**1.0000**	**1.0000**
HAO colloidal adsorption rate	**1.0000**	**1.0000**	**1.0000**
Residual Xsc for adsorption to HAO	**5.0000**	**5.0000**	**1.0000**
Slope for Xsc residual	**1.0000**	**1.0000**	**1.0000**

Al rates

Name	Default	Value	
A in aging rate = A * exp(-G/B) [1/d)]	**16.1550**	**16.1550**	**1.0000**
B in aging rate = A * exp(-G/B) [1/s)]	**57.3000**	**57.3000**	**1.0000**
HAO(L) aging rate factor	**2.500E-4**	**2.500E-4**	**1.0000**
HAO(H) with H2PO4- bound aging factor []	**1.000E-5**	**1.000E-5**	**1.0000**
HAO(L) with H2PO4- bound aging factor []	**0.4000**	**0.4000**	**1.0000**
H2PO4- coprecipitation rate [mol/(L d)]	**1.500E-9**	**1.500E-9**	**1.0000**
H2PO4- Adsorption rate [mol /(L d)]	**1.000E-9**	**1.000E-9**	**1.0000**

Al constants

Name	Default	Value
Al active site factor(high) [{mol Sites}/{mol HAO(H)}]	3.0000	3.0000
Al active site factor(low) [{mol Sites}/{mol HAO(L)}]	1.5000	1.5000
Equilibrium constant for AlOH3-H2PO4- [{mf HAO(H).H2PO4}/({mol H2PO4-}{mf HAO(H)}^2)]	8.000E-10	8.000E-10
Colloidal COD removed with Al [gCOD/Al active site]	30.0000	30.0000
Minimum residual P level with Al addition [mgP/L]	0.0150	0.0150
HAO(H) with H2PO4- P release factor	10,000.0000	10,000.0000
HAO(L) with H2PO4- P release factor	10,000.0000	10,000.0000

Pipe and pump parameters

Name	Default	Value
Static head [ft]	0.8202	0.8202
Pipe length (headloss calc.s) [ft]	164.0420	164.0420
Pipe inside diameter [in]	19.68504	19.68504
K(fittings) - Total minor losses K	5.0000	5.0000
Pipe roughness [in]	0.00787	0.00787
'A' in overall pump efficiency = A + B*Q + C*(Q^2)[-]	0.8500	0.8500
'B' in overall pump efficiency = A + B*Q + C*(Q^2)[[-]/(mgd)]	0	0
'C' in overall pump efficiency = A + B*Q + C*(Q^2)[[-]/(mgd)^2]	0	0

Fittings and loss coefficients ('K' values)

Name	Default	Value
Pipe entrance (bellmouth)	0.0500	1.0000
90° bend	0.7500	5.0000
45° bend	0.3000	2.0000

Butterfly value (open)	**0.3000**	**1.0000**
Non-return value	**1.0000**	**0**
Outlet (bellmouth)	**0.2000**	**1.0000**

Aeration

Name	Default	Value
Surface pressure [kPa]	**101.3250**	**101.3250**
Fractional effective saturation depth (Fed) [-]	**0.3250**	**0.3250**
Supply gas CO2 content [vol. %]	**0.0400**	**0.0400**
Supply gas O2 [vol. %]	**20.9500**	**20.9500**
Off-gas CO2 [vol. %]	**2.0000**	**2.0000**
Off-gas O2 [vol. %]	**18.8000**	**18.8000**
Off-gas H2 [vol. %]	**0**	**0**
Off-gas NH3 [vol. %]	**0**	**0**
Off-gas CH4 [vol. %]	**0**	**0**
Off-gas N2O [vol. %]	**0**	**0**
Surface turbulence factor [-]	**2.0000**	**2.0000**
Set point controller gain []	**1.0000**	**1.0000**

MABR Membrane effective diffusivities

Name	Default	Value	
O2 [m2/s]	**2.500E-11**	**2.500E-9**	**1.0000**
N2 [m2/s]	**1.900E-11**	**1.900E-9**	**1.0000**
CO2 [m2/s]	**1.960E-11**	**1.960E-9**	**1.0000**
H2 [m2/s]	**5.850E-11**	**5.850E-9**	**1.0000**
CH4 [m2/s]	**1.963E-11**	**1.963E-9**	**1.0000**

NH3 [m2/s]	2.000E-11	2.000E-9	1.0000
N2O [m2/s]	1.607E-11	1.607E-9	1.0000
H2S [m2/s]	1.530E-11	1.530E-9	1.0000
Ind 1 [m2/s]	7.240E-12	7.240E-10	1.0000
Ind 2 [m2/s]	8.900E-12	8.900E-10	1.0000
Ind 3 [m2/s]	7.960E-12	7.960E-10	1.0000

MABR Membrane transfer factors

Name	Default	Value	
O2 []	1.0000	1.0000	1.0000
N2 []	1.0000	1.0000	1.0000
CO2 []	1.0000	1.0000	1.0000
H2 []	1.0000	1.0000	1.0000
CH4 []	1.0000	1.0000	1.0000
NH3 []	1.0000	1.0000	1.0000
N2O []	1.0000	1.0000	1.0000
H2S []	1.0000	1.0000	1.0000
Ind 1 []	1.0000	1.0000	1.0000
Ind 2 []	1.0000	1.0000	1.0000
Ind 3 []	1.0000	1.0000	1.0000

Blower

Name	Default	Value
Intake filter pressure drop [psi]	0.5076	0.5076
Pressure drop through distribution system (piping/valves) [psi]	0.4351	0.4351
Adiabatic/polytropic compression exponent (1.4 for adiabatic)	1.4000	1.4000

'A' in blower efficiency = A + B*Qa + C*(Qa^2)[-]	**0.7500**	**0.7500**
'B' in blower efficiency = A + B*Qa + C*(Qa^2)[[-]/(ft3/min (20C, 1 atm))]	**0**	**0**
'C' in blower efficiency = A + B*Qa + C*(Qa^2)[[-]/(ft3/min (20C, 1 atm))^2]	**0**	**0**

Diffuser

Name	Default	Value
k1 in C = k1(PC)^0.25 + k2	**1.2400**	**1.2400**
k2 in C = k1(PC)^0.25 + k2	**0.8960**	**0.8960**
Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	**0.8880**	**0.8880**
Area of one diffuser [ft2]	**0.4413**	**0.4413**
Diffuser mounting height [ft]	**0.8202**	**0.8202**
Min. air flow rate per diffuser ft3/min (20C, 1 atm)	**0.2943**	**0.2943**
Max. air flow rate per diffuser ft3/min (20C, 1 atm)	**5.8858**	**5.8858**
'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2 [psi]	**0.4351**	**0.4351**
'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[psi/(ft3/min (20C, 1 atm))]	**0**	**0**
'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[psi/(ft3/min (20C, 1 atm))^2]	**0**	**0**

Surface aerators

Name	Default	Value
Surface aerator Std. oxygen transfer rate [lb O /(hp hr)]	**2.46697**	**3.65000**

Modified Vesilind

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.387	0.355
Vesilind hindered zone settling parameter (K) [L/g]	0.370	0.482
Clarification switching function [mg/L]	100.000	100.000
Specified TSS conc.for height calc. [mg/L]	2,500.000	2,500.000
Maximum compactability constant [mg/L]	15,000.000	15,000.000
Maximum compactability slope [L/mg]	0.010	0.010

Double exponential

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.934	0.934
Maximum (practical) settling velocity (Vo') [ft/min]	0.615	0.615
Hindered zone settling parameter (Kh) [L/g]	0.400	0.400
Flocculent zone settling parameter (Kf) [L/g]	2.500	2.500
Maximum non-settleable TSS [mg/L]	20.0000	20.0000
Non-settleable fraction [-]	1.000E-3	1.000E-3
Specified TSS conc. for height calc. [mg/L]	2,500.0000	2,500.0000

Emission factors

Name	Default	Value
Carbon dioxide equivalence of nitrous oxide	296.0000	296.0000
Carbon dioxide equivalence of methane	23.0000	23.0000

Biofilm general

Name	Default	Value	
Attachment rate [g / (m2 d)]	8.0000	8.0000	1.0000
Attachment TSS half sat. [mg/L]	100.0000	100.0000	1.0000
Detachment rate [g/(m3 d)]	8,000.0000	8,000.0000	1.0000
Solids movement factor []	10.0000	10.0000	1.0000
Diffusion neta []	0.8000	0.8000	1.0000
Thin film limit [mm]	0.5000	0.5000	1.0000
Thick film limit [mm]	3.0000	3.0000	1.0000
Assumed Film thickness for tank volume correction (temp independent) [mm]	1.2500	1.2500	1.0000
Film surface area to media area ratio - Max.[ ]	1.0000	1.0000	1.0000
Minimum biofilm conc. for streamer formation [gTSS/m2]	4.0000	4.0000	1.0000

Maximum biofilm concentrations [mg/L]

Name	Default	Value	
Biomass - Ordinary heterotrophic	5.000E+4	5.000E+4	1.0000
Biomass - Methylotrophic	5.000E+4	5.000E+4	1.0000
Biomass - Ammonia oxidizing	1.000E+5	1.000E+5	1.0000
Biomass - Nitrite oxidizing	1.000E+5	1.000E+5	1.0000
Biomass - Anaerobic ammonia oxidizing	5.000E+4	5.000E+4	1.0000
Biomass - Phosphorus accumulating	5.000E+4	5.000E+4	1.0000
Biomass - Propionic acetogenic	5.000E+4	5.000E+4	1.0000
Biomass - Acetoclastic methanogenic	5.000E+4	5.000E+4	1.0000
Biomass - Hydrogenotrophic methanogenic	5.000E+4	5.000E+4	1.0000
Biomass - Endogenous products	3.000E+4	3.000E+4	1.0000
CODp - Slowly degradable particulate	5,000.0000	5,000.0000	1.0000
CODp - Slowly degradable colloidal	4,000.0000	4,000.0000	1.0000
CODp - Degradable external organics	5,000.0000	5,000.0000	1.0000
CODp - Undegradable non-cellulose	5,000.0000	5,000.0000	1.0000

CODp - Undegradable cellulose	**5,000.0000**	**5,000.0000**	**1.0000**
N - Particulate degradable organic	**0**	**0**	**1.0000**
P - Particulate degradable organic	**0**	**0**	**1.0000**
N - Particulate degradable external organics	**0**	**0**	**1.0000**
P - Particulate degradable external organics	**0**	**0**	**1.0000**
N - Particulate undegradable	**0**	**0**	**1.0000**
P - Particulate undegradable	**0**	**0**	**1.0000**
CODp - Stored PHA	**5,000.0000**	**5,000.0000**	**1.0000**
P - Releasable stored polyP	**1.150E+6**	**1.150E+6**	**1.0000**
P - Unreleasable stored polyP	**1.150E+6**	**1.150E+6**	**1.0000**
CODs - Complex readily degradable	**0**	**0**	**1.0000**
CODs - Acetate	**0**	**0**	**1.0000**
CODs - Propionate	**0**	**0**	**1.0000**
CODs - Methanol	**0**	**0**	**1.0000**
Gas - Dissolved hydrogen	**0**	**0**	**1.0000**
Gas - Dissolved methane	**0**	**0**	**1.0000**
N - Ammonia	**0**	**0**	**1.0000**
N - Soluble degradable organic	**0**	**0**	**1.0000**
Gas - Dissolved nitrous oxide	**0**	**0**	**1.0000**
N - Nitrite	**0**	**0**	**1.0000**
N - Nitrate	**0**	**0**	**1.0000**
Gas - Dissolved nitrogen	**0**	**0**	**1.0000**
P - Soluble phosphate	**0**	**0**	**1.0000**
CODs - Undegradable	**0**	**0**	**1.0000**
N - Soluble undegradable organic	**0**	**0**	**1.0000**
Influent inorganic suspended solids	**1.300E+6**	**1.300E+6**	**1.0000**
Precipitate - Struvite	**8.500E+5**	**8.500E+5**	**1.0000**
Precipitate - Brushite	**1.165E+6**	**1.165E+6**	**1.0000**
Precipitate - Hydroxy - apatite	**1.600E+6**	**1.600E+6**	**1.0000**
Precipitate - Vivianite	**1.340E+6**	**1.340E+6**	**1.0000**
HFO - High surface	**5.000E+4**	**5.000E+4**	**1.0000**

HFO - Low surface	**5.000E+4**	**5.000E+4**	**1.0000**
HFO - High with H2PO4- adsorbed	**5.000E+4**	**5.000E+4**	**1.0000**
HFO - Low with H2PO4- adsorbed	**5.000E+4**	**5.000E+4**	**1.0000**
HFO - Aged	**5.000E+4**	**5.000E+4**	**1.0000**
HFO - Low with H+ adsorbed	**5.000E+4**	**5.000E+4**	**1.0000**
HFO - High with H+ adsorbed	**5.000E+4**	**5.000E+4**	**1.0000**
HAO - High surface	**5.000E+4**	**5.000E+4**	**1.0000**
HAO - Low surface	**5.000E+4**	**5.000E+4**	**1.0000**
HAO - High with H2PO4- adsorbed	**5.000E+4**	**5.000E+4**	**1.0000**
HAO - Low with H2PO4- adsorbed	**5.000E+4**	**5.000E+4**	**1.0000**
HAO - Aged	**5.000E+4**	**5.000E+4**	**1.0000**
P - Bound on aged HMO	**5.000E+4**	**5.000E+4**	**1.0000**
Metal soluble - Magnesium	**0**	**0**	**1.0000**
Metal soluble - Calcium	**0**	**0**	**1.0000**
Metal soluble - Ferric	**0**	**0**	**1.0000**
Metal soluble - Ferrous	**0**	**0**	**1.0000**
Metal soluble - Aluminum	**0**	**0**	**1.0000**
Other Cations (strong bases)	**0**	**0**	**1.0000**
Other Anions (strong acids)	**0**	**0**	**1.0000**
Gas - Dissolved total CO2	**0**	**0**	**1.0000**
User defined - UD1	**0**	**0**	**1.0000**
User defined - UD2	**0**	**0**	**1.0000**
User defined - UD3	**5.000E+4**	**5.000E+4**	**1.0000**
User defined - UD4	**5.000E+4**	**5.000E+4**	**1.0000**
Biomass - Sulfur oxidizing	**1.000E+5**	**1.000E+5**	**1.0000**
Biomass - Sulfur reducing propionic acetogenic	**5.000E+4**	**5.000E+4**	**1.0000**
Biomass - Sulfur reducing acetotrophic	**5.000E+4**	**5.000E+4**	**1.0000**
Biomass - Sulfur reducing hydrogenotrophic	**1.000E+5**	**1.000E+5**	**1.0000**
Gas - Dissolved total sulfides	**0**	**0**	**1.0000**
S - Soluble sulfate	**0**	**0**	**1.0000**
S - Particulate elemental sulfur	**5.000E+4**	**5.000E+4**	**1.0000**

Precipitate - Ferrous sulfide	**5.000E+4**	**5.000E+4**	**1.0000**
CODp - Adsorbed hydrocarbon	**5.000E+4**	**5.000E+4**	**1.0000**
CODs - Degradable volatile ind. #1	**0**	**0**	**1.0000**
CODs - Degradable volatile ind. #2	**0**	**0**	**1.0000**
CODs - Degradable volatile ind. #3	**0**	**0**	**1.0000**
CODs - Soluble hydrocarbon	**0**	**0**	**1.0000**
Gas - Dissolved oxygen	**0**	**0**	**1.0000**

Effective diffusivities [m2/s]

Name	Default	Value	
Biomass - Ordinary heterotrophic	**5.000E-14**	**5.000E-14**	**1.0290**
Biomass - Methylotrophic	**5.000E-14**	**5.000E-14**	**1.0290**
Biomass - Ammonia oxidizing	**5.000E-14**	**5.000E-14**	**1.0290**
Biomass - Nitrite oxidizing	**5.000E-14**	**5.000E-14**	**1.0290**
Biomass - Anaerobic ammonia oxidizing	**5.000E-14**	**5.000E-14**	**1.0290**
Biomass - Phosphorus accumulating	**5.000E-14**	**5.000E-14**	**1.0290**
Biomass - Propionic acetogenic	**5.000E-14**	**5.000E-14**	**1.0290**
Biomass - Acetoclastic methanogenic	**5.000E-14**	**5.000E-14**	**1.0290**
Biomass - Hydrogenotrophic methanogenic	**5.000E-14**	**5.000E-14**	**1.0290**
Biomass - Endogenous products	**5.000E-14**	**5.000E-14**	**1.0290**
CODp - Slowly degradable particulate	**5.000E-14**	**5.000E-14**	**1.0290**
CODp - Slowly degradable colloidal	**5.000E-10**	**5.000E-10**	**1.0290**
CODp - Degradable external organics	**5.000E-14**	**5.000E-14**	**1.0290**
CODp - Undegradable non-cellulose	**5.000E-14**	**5.000E-14**	**1.0290**
CODp - Undegradable cellulose	**5.000E-14**	**5.000E-14**	**1.0290**
N - Particulate degradable organic	**5.000E-14**	**5.000E-14**	**1.0290**
P - Particulate degradable organic	**5.000E-14**	**5.000E-14**	**1.0290**
N - Particulate degradable external organics	**5.000E-14**	**5.000E-14**	**1.0290**
P - Particulate degradable external organics	**5.000E-14**	**5.000E-14**	**1.0290**

N - Particulate undegradable	**5.000E-14**	**5.000E-14**	**1.0290**
P - Particulate undegradable	**5.000E-14**	**5.000E-14**	**1.0290**
CODp - Stored PHA	**5.000E-14**	**5.000E-14**	**1.0290**
P - Releasable stored polyP	**5.000E-14**	**5.000E-14**	**1.0290**
P - Unreleasable stored polyP	**5.000E-14**	**5.000E-14**	**1.0290**
CODs - Complex readily degradable	**6.900E-10**	**6.900E-10**	**1.0290**
CODs - Acetate	**1.240E-9**	**1.240E-9**	**1.0290**
CODs - Propionate	**8.300E-10**	**8.300E-10**	**1.0290**
CODs - Methanol	**1.600E-9**	**1.600E-9**	**1.0290**
Gas - Dissolved hydrogen	**5.850E-9**	**5.850E-9**	**1.0290**
Gas - Dissolved methane	**1.963E-9**	**1.963E-9**	**1.0290**
N - Ammonia	**2.000E-9**	**2.000E-9**	**1.0290**
N - Soluble degradable organic	**1.370E-9**	**1.370E-9**	**1.0290**
Gas - Dissolved nitrous oxide	**1.607E-9**	**1.607E-9**	**1.0290**
N - Nitrite	**2.980E-9**	**2.980E-9**	**1.0290**
N - Nitrate	**2.980E-9**	**2.980E-9**	**1.0290**
Gas - Dissolved nitrogen	**1.900E-9**	**1.900E-9**	**1.0290**
P - Soluble phosphate	**2.000E-9**	**2.000E-9**	**1.0290**
CODs - Undegradable	**6.900E-10**	**6.900E-10**	**1.0290**
N - Soluble undegradable organic	**6.850E-10**	**6.850E-10**	**1.0290**
Influent inorganic suspended solids	**5.000E-14**	**5.000E-14**	**1.0290**
Precipitate - Struvite	**5.000E-14**	**5.000E-14**	**1.0290**
Precipitate - Brushite	**5.000E-14**	**5.000E-14**	**1.0290**
Precipitate - Hydroxy - apatite	**5.000E-14**	**5.000E-14**	**1.0290**
Precipitate - Vivianite	**5.000E-14**	**5.000E-14**	**1.0290**
HFO - High surface	**5.000E-14**	**5.000E-14**	**1.0290**
HFO - Low surface	**5.000E-14**	**5.000E-14**	**1.0290**
HFO - High with H2PO4- adsorbed	**5.000E-14**	**5.000E-14**	**1.0290**
HFO - Low with H2PO4- adsorbed	**5.000E-14**	**5.000E-14**	**1.0290**
HFO - Aged	**5.000E-14**	**5.000E-14**	**1.0290**
HFO - Low with H+ adsorbed	**5.000E-14**	**5.000E-14**	**1.0290**

HFO - High with H+ adsorbed	**5.000E-14**	**5.000E-14**	**1.0290**
HAO - High surface	**5.000E-14**	**5.000E-14**	**1.0290**
HAO - Low surface	**5.000E-14**	**5.000E-14**	**1.0290**
HAO - High with H2PO4- adsorbed	**5.000E-14**	**5.000E-14**	**1.0290**
HAO - Low with H2PO4- adsorbed	**5.000E-14**	**5.000E-14**	**1.0290**
HAO - Aged	**5.000E-14**	**5.000E-14**	**1.0290**
P - Bound on aged HMO	**5.000E-14**	**5.000E-14**	**1.0290**
Metal soluble - Magnesium	**7.200E-10**	**7.200E-10**	**1.0290**
Metal soluble - Calcium	**7.200E-10**	**7.200E-10**	**1.0290**
Metal soluble - Ferric	**4.800E-10**	**4.800E-10**	**1.0290**
Metal soluble - Ferrous	**4.800E-10**	**4.800E-10**	**1.0290**
Metal soluble - Aluminum	**4.800E-10**	**4.800E-10**	**1.0290**
Other Cations (strong bases)	**1.440E-9**	**1.440E-9**	**1.0290**
Other Anions (strong acids)	**1.440E-9**	**1.440E-9**	**1.0290**
Gas - Dissolved total CO2	**1.960E-9**	**1.960E-9**	**1.0290**
User defined - UD1	**6.900E-10**	**6.900E-10**	**1.0290**
User defined - UD2	**6.900E-10**	**6.900E-10**	**1.0290**
User defined - UD3	**5.000E-14**	**5.000E-14**	**1.0290**
User defined - UD4	**5.000E-14**	**5.000E-14**	**1.0290**
Biomass - Sulfur oxidizing	**5.000E-14**	**5.000E-14**	**1.0290**
Biomass - Sulfur reducing propionic acetogenic	**5.000E-14**	**5.000E-14**	**1.0290**
Biomass - Sulfur reducing acetotrophic	**5.000E-14**	**5.000E-14**	**1.0290**
Biomass - Sulfur reducing hydrogenotrophic	**5.000E-14**	**5.000E-14**	**1.0290**
Gas - Dissolved total sulfides	**1.530E-9**	**1.530E-9**	**1.0290**
S - Soluble sulfate	**2.130E-10**	**2.130E-10**	**1.0290**
S - Particulate elemental sulfur	**5.000E-14**	**5.000E-14**	**1.0290**
Precipitate - Ferrous sulfide	**5.000E-14**	**5.000E-14**	**1.0290**
CODp - Adsorbed hydrocarbon	**5.000E-14**	**5.000E-14**	**1.0290**
CODs - Degradable volatile ind. #1	**7.240E-10**	**7.240E-10**	**1.0290**
CODs - Degradable volatile ind. #2	**8.900E-10**	**8.900E-10**	**1.0290**
CODs - Degradable volatile ind. #3	**7.960E-10**	**7.960E-10**	**1.0290**

CODs - Soluble hydrocarbon	**7.120E-10**	**7.120E-10**	**1.0290**
Gas - Dissolved oxygen	**2.500E-9**	**2.500E-9**	**1.0290**

EPS Strength coefficients [ ]

Name	**Default**	**Value**	
Biomass - Ordinary heterotrophic	**1.0000**	**1.0000**	**1.0000**
Biomass - Methylotrophic	**1.0000**	**1.0000**	**1.0000**
Biomass - Ammonia oxidizing	**5.0000**	**5.0000**	**1.0000**
Biomass - Nitrite oxidizing	**25.0000**	**25.0000**	**1.0000**
Biomass - Anaerobic ammonia oxidizing	**10.0000**	**10.0000**	**1.0000**
Biomass - Phosphorus accumulating	**1.0000**	**1.0000**	**1.0000**
Biomass - Propionic acetogenic	**1.0000**	**1.0000**	**1.0000**
Biomass - Acetoclastic methanogenic	**1.0000**	**1.0000**	**1.0000**
Biomass - Hydrogenotrophic methanogenic	**1.0000**	**1.0000**	**1.0000**
Biomass - Endogenous products	**1.0000**	**1.0000**	**1.0000**
CODp - Slowly degradable particulate	**1.0000**	**1.0000**	**1.0000**
CODp - Slowly degradable colloidal	**1.0000**	**1.0000**	**1.0000**
CODp - Degradable external organics	**1.0000**	**1.0000**	**1.0000**
CODp - Undegradable non-cellulose	**1.0000**	**1.0000**	**1.0000**
CODp - Undegradable cellulose	**1.0000**	**1.0000**	**1.0000**
N - Particulate degradable organic	**1.0000**	**1.0000**	**1.0000**
P - Particulate degradable organic	**1.0000**	**1.0000**	**1.0000**
N - Particulate degradable external organics	**1.0000**	**1.0000**	**1.0000**
P - Particulate degradable external organics	**1.0000**	**1.0000**	**1.0000**
N - Particulate undegradable	**1.0000**	**1.0000**	**1.0000**
P - Particulate undegradable	**1.0000**	**1.0000**	**1.0000**
CODp - Stored PHA	**1.0000**	**1.0000**	**1.0000**
P - Releasable stored polyP	**1.0000**	**1.0000**	**1.0000**
P - Unreleasable stored polyP	**1.0000**	**1.0000**	**1.0000**

CODs - Complex readily degradable	**0**	**0**	**1.0000**
CODs - Acetate	**0**	**0**	**1.0000**
CODs - Propionate	**0**	**0**	**1.0000**
CODs - Methanol	**0**	**0**	**1.0000**
Gas - Dissolved hydrogen	**0**	**0**	**1.0000**
Gas - Dissolved methane	**0**	**0**	**1.0000**
N - Ammonia	**0**	**0**	**1.0000**
N - Soluble degradable organic	**0**	**0**	**1.0000**
Gas - Dissolved nitrous oxide	**0**	**0**	**1.0000**
N - Nitrite	**0**	**0**	**1.0000**
N - Nitrate	**0**	**0**	**1.0000**
Gas - Dissolved nitrogen	**0**	**0**	**1.0000**
P - Soluble phosphate	**0**	**0**	**1.0000**
CODs - Undegradable	**0**	**0**	**1.0000**
N - Soluble undegradable organic	**0**	**0**	**1.0000**
Influent inorganic suspended solids	**0.3300**	**0.3300**	**1.0000**
Precipitate - Struvite	**1.0000**	**1.0000**	**1.0000**
Precipitate - Brushite	**1.0000**	**1.0000**	**1.0000**
Precipitate - Hydroxy - apatite	**1.0000**	**1.0000**	**1.0000**
Precipitate - Vivianite	**1.0000**	**1.0000**	**1.0000**
HFO - High surface	**1.0000**	**1.0000**	**1.0000**
HFO - Low surface	**1.0000**	**1.0000**	**1.0000**
HFO - High with H2PO4- adsorbed	**1.0000**	**1.0000**	**1.0000**
HFO - Low with H2PO4- adsorbed	**1.0000**	**1.0000**	**1.0000**
HFO - Aged	**1.0000**	**1.0000**	**1.0000**
HFO - Low with H+ adsorbed	**1.0000**	**1.0000**	**1.0000**
HFO - High with H+ adsorbed	**1.0000**	**1.0000**	**1.0000**
HAO - High surface	**1.0000**	**1.0000**	**1.0000**
HAO - Low surface	**1.0000**	**1.0000**	**1.0000**
HAO - High with H2PO4- adsorbed	**1.0000**	**1.0000**	**1.0000**
HAO - Low with H2PO4- adsorbed	**1.0000**	**1.0000**	**1.0000**

HAO - Aged	**1.0000**	**1.0000**	**1.0000**
P - Bound on aged HMO	**1.0000**	**1.0000**	**1.0000**
Metal soluble - Magnesium	**0**	**0**	**1.0000**
Metal soluble - Calcium	**0**	**0**	**1.0000**
Metal soluble - Ferric	**0**	**0**	**1.0000**
Metal soluble - Ferrous	**0**	**0**	**1.0000**
Metal soluble - Aluminum	**0**	**0**	**1.0000**
Other Cations (strong bases)	**0**	**0**	**1.0000**
Other Anions (strong acids)	**0**	**0**	**1.0000**
Gas - Dissolved total CO2	**0**	**0**	**1.0000**
User defined - UD1	**0**	**0**	**1.0000**
User defined - UD2	**0**	**0**	**1.0000**
User defined - UD3	**1.0000**	**1.0000**	**1.0000**
User defined - UD4	**1.0000**	**1.0000**	**1.0000**
Biomass - Sulfur oxidizing	**1.0000**	**1.0000**	**1.0000**
Biomass - Sulfur reducing propionic acetogenic	**1.0000**	**1.0000**	**1.0000**
Biomass - Sulfur reducing acetotrophic	**1.0000**	**1.0000**	**1.0000**
Biomass - Sulfur reducing hydrogenotrophic	**1.0000**	**1.0000**	**1.0000**
Gas - Dissolved total sulfides	**0**	**0**	**1.0000**
S - Soluble sulfate	**0**	**0**	**1.0000**
S - Particulate elemental sulfur	**1.0000**	**1.0000**	**1.0000**
Precipitate - Ferrous sulfide	**1.0000**	**1.0000**	**1.0000**
CODp - Adsorbed hydrocarbon	**1.0000**	**1.0000**	**1.0000**
CODs - Degradable volatile ind. #1	**0**	**0**	**1.0000**
CODs - Degradable volatile ind. #2	**0**	**0**	**1.0000**
CODs - Degradable volatile ind. #3	**0**	**0**	**1.0000**
CODs - Soluble hydrocarbon	**0**	**0**	**1.0000**
Gas - Dissolved oxygen	**0**	**0**	**1.0000**

APPENDIX H:

OVIVO CARROUSEL MLE PRELIMINARY SIZING

MANATEE NWRF (10/28/22)

TN <10 mg/l

Max month loading in three trains. (3.1 MG aerobic, 0.58 MG anoxic each), each with 3 x 125 HP aerators.

- **Aerobic volume** – ample with 16 day SRT, 4000 mg/l MLSS.
- **HP required** is 778 HP (621 HP with denite credit). HP required is slightly higher than that shown above due to the longer SRT in three trains. With 3 x 125 HP per train, the installed HP would be ample at 1125 HP, with two installed spares. AOR/SOR as shown below. HP is also sufficient for peak day, described further below.

AOR NO DENITE CREDIT, lbs/day	45053
AOR WITH DENITE CREDIT, lbs/day	36210
SOR NO DENITE CREDIT, lbs/day	67102
SOR WITH DENITE CREDIT, lbs/day	54012

- **Anoxic volume** - sufficient. We estimate 7 mg/l SNDN (796 ppd), conservatively, and the anoxic zones can remove 2295 ppd. Internal Recycle required is 2.5Q, or 11.3 MGD per train (13.6 MGD X 2.5/3 basins=11.3 MGD per train).

Peak Day loading in three trains.

- **Aerobic volume** – sufficient. 11 d SRT, 4000 mg/l MLSS.
- **HP required** 901 HP (746 HP with denite credit). With 3 X 125 HP per train, or 1125 HP, which provides one spare aerator at that condition.

AOR NO DENITE CREDIT, lbs/day	50,328
AOR WITH DENITE CREDIT, lbs/day	41,930
SOR NO DENITE CREDIT, lbs/day	77,850
SOR WITH DENITE CREDIT, lbs/day	64,860

- **Anoxic volume**. Using existing 3 x 0.58 MG anoxic zones, volume is insufficient. Effluent nitrate-N estimated at 11 mg/l. Chemical addition will be required.

OVIVO
Worldwide Experts in Water Treatment

TN <3 mg/l

Max Month loading in three trains.

- **Aerobic volume** - ample with 16 day SRT, 4000 mg/l MLSS.
- **HP required** 778 (580 HP with denite credit – at TN of 3 we get a little more denite credit). With 3 x 125 HP per train, the installed HP would be ample at 1125 HP, with two installed spares. AOR/SOR as shown below.

AOR NO DENITE CREDIT, lbs/day	45053
AOR WITH DENITE CREDIT, lbs/day	33933
SOR NO DENITE CREDIT, lbs/day	67102
SOR WITH DENITE CREDIT, lbs/day	50615

- **Anoxic volume** options (for each option, we estimate that in-channel denitrification can remove at least 7 mg/l of NO3-N):
  - *Option 1: Keep existing first anoxic as is, assume 2.5Q internal recycle pump capacity is available (11.3 MGD per train). Add second anoxic zone of approximately 1.6 MG per train and reaeration zone of 0.142 MG per train. This is a Four-Stage Bardenpho System.®
  - *Option 2: Expand existing first anoxic zone by ~10’ of length, making each 0.695 MG (so adding 0.115 MG to each); add second anoxic zone of approximately 1.25 MG per train and reaeration zone of 0.142 MG per train. Add more internal recycle pump capacity: 4.6Q is required, or 21 MGD per train. Net result: 10% reduction in anoxic volume overall, but big jump in IR pump capacity. This is a Four-Stage Bardenpho System.®
  - Option 3: Use chemical carbon addition, either to the process, or downstream.

*For all options, provide option for carbon addition, either to the process or downstream. We recommend chemical polishing for any plant with permit limit for TN of 3 mg/l.

Peak Day loading in three trains.

- Similar to previous evaluation. Aerobic volume sufficient, HP sufficient, but anoxic volume insufficient. Chemical addition will be required.

One additional consideration at TN 10 mg/l:

Could two trains handle Max Month loadings? We don't recommend it for normal operation but with the third aerator added to each of the two existing trains and some anoxic modifications, the volumes appear sufficient.

- *Aerobic volume – sufficient with 10 day SRT, 4000 mg/l MLSS.*
- *HP required is 769 HP (613 HP with denite credit). If a third 125 HP unit is placed in each train, 750 HP would be available. Taking denite credit on the HP, the aerators would provide enough in theory. AOR/SOR shown below.*

AOR NO DENITE CREDIT, lbs/day	42464
AOR WITH DENITE CREDIT, lbs/day	34113
SOR NO DENITE CREDIT, lbs/day	66424
SOR WITH DENITE CREDIT, lbs/day	53360

- *Anoxic volume – the existing anoxic volume could be baffled into two cells and the improved kinetics plus some in-channel denite would remove the required nitrate.*

Average loadings could likely be managed in two trains for some time in an emergency.

APPENDIX I:

NRWRF HEADWORKS CONCEPTUAL CORROSION MITIGATION TM

McKIM&CREED
ENGINEERS SURVEYORS PLANNERS

1365 HAMLET AVENUE, CLEARWATER, FL 33756
TEL (727) 442-7196 ● FAX (727) 461-3827

TECHNICAL MEMORANDUM

TO: Manatee County Utilities

FROM: Neil Coffman, P.E. and Dan Keck, P.E., McKim & Creed

CC: Mike Nixon, P.E., McKim & Creed

DATE: March 31, 2023

RE: Manatee NRWRF Headworks & Splitter Box Conceptual Corrosion Mitigation and Rehab

INTRODUCTION & BACKGROUND

The Manatee County North Regional Water Reclamation Facility (NRWRF) is currently permitted for a three-month rolling average daily flow (TMRADF) of 7.5 MGD. As part of the CER, the capacity is expanding to 12.5 MGD annual average daily flow (AADF) with a resultant peak hour flow (PHF) of 31.25 MGD. Manatee County (County) contacted McKim & Creed and expressed a concern about ongoing corrosion at the NRWRF headworks and splitter box slide gates, which are exhibiting significant degradation of concrete behind the slide gate frame. The County also requested McKim & Creed to evaluate rehabilitation of the existing headworks and splitter box structure, including replacement of the screens and potential to add more trays to the existing HeadCell grit chambers. This evaluation includes a summary of the corrosion present at the headworks and splitter box zones, recommendations to remove the corrosion and restore the surfaces, phasing and scheduling considerations, and an opinion of the probable costs for the restoration.

AREAS OF CORROSION AT THE HEADWORKS

A site visit was held with County staff in August of 2022. Plant staff removed the channel covers and corrosion was observed at the slide gates and stop gates side slots. The gates themselves looked in acceptable condition, though. The corrosion was more apparent on the concrete behind and adjacent to the gate frames rather than on the gate frames themselves.

The main source of observed corrosion is believed due to microbiologically influenced corrosion (MIC) with hydrogen sulfide (H_2S) and sulfuric acid (H_2SO_4) being key byproducts. Dissolved sulfide is microbiologically converted from sulfur compounds in the wastewater under anaerobic conditions in the collection system. H_2S is stripped from dissolved sulfide in the liquid phase to the gaseous phase based on certain factors, such as wastewater pH (dissolved sulfides are more soluble in water at higher pH, higher pH = higher vapor phase H_2S), and dissolved sulfide concentration in the water (higher dissolved sulfide = higher vapor phase H_2S). Dissolved sulfide concentrations can vary widely in municipal wastewater and are based on the concentration of sulfur compounds in the potable water and infiltration and inflow, as well as physical and environmental conditions of the collection system. Detention time, temperature, dissolved oxygen, and other chemicals in the wastewater, such as nitrate, impact the rate of conversion to H_2S. H_2SO_4 is microbiologically formed and also naturally formed by dissolving in unbuffered condensate in the headspace of the headworks channels from H_2S and is highly corrosive to metals, concrete, etc. One way sulfide stripping is accelerated from liquid to gaseous phase is from water turbulence, which aggressively occurs at the discharge of the screen channels and also at the discharge from the grit chambers. **Figures 1 and 2** show the configuration of the headworks & splitter box and the elevation drops which result in turbulence. In addition, there is a concern that wastewater from Piney Point has accelerated the corrosion for two reasons, the corrosivity of the Piney Point wastewater and the County has suspended magnesium hydroxide dosing in the collection system to avoid struvite formation at the elevated pH with the high concentrations (over 300 mg/L TP) of phosphorus in the Piney Point wastewater. The suppressed pH of the influent wastewater to the headworks compared to typical operations in the collections system is presumed to have increased H_2S stripping in the headworks channels.

It is important to note that the wastewater channels have a protective liner that is mostly intact and effectively protecting the concrete structure. Corrosion appears to be localized to the areas where slide gates and stop log slots are installed. McKim & Creed believes that a significant contributor of the observed corrosion in these locations is that the protective coating applied to the concrete surface of the channels, was not applied underneath the slide gate frame and stop log slots, as these structures appear to have been cast into the walls during the construction. The coating was later applied and not designed to adhere to the stainless-steel gate frame and stop log slots, allowing corrosive gasses to penetrate the hairline crack between the stainless steel and concrete, and also behind/underneath the protective coating system adjacent to these structures. McKim & Creed recommends that future rehabilitation of these structures include proper protection of the concrete underneath the stainless-steel mountings to prevent similar occurrences of corrosion. **Figure 3** shows the slide gate where corrosion was observed at the headworks and one of the stop log slots where corrosion is also observed. **Figures 4** and **5** show field pictures of these observations. Corrosion in other parts of the headworks and splitter box channels, besides at the slide gate and stop log slots, is also possible. One area identified for further investigation during the design phase includes the HeadCell effluent channel which receives flow spilling over a weir and also receives a blend of returned activated sludge (RAS), the plant drain pump station line, and landfill leachate. These three flows combine into a common header line and are pumped into the south side of the HeadCell effluent common channel. **Photos 1 & 2** at the end of this technical memorandum show field pictures of the observed corrosion.

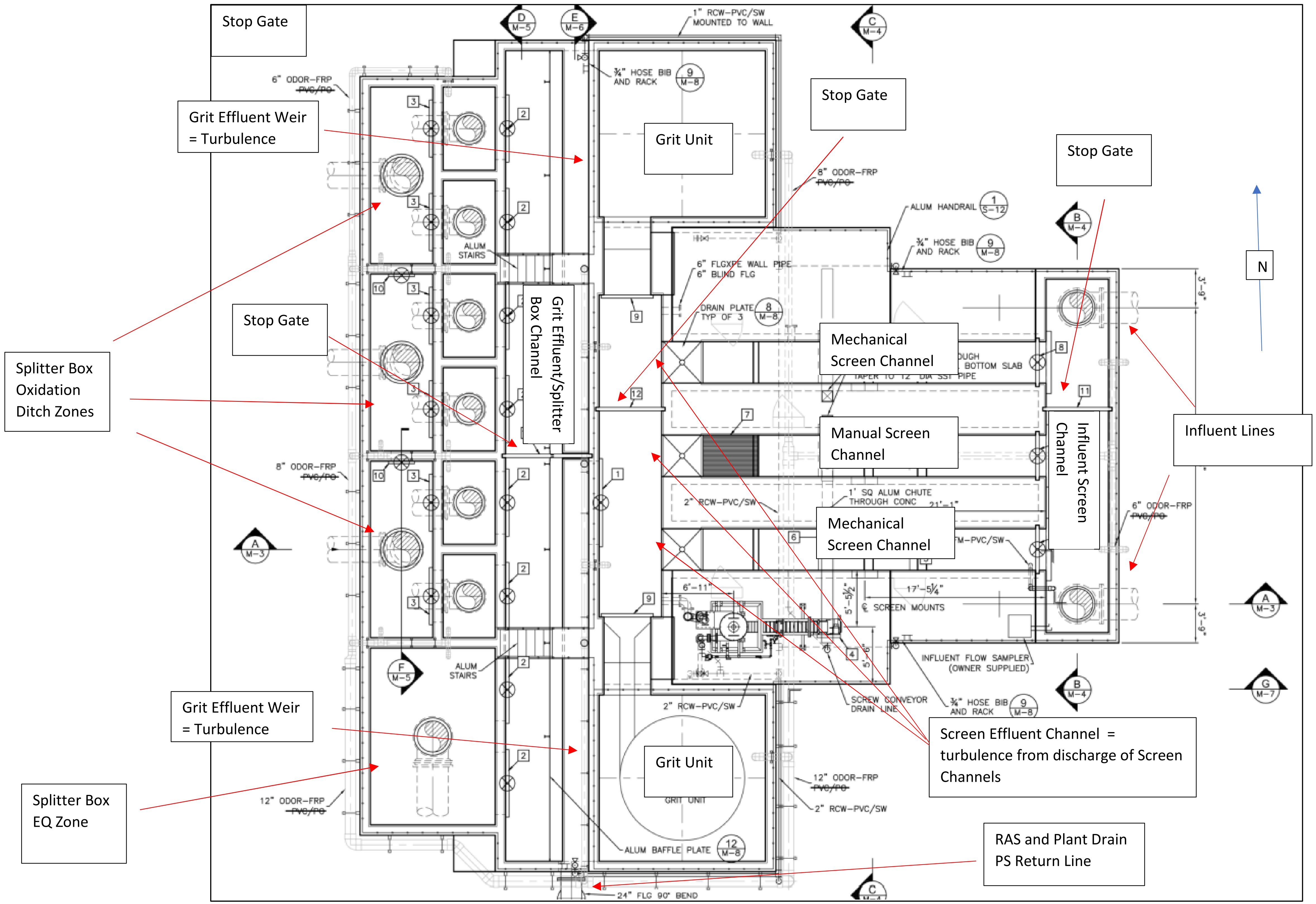


Figure 1: Manatee NRWRF Headworks & Splitter Box Layout Plan View

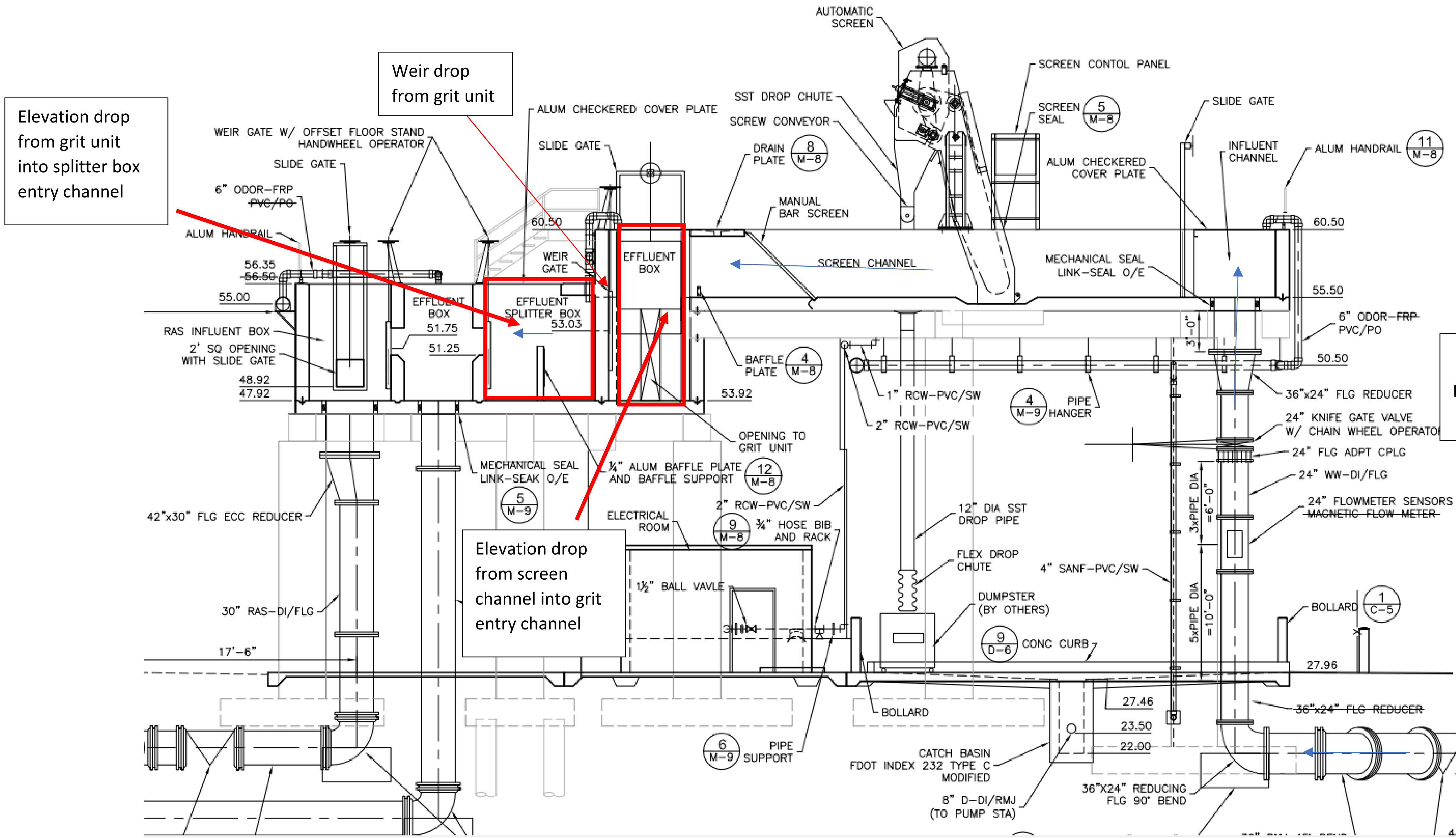


Figure 2: Manatee NRWRF Headworks & Splitter Box Layout Section View

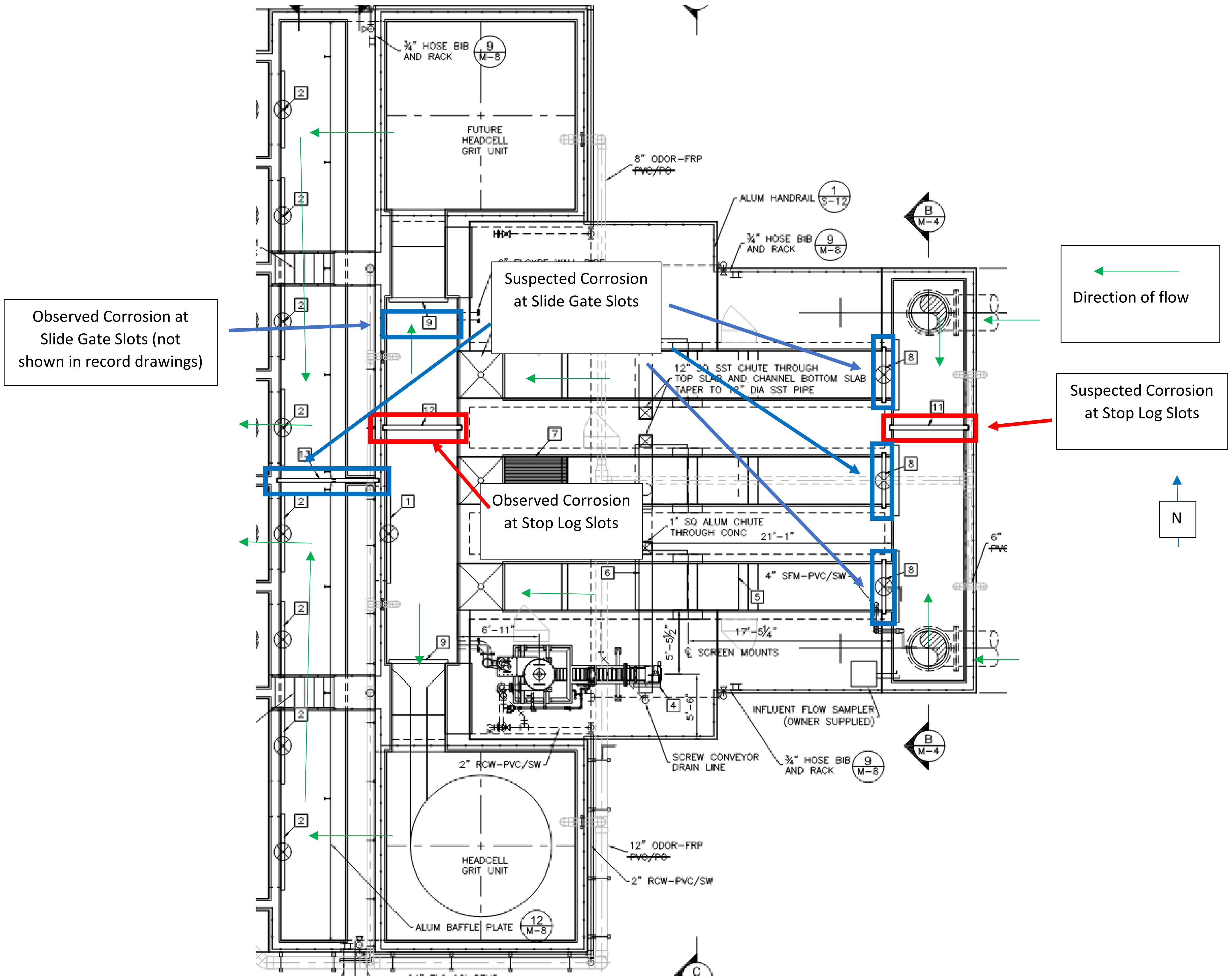


Figure 3: Areas of Observed/Suspected Corrosion at the Headworks Gates

Figure 4: Corrosion at Stop Log Slots Downstream of Screen Channels

Figure 5: Corrosion at Stop Plate

CORROSION MITIGATION EVALUATION

As seen in **Figures 1, 2**, and **3** there are influent pipes which feed into a header channel, smaller individual screening channels, and another header channel downstream of the individual channels. Changes in channel geometry, such as changes in channel width and sharp turns, increase turbulence, and that can increase the chances of H_2S stripping. Also, the elevation drops between channels and from the screens to the grit as well as water flowing over a weir can result in splashing and associated "air-stripping" that will exacerbate release of hydrogen sulfide.

As shown in **Figure 3**, two (2) 36" forcemains enter on the north and south sides of the influent channel. The influent channel can feed into one of three (3) channels – one of the duty mechanical screen channels or the manual screen channel. There is a manual stop gate in between the north duty screen channel and the manual screen channel. This stop gate has the ability to isolate flow into one of the duty screen channels or the manual screen channel. The individual screen channels enter into a header channel downstream which feeds one of the two grit units, and the flow can be isolated toward one of them via a stop gate similar to the influent channel. There are weir gates after the grit units which control the water levels upstream in the screen channels. **Table 1** shows a summary of the headworks/splitter box channel dimensions.

Table 1: Headworks & Splitter Box Channel Dimensions

Gate Channel	Length (ft)	Width (ft)	Height (ft)
Influent Screen Header	35	5	5
Duty Screen #1	35	4	5[1]
Duty Screen #2	35	4	5[1]
Manual Screen	35	4	5
Effluent Screen Header	35	5	5
Effluent Grit Header	78	8	5
Splitter Box Oxidation Ditch & EQ Tank Zones	17	6	5

[1]Channels are 6" deeper at mechanical screens

HEADWORKS INFLUENT FORCEMAINS

Prior to the headworks, there are two (2) influent forcemains which manifold into a single 48" header main. The 48" main then splits back into the two (2) influent 36" mains which were shown in **Figure 3**. There are plug valves on the forcemains prior to and after the 48" main to direct the influent flow to either the north or south side of the headworks influent channel. **Figure 6** shows the configuration for this.

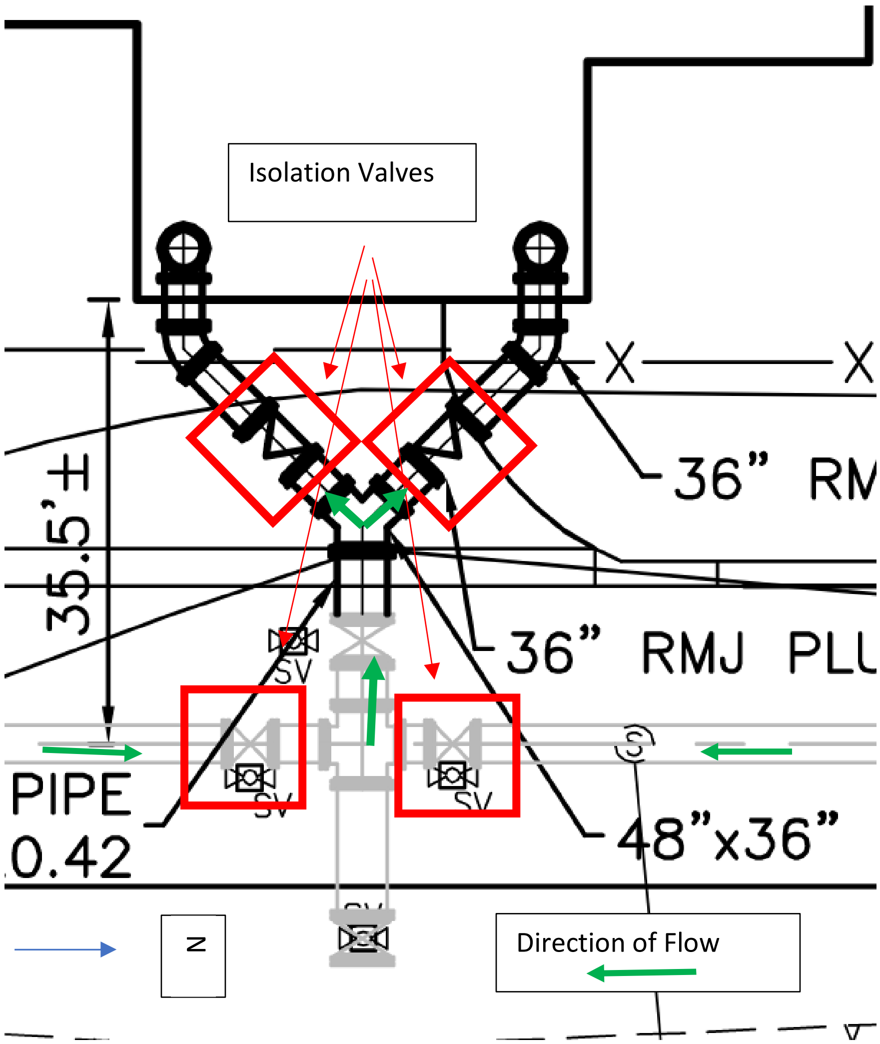


Figure 6: Headworks Influent Piping and Isolation Valves

Each individual 36” main after the 48” header is designed to handle a flow of 20 MGD, and the same applies to each screen channel and grit unit. The 48” header can also handle the combined 40 MGD.

CORROSION MITIGATION RECOMMENDATIONS

It is recommended to remove the gates and gate frames from the channels to gain access to the corroded areas, perform a detailed site evaluation to determine the extent of corrosion and limits of concrete restoration/recoating, remove the existing areas of damaged concrete coatings, and apply new coatings. The old coatings will be replaced with new County approved collection system coatings such as Green Monster. The detailed site evaluation may identify other areas of corrosion. **Figure 3** shows the areas where corrosion was observed/is suspected. Repairs to the concrete and rebar may also need to be performed. Some other options for reducing corrosion in the future are:

- Grouting the ramps in the screen influent and effluent channels

- Constructing fillets in the corners of the screen influent and effluent channels to reduce turbulence and improve conveyance (This option has been included in the cost estimate in **Table 2**).
- Sample and measure the H_2S concentrations at higher ventilation rates than the normal rate. Approximately 1.5 to 3 times the current ventilation rate should be tested for the resultant H_2S concentration.
  - Typical odor ventilation rates in headworks are 12 or more air changes per hour based on the volume of air to be removed.
  - It would need to be investigated to see if the existing odor control system can handle 1.5 – 3+ times the current ventilation rate. (The current odor control system airflow rate is unknown)
- Implementing chemical corrosion control for liquid phase treatment.
  - Magnesium hydroxide increases the pH of the influent wastewater and causes less H_2S stripping as a result due to the dissolved sulfides staying more in solution rather than stripping out at lower pH values.
  - The County had previously used magnesium hydroxide in the collection system and this reportedly has caused struvite precipitation issues, resulting in the cessation of magnesium hydroxide feed.
  - Identifying and implementing a liquid hydrogen sulfide control system as part of a comprehensive approach to reducing air phase hydrogen sulfide concentrations at the headworks will further reduce the potential for long term corrosion at the structure.

Of these options, constructing concrete fillets in the corners of the channels and increasing the odor control ventilation rate are the most cost-effective alternative to help reduce the corrosion. However, grouting the ramps is likely to have the least impact on hydrogen sulfide reduction. Liquid phase chemical corrosion control, while the most costly alternative, would be more effective in reducing the H_2S concentration in the headworks and extend its life expectancy.

CORROSION MITIGATION CONCEPTUAL PHASING PLAN

To mitigate the corrosion issues, the following steps should be taken.

1. Coordinate with County operational staff and provide at least 30 days' notice prior to taking any portion of the headworks offline.
2. Close the existing stop logs in the influent channel before the screens and effluent channel after the screens (shown in blue in **Figure 3**) to force flow into the north screen channel and north grit unit.
3. Close the south 36" influent plug valve after the 48" header to force flow into the north 36" influent line.
4. Drain the water out of the channels south of the existing stop logs, remove the existing slide gates, rehab the concrete in the existing screen and grit channels, apply new coatings in the channels and existing gate slots, and reinstall the existing slide gates into the existing gate slots.
5. Install new stop log slots and stop logs in the influent channel before the screens and effluent channel after the screens both south of existing stop logs (shown in red in **Figure 3**) to force flow into the south screen channel and south grit unit.

6. Close the existing stop logs and slide gates in the south screen and grit channels that have just been rehabbed to force flow through the south screen channels and south grit unit.
7. Close the north 36” influent plug valve after the 48” header to force flow into the south 36” influent line.
8. Drain the water out of the channels north of the existing stop gates, remove the existing slide gates, rehab the concrete in the existing screen and grit channels, apply new coatings in the channels and existing gate slots, and reinstall the existing slide gates into the existing gate slots.
9. Close the existing stop logs in the splitter box entry channel (shown in blue in **Figure 7**) to force flow south of it.
10. Send flow through the south screens and grit units to send flow south of the existing stop logs.
11. Drain the water out of the splitter box channels north of the existing stop logs, remove the existing slide gates, rehab the concrete in the existing splitter box channels, apply new coatings in the channels and existing gate slots, and reinstall the existing slide gates into the existing gate slots.
12. Remove the existing stairs on the north side of the splitter box.
13. Install new stop log slots and stop logs in the splitter box influent channel north of existing stop logs (shown in red in **Figure 7**) to force flow into north side of the splitter box channel.
14. Send flow through the north screens and grit units to send flow north of the new stop logs.
15. Drain the water out of the splitter box channels south of the new stop logs, remove the existing slide gates, rehab the concrete in the existing splitter box channels, apply new coatings in the channels and existing gate slots, and reinstall the existing slide gates into the existing gate slots.
16. Temporary stop plates can be installed and removed in the channels as needed during this mitigation process.

    At this point, the headworks and splitter box concrete, existing and new stop logs and stop log slots, existing slide gates and slide gate slots have been rehabbed and recoated (mitigated for corrosion). Next, remove the temporary stop plates and new stop logs installed during the mitigation process leaving the new stop log slots in place and keep the existing stop logs closed.
17. Open and close slide gates to their respective screen, grit, and splitter box channels to force flow to their desired operating screen, grit, and splitter box unit/zone.
18. Open/close the 36” lines according to which screen, grit, and splitter box unit/zone will be in service and resume normal operations.

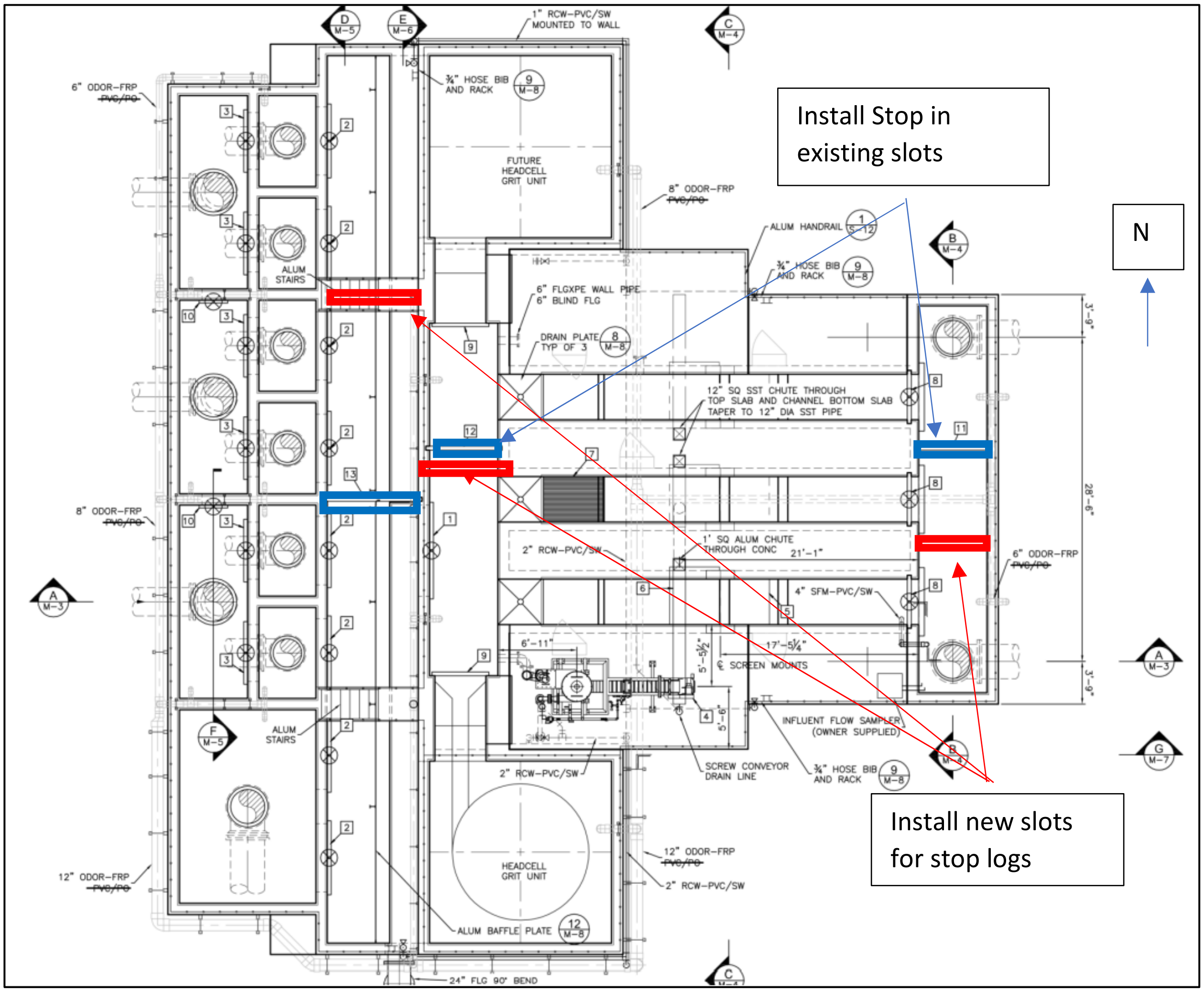


Figure 7: Locations for Additional Isolation in Headworks

This phasing plan allows for the plant to operate with one HeadCell and one mechanical bar screen in service eliminating the need to use the manual bar screen channel. A detailed risk and schedule evaluation should be performed to determine if feasible to remove the stop logs if peak flows are encountered during construction, or whether bypass pumping should be used to provide further assurances.

Corrosion Mitigation Schedule

- Mobilization = 30 days
- Isolate flow to run flow through north screen channel
  - Install temporary stop gate slots in headworks influent & effluent header channels and splitter box entry channel = 5 days per channel
  - 15 days total
- Remove existing gates, clean/recoat existing concrete by gate frames, & reinstall gate for each channel = 3 weeks per channel (per TNEMEC)
  - Total = 30 weeks total, 5 days/week (150 days)

- Demobilize = 5 days
- Total = 40 weeks, 5 days/week
    - 200 days total

CORROSION MITIGATION ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COSTS

Table 2 shows a conceptual breakdown of the estimated costs for this work.

Table 2: Corrosion Cost Breakdown

Item	Description	Unit	QTY	Unit Price	Total
1	Demo & Restoration	LS	1	$10,000	$10,000
2	Mobilization & Demobilization	LS	1	$43,000	$43,000
3	5' W x 5' H Stop Plate Installation & Removal	EA	1	$21,000	$21,000
4	8' W x 5' H Stop Plate Removal & Reinstallation	EA	1	$1,000	$1,000
5	5' W x 5' H Stop Plate Removal & Reinstallation	EA	1	$1,000	$1,000
6	Temporary 5' W x 5' H Aluminum Plate Installation & Removal	EA	3	$1,000	$3,000
7	Temporary 4' W x 5' H Aluminum Plate Installation & Removal	EA	3	$1,000	$3,000
8	Temporary 8' W x 5' H Aluminum Plate Installation & Removal	EA	2	$1,000	$2,000
9	Temporary 8' W x 8' H Aluminum Plate Installation & Removal	EA	4	$1,000	$4,000
10	Channel Isolation	DAY	200	$1,000	$200,000
11	By-Pass Pumping	DAY	200	$1,200	$240,000
12	Concrete Repair & Coating by Gates	CY	75	$1,900	$142,500
13	Protective Coating	SF	8,000	$25	$200,000
14	Concrete Fillets by Influent and Effluent Screen & Grit Channels & Splitter Box Channels	CY	15	$1,900	$28,500
15	Maintenance of Plant Operations (2 Operators)	HR	2,560	$30	$76,800
				Subtotal	**$975,800**
				Contingency (30%)	**$292,740**
				Total (Rounded)	**$1,268,500**

As can be seen from **Table 2**, rehabbing/mitigating the existing headworks from corrosion due to H_2S is approximately $1.3M. By-pass pumping should not be required for this, but it is included in **Table 2** in case it is necessary. Possible upgrades to the existing odor control system may be needed but is undetermined at this stage. Further modifications and costs for rehabbing the existing headworks and splitter box structure and equipment was investigated.

SCREENING AND GRIT REMOVAL IMPROVEMENTS

In addition to what is shown in **Table 2**, there are some additional improvements to the headworks that are needed based on increasing the flow to the headworks from 7.5 to 12.5 MGD AADF and 31.25 MGD PHF. This evaluation is based on matching the existing design capacity of the headworks at 40 MGD. In preliminary design the design capacity should be agreed upon between the expansion PHF 31.25 MGD, 40 MGD current capacity, or another flow capacity.

1. The two (2) grit units (HeadCell units) use trays to obtain grit removal. The current grit units have 8 trays installed, and they are designed to have up to 12 trays total. The additional 4 trays need to be installed as part of the expansion to the existing headworks capacity of 40 MGD PHF.
2. There are currently two (2) band screens installed in the duty screen channels and one (1) manual screen in the bypass screen channel. Ragging has been a maintenance and plant performance problem for the internal recycle pumps and plugging in clarifier withdraw and underflow pumping. The County wants to convert to center flow fine screens similar to the Hydro-Dyne screens recently commissioned at the Manatee County Southwest Water Reclamation Facility (SWWRF). These types of screens have zero carryover and would resolve downstream ragging problems. Therefore, the Hydro-Dyne screens will need to be retrofitted into the existing screen channels including the by-pass channel. That is three (3) new screens in total.
3. Structural modifications need to be made to the existing screen channels to retrofit these new screens into the existing screen channels.

NEW CENTER FLOW FINE SCREENS IN THE EXISTING SCREEN CHANNELS

As mentioned previously, the County wants the existing screens (Parkson band screens) to be replaced with center flow fine screens by Hydro-Dyne or equal, similar to the SWWRF plant. As shown in **Table 1**, the existing screen channels are 35’ long, 4’ wide, and 5’ deep, and the side water depth is 4’ at 20 MGD leaving 1’ of freeboard. The center flow screens should also be sized for a flow of 20 MGD each, similar to the existing screens. When discussing the screens with Hydro-Dyne, they recommended modifying the channel width around the screen from the existing 4’ to 6’ to allow flow to exit the screen from both sides similar what is shown in **Figure 8**.

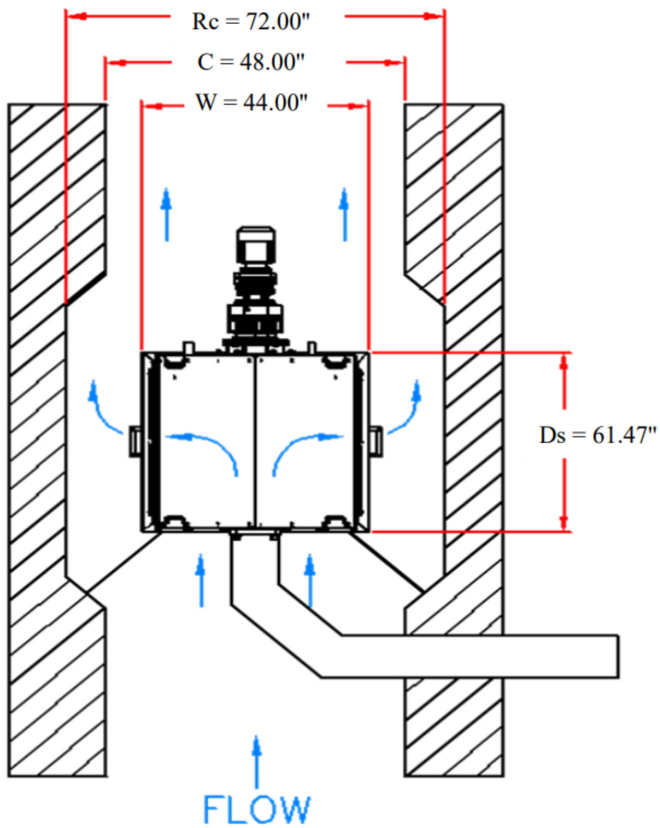


Figure 8: Recommended Hydro-Dyne Screen and Bump-out Dimensions

As can be seen in **Figure 8**, the channel width offsets the existing screen channel by 1’ on each side to allow the water to exit the screen on both sides before reducing back down to 4’ (resembling the existing channel) after the screen. Therefore, the existing screen channels would need to be modified structurally to provide this width. The structural sheet in **Figure 9** shows there is enough room on each side of the screen (5’) to increase the channel width by 1’ on each side.

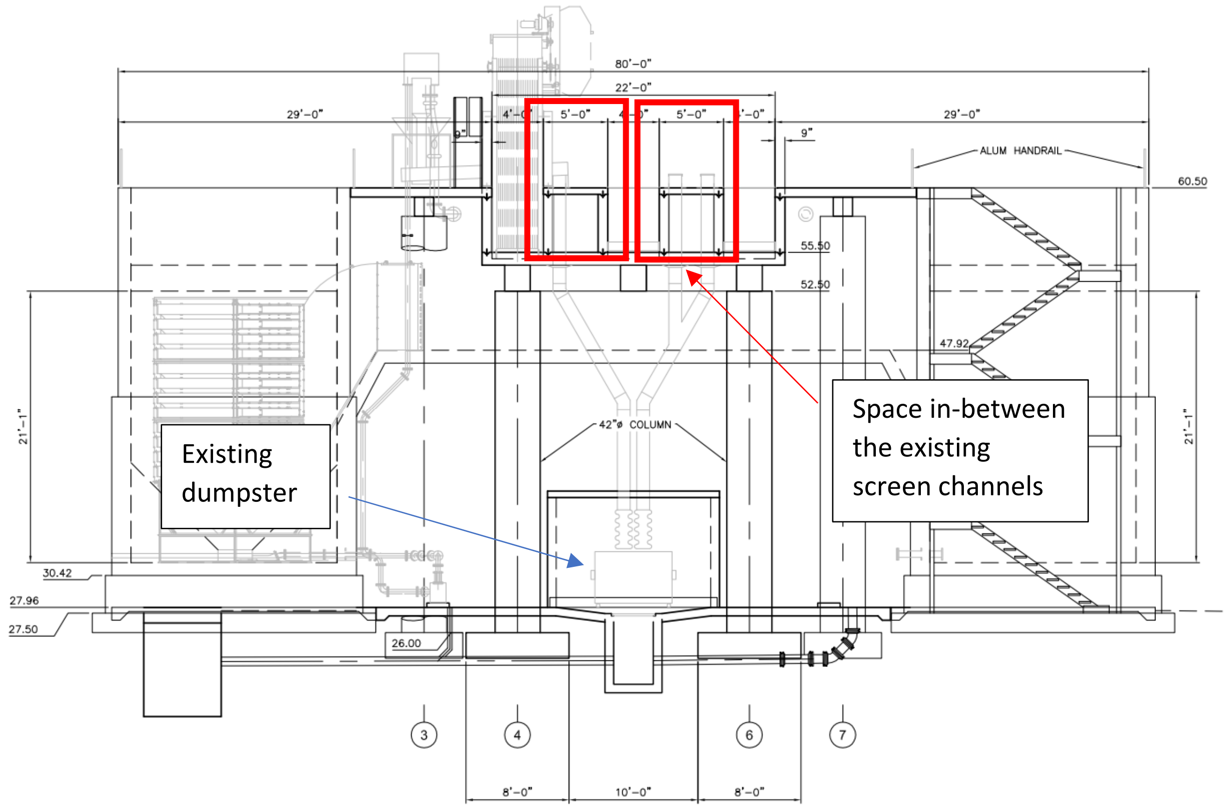


Figure 9: Space In-Between Screen Channels

As shown in **Figure 9**, there is 5' of space in-between screen channels. This would reduce down to 3' in-between channels if the screens are all in-line (symmetric) with each other and 4' if the screens are staggered. Hydro-Dyne indicated that the middle screen would make the most sense to stagger than the two (2) outer ones, and that would not hurt plant hydraulics (cause excess headloss) either.

Besides the screens themselves, washer compactors are needed to dispose the screenings on the top floor into the dumpster below on the first floor as seen in **Figure 7**. Due to the limited footprint at the existing headworks structure, a similar washer compactor layout concept at SWWRF is recommended at this headworks. **Figure 10** shows this concept.

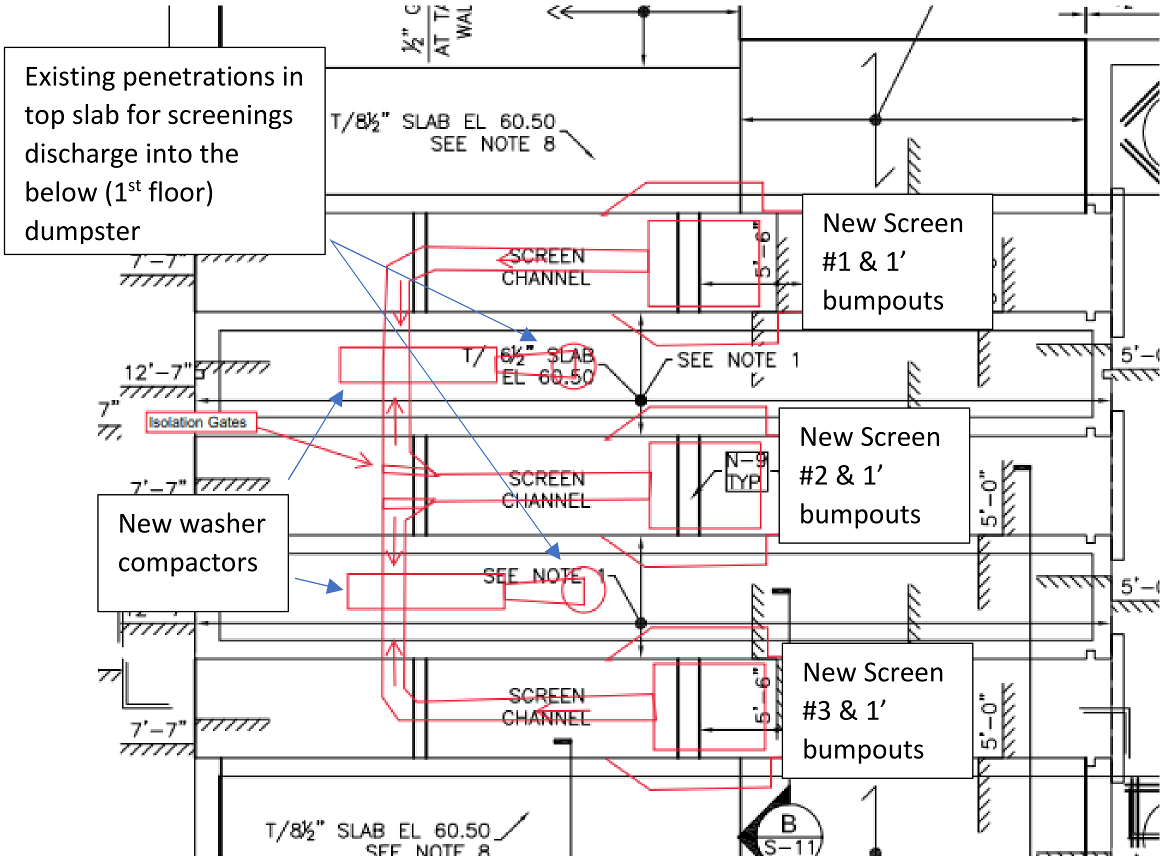


Figure 10: Recommended Washer Compactor Layout

As shown in **Figure 10**, there are two washer compactors for the three screens. Each washer compactor is sized for the screenings of two (2) screens. Screens 1 & 3 would discharge their screenings to the nearest washer compactor, and screen 2 would have the ability to discharge into either washer compactor via the isolation gates as the troughs leading up to the washer compactors are sloped towards them. The compacted screens would then discharge through the existing floor openings into the dumpster below the screens. If screen #2 is staggered, the trough before the isolation gates would just be longer/shorter depending on its positioning. By-pass pumping of the screens would not be needed as all the flow can be pushed through one of the existing screens during construction of the first two new screens and washer compactors and then sent to one of the new screens while the last new screen is installed. The last new screen washer compactor trough can then connect to the already installed washer compactor as screen #2 has the ability to send its screenings to either washer compactor.

With the new screens, the channel widths around them would need to be increased from 4' to 6'. This will involve structural modifications/rehab to the existing screen channels.

MODIFICATIONS TO THE EXISTING GRIT UNITS

As mentioned previously, the two (2) existing grit units need to have the remaining four (4) tray units installed in both units. The existing trays are made of high-density polyethylene (HDPE), and the new trays (which will be installed above the existing ones) will also be made of HDPE. After each grit unit is drained, taken out of service, and cleaned in sequences, the manufacturer (Hydro International) will lower the new HDPE trays into the existing grit units via the entry duct and anchor the new trays to the existing units. After installing the new trays, each unit should be cleaned again via plant water prior to putting them back into service. Hydro International indicated that the existing grit units should be in good operating shape and not have to be replaced as their life expectancy exceeds 23 years (their oldest installed unit), but they provided budgetary pricing in case inspection determines replacement is recommended.

STRUCTURAL MODIFICATIONS TO THE EXISTING SCREEN CHANNELS

As mentioned previously, the screen channel widths need to be increased around the new screens by 1' on each side to resemble what is shown in **Figure 8** and **Figure 10**. In doing so, the existing concrete around the new screens and rebar will need to be cut out and repoured around the screens (before and after the screens) to give 1' of buffer on each side of the screens. In order to connect new rebar to the existing concrete, holes for doweling rebar will need to be drilled into the existing concrete walls. From there, the new rebar can be laid out around the screens, and new concrete can be poured to form the new walls. The existing screen walls are about 1' thick and 5' tall.

One more structural recommendation, as previously mentioned, would be to stagger the screens. Staggering the new screen #2 would be more constructible than having it symmetric with screens #1 and #3. Also, staggering screen #2 would provide more space in-between channels (4' vs. 3'), which is better structurally. In addition to that, the same penetrations through the top floor for the washer compactors discharge into the dumpsters will be utilized rather than creating new penetrations. The current penetrations are 12" in diameter, and Hydro-Dyne recommends increasing them (making them wider to 24" or 36" diameter) to increase the capacity of the washer compactors discharge. The County would also need a bigger dumpster due to the higher screenings and grit loadings. A 30 cubic yard (yd^3) dumpster would be the optimal dumpster size which would give 1 – 2 days of screening and grit capacity before needing to be hauled away to a landfill. These structural modifications have been included in the rehab costs in **Table 3**.

COST FOR MODIFICATIONS TO THE EXISTING HEADWORKS/FLOW SPLITTER BOX

Table 3 shows a breakdown of the approximate costs associated with modifications/rehab to the existing headworks and splitter box structure. By-pass pumping should not be required for this, but it is included in **Table 3** in case it is necessary.

Table 3: Headworks and Splitter Box Modifications Cost Separate from Corrosion Mitigation

Item	Description	Unit	QTY	Unit Price	Total
1	Demo & Restoration	LS	1	$10,000	$10,000
2	Mobilization & Demobilization	LS	1	$213,500	$213,500
3	5' W x 5' H Stop Plate Installation & Removal	EA	2	$21,000	$42,000
4	8' W x 5' H Stop Plate Removal & Reinstallation	EA	1	$1,000	$1,000
5	5' W x 5' H Stop Plate Removal & Reinstallation	EA	1	$1,000	$1,000

6	Temporary 5' W x 5' H Aluminum Plate Installation & Removal	EA	3	$1,000	$3,000
7	Temporary 4' W x 5' H Aluminum Plate Installation & Removal	EA	3	$1,000	$3,000
8	Temporary 8’ W x 5’ H Aluminum Plate Installation & Removal	EA	2	$1,000	$2,000
9	Temporary 8’ W x 8’ H Aluminum Plate Installation & Removal	EA	4	$1,000	$4,000
10	Channel Isolation	DAY	50	$1,000	$50,000
11	By-Pass Pumping	DAY	50	$1,200	$60,000
12	Cutting Concrete for Screen Bumpouts	CY	15	$1,500	$22,500
13	Pouring New Concrete for Screen Bumpouts	CY	15	$1,900	$28,500
14	New Screens and Washer Compactors	LS	1	$1,750,000	$1,750,000
15	New Screens and Washer Compactors Installation	LS	1	$700,000	$700,000
16	Headworks Plant Water Booster Pumps	EA	2	$6,000	$12,000
17	Headworks Plant Water 4” PVC Piping, Valves, & Fittings	LF	500	$40	$20,000
18	Installing New Trays in Grit Units	EA	2	$50,000	$100,000
19	30 CY Dumpster	EA	2	$1,150	$2,300
20	Electrical (25%)	LS	1	$725,000	$725,000
21	Instrumentation & SCADA (25%)	LS	1	$725,000	$725,000
22	Maintenance of Plant Operations (2 Operators)	HR	800	$30	$24,000
				Subtotal	**$4,498,800**
				Contingency (30%)	**$1,349,640**
				Total (Rounded)	**$5,848,500**

When adding the costs from **Table 3** with the corrosion mitigation cost from **Table 2**, the total costs for rehabbing the existing headworks and splitter box structures and equipment are approximately $7.1M. If the County decided to replace the existing grit units, which is not necessary at this time according to Hydro International, the additional cost would be $3M.

APPROXIMATE COST OF NEW HEADWORKS AND FLOW SPLITTER BOX

As an alternative, McKim & Creek evaluated the improvements described above comparing them to a scenario in which an entirely new headworks would be built. The purpose is to determine whether the rehabilitation approach is cost effective. Using recent headworks projects from similarly sized headworks and extrapolating to match the conditions for the NRWRF headworks, **Table 4** shows an opinion of approximate cost to demo the existing headworks and build a new headworks structure with all the associated new equipment.

Table 4: New Headworks and Flow Splitter Box

Item	Description	Unit	QTY	Unit Price	Total
1	Demo of Existing Headworks and Splitter Box & Restoration	LS	1	$285,000	$285,000
2	Mobilization & Demobilization	LS	1	$933,000	$933,000
3	Sitework, Piping and Valves	LS	1	$3,000,000	$3,000,000
4	Headworks Process Equipment	LS	1	$5,700,000	$5,700,000
5	Structures, Buildings and Concrete Pads	LS	1	$5,631,500	$5,631,500
6	Electrical, Power & Grounding	LS	1	$2,000,000	$2,000,000
7	Instrumentation & SCADA	LS	1	$875,000	$875,000
8	HVAC	LS	1	$60,000	$60,000
9	Odor Control	LS	1	$1,100,000	$1,100,000
10	30 CY Dumpster	EA	2	$1,150	$2,300
				Subtotal	**$19,586,800**
				Contingency (30%)	**$5,876,040**
				Total (Rounded)	**$25,462,840**

As can be seen from **Table 4**, the estimated cost for a new headworks and splitter box structure is approximately $25.5M. Comparing to the cost of rehabilitating the existing structure (which is approximately 13 years old) to constructing a new structure, that is a difference of approximately $18.4M.

Here are some pros and cons of rehabilitating the existing headworks/splitter box structure compared to building a new structure:

Pros:

- It will cost about $18.4M less to rehab the existing structure than to build a new structure.
- Rehabilitation will take less time that constructing new.
- There will be less footprint consumed by the existing structure than a new structure.
- The existing structure, piping, and equipment will be up to date, recoated with new anticorrosion coatings, and operate the same as a new structure other than existing wear and tear on the existing structure. This will increase its lifespan.
- A new structure will also require rehab and updates to its equipment over time similar to the existing structure due to corrosion.
- The rehabbed structure, similar to a new structure, will also have three (3) mechanical screens rather than two (2) mechanical screens and one (1) manual screen.

Cons:

- The existing headworks structure is a bit tight on space/footprint which makes the sluice system for the screen washer compactors more complex than it would be if the footprint were wider with a new headworks.
- Similar corrosion issues may still occur over time even after rehabbing/recoating the existing structure due to potentially not applying the coatings correctly.
- Rehabbing the existing structure will take time (approximately 9 months or more) and will involve isolating different portions of screens, grit, and splitter box in sequences in order to rehab each portion and keep the existing structure in service without the need for bypass pumping.
- Bypass pumping may still be necessary even though it is not listed in either **Table 2** or **Table 3**. Bypass pumping should not be required based on the procedure listed in conceptual phasing plan section.

Based on what was previously mentioned in the prior sections and the pros and cons above, especially cost, it is recommended to rehabilitate the existing headworks and splitter box structure and equipment rather than build a new structure with new equipment.

APPENDIX J:

VISUAL HYDRAULICS MODEL REPORT OUTPUT – 12.5 MGD WITH MLE AND AGS PHF

Visual Hydraulics Summary Report - Hydraulic Analysis

Project: **NRWRF Expansion to 12.5 MGD_12.5 MLE AGS PHF 2023-02-28.vhf**
Company: **McKim & Creed**
Date: **February 28, 2023**

Current flow conditions

Forward Flow =	31.25 mgd
Return I Flow =	9.38 mgd
Return II Flow =	12 mgd
Return III Flow =	-----

Section Description	Water Surface Elevation
CCC1 Train 2 Effluent Cipolletti Weir	**29.43**
CCC2 NORTH Effluent Cipolletti Weir	**25.21**
CCC2 SOUTH Effluent Cipolletti Weir	**25.22**
CCC1 Train 1 Effluent Cipolletti Weir	**28.75**
CCC1 Slide Gate #2	**29.45**

Opening type = rectangular gate
Opening diameter/width = 72 in
Gate height = 72 in
Invert = 25.75
Number of gates = 1
Flow through gate(s) = 7.812 mgd
Total area of opening(s) = 36 ft^2
Velocity through gate(s) = 0.34 ft/s

CCC2 Influent Slide Gate 1 — **29.45**

Opening type = rectangular gate
Opening diameter/width = 72 in
Gate height = 64 in
Invert = 25.81
Number of gates = 1
Flow through gate(s) = 7.812 mgd
Total area of opening(s) = 32 ft^2
Velocity through gate(s) = 0.38 ft/s

CCC2 Influent Slide Gate 2 — **29.45**

Section Description	Water Surface Elevation
Opening type = rectangular gate	
Opening diameter/width = 72 in	
Gate height = 64 in	
Invert = 25.81	
Number of gates = 1	
Flow through gate(s) = 7.812 mgd	
Total area of opening(s) = 32 ft^2	
Velocity through gate(s) = 0.38 ft/s	
CCC2 Influent Chamber	**29.45**
User defined loss for flow split = 0 ft	
Total flow through flow split = 15.625 mgd	
Pipe - tee to CCC2	**29.58**
Pipe shape = Circular	
Diameter = 42 in	
Length = 10 ft	
Flow = 15.625 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.3	
Pipe area = 9.62 ft²	
Pipe hydraulic radius = 0.875	
Age factor = 1	
Solids factor = 1	
Velocity = 2.51 ft/s	
Friction loss = 0.01 ft	
Fitting loss = 0.13 ft	
Total loss = 0.13 ft	
Tee connecting AquaDiamond Filters to Disk Filters Eff	
CCC1 Slide Gate #1	**29.45**
Opening type = rectangular gate	
Opening diameter/width = 72 in	
Gate height = 72 in	
Invert = 25.75	
Number of gates = 1	
Flow through gate(s) = 7.812 mgd	
Total area of opening(s) = 36 ft^2	
Velocity through gate(s) = 0.34 ft/s	
CCC1 Influent Chamber	**29.45**
User defined loss for flow split = 0 ft	
Total flow through flow split = 15.625 mgd	
Filters to CCC1 after Wye	**29.74**
Pipe shape = Circular	

Section Description	Water Surface Elevation

Diameter = 42 in
Length = 60 ft
Flow = 15.625 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 2.65
Pipe area = 9.62 ft²
Pipe hydraulic radius = 0.875
Age factor = 1
Solids factor = 1
Velocity = 2.51 ft/s
Friction loss = 0.03 ft
Fitting loss = 0.26 ft
Total loss = 0.29 ft

Wye to CCCs — **29.74**

User defined loss for flow split = 0 ft
Total flow through flow split = 15.625 mgd

AquaDiamond Filters to CCC Pipe 1 — **30.05**

Pipe shape = Circular
Diameter = 42 in
Length = 167 ft
Flow = 15.625 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 2.18
Pipe area = 9.62 ft²
Pipe hydraulic radius = 0.875
Age factor = 1
Solids factor = 1
Velocity = 2.51 ft/s
Friction loss = 0.09 ft
Fitting loss = 0.21 ft
Total loss = 0.31 ft

AquaDiamond Filters to Disk Filters Eff Pipe — **30.05**

User defined loss for flow split = 0 ft
Total flow through flow split = 21.75 mgd

AquaDiamond Filters Common Eff. Channel — **30.07**

Channel shape = Rectangular
Manning's 'n' = 0.012
Channel length = 47 ft
Channel width/diameter = 3 ft
Flow = 21.75 mgd
Downstream channel invert = 26

Section Description	**Water Surface Elevation**
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 12.18 ft^2	
Hydraulic radius = 1.095	
Normal depth = infinite	
Critical depth = 1.57 ft	
Depth downstream = 4.05 ft	
Bend loss = 0 ft	
Depth upstream = 4.07 ft	
Velocity = 2.77 ft/s	
Flow profile = Horizontal	
Disk Filters to CCCs	**29.92**
Pipe shape = Circular	
Diameter = 42 in	
Length = 132 ft	
Flow = 15.625 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.66	
Pipe area = 9.62 ft²	
Pipe hydraulic radius = 0.875	
Age factor = 1	
Solids factor = 1	
Velocity = 2.51 ft/s	
Friction loss = 0.07 ft	
Fitting loss = 0.26 ft	
Total loss = 0.33 ft	
Pipe - Disk Filters to Wye	**29.58**
Pipe shape = Circular	
Diameter = 36 in	
Length = 30 ft	
Flow = 0 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 0	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 0 ft/s	
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
Disk Filters Effluent Pipe	**30**

Section Description	Water Surface Elevation

Pipe shape = Circular
Diameter = 36 in
Length = 72 ft
Flow = 9.5 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 0.8
Pipe area = 7.07 ft²
Pipe hydraulic radius = 0.75
Age factor = 1
Solids factor = 1
Velocity = 2.08 ft/s
Friction loss = 0.03 ft
Fitting loss = 0.05 ft
Total loss = 0.09 ft

Pipe - AquaDiamond Filters to Disk Filters Eff Pipe **29.95**

Pipe shape = Circular
Diameter = 42 in
Length = 35 ft
Flow = 6.125 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 1.93
Pipe area = 9.62 ft²
Pipe hydraulic radius = 0.875
Age factor = 1
Solids factor = 1
Velocity = 0.98 ft/s
Friction loss = 0 ft
Fitting loss = 0.03 ft
Total loss = 0.03 ft

Disk Filters Common Eff. Channel

Disk Filters Eff. Weir - Contracted 1 **31.81**

Weir invert (top of weir) = 31.35
Number of contracted sides = 2
Weir length = 7.5 ft
Flow over weir = 4.75 mgd
Submergence = unsubmerged
Head over weir = 0.46 ft

Disk Filters Eff. Weir - Contracted 2 **31.81**

Weir invert (top of weir) = 31.35
Number of contracted sides = 2
Weir length = 7.5 ft

Section Description	Water Surface Elevation
Flow over weir = 4.75 mgd Submergence = unsubmerged Head over weir = 0.46 ft	
Disk Filters Inf. Weir 2	**33.29**
Weir invert (top of weir) = 32.9 Weir length = 9.17 ft Weir 'C' coefficient = 3.33 Flow over weir = 4.75 mgd Weir submergence = unsubmerged Head over weir = 0.39 ft	
Disk Filters Inf. Slide Gate 2	**33.33**
Opening type = rectangular gate Opening diameter/width = 36 in Gate height = 30 in Invert = 30.41 Number of gates = 1 Flow through gate(s) = 4.75 mgd Total area of opening(s) = 7.5 ft^2 Velocity through gate(s) = 0.98 ft/s Flow behavior = weir control Gate loss = 0.04 ft Downstream water level = 33.29 Upstream water level = 33.33	
Disk Filters Inf. Weir 1	**33.29**
Weir invert (top of weir) = 32.9 Weir length = 9.17 ft Weir 'C' coefficient = 3.33 Flow over weir = 4.75 mgd Weir submergence = unsubmerged Head over weir = 0.39 ft	
Disk Filters Inf. Slide Gate 1	**33.33**
Opening type = rectangular gate Opening diameter/width = 36 in Gate height = 30 in Invert = 30.41 Number of gates = 1 Flow through gate(s) = 4.75 mgd Total area of opening(s) = 7.5 ft^2 Velocity through gate(s) = 0.98 ft/s Flow behavior = weir control Gate loss = 0.04 ft Downstream water level = 33.29 Upstream water level = 33.33	

Section Description	Water Surface Elevation
Disk Filters Common Inf. Channel Flow Split	**33.33**
User defined loss for flow split = 0 ft	
Total flow through flow split = 9.5 mgd	
Filter FSB to Disk Filters - Pipe	**33.46**
Pipe shape = Circular	
Diameter = 36 in	
Length = 19 ft	
Flow = 9.5 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.8	
Pipe area = 7.07 ft^2	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 2.08 ft/s	
Friction loss = 0.01 ft	
Fitting loss = 0.12 ft	
Total loss = 0.13 ft	
Filter FSB Eff. Weir to Disk Filters	**35.28**
Weir invert (top of weir) = 34.54	
Weir length = 7 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 9.5 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.74 ft	
AquaDiamond Filters Common Eff. Channel Flow Comb	
AquaDiamond Filters Eff. Weir 2	**30.98**
Weir invert (top of weir) = 30.58	
Weir length = 20 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 10.875 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.4 ft	
AquaDiamond Filters Eff. Weir 1	**30.98**
Weir invert (top of weir) = 30.58	
Weir length = 20 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 10.875 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.4 ft	

Section Description	Water Surface Elevation
AquaDiamond Filters Inf. Weir 1	**32.06**
Weir invert (top of weir) = 31.58	
Weir length = 15 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 10.875 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.48 ft	
AquaDiamond Filters Inf. Slide Gate #1	**32.23**
Opening type = rectangular gate	
Opening diameter/width = 36 in	
Gate height = 45 in	
Invert = 29.58	
Number of gates = 1	
Flow through gate(s) = 10.875 mgd	
Total area of opening(s) = 11.25 ft^2	
Velocity through gate(s) = 1.5 ft/s	
AquaDiamond Filters Inf. Weir 2	**32.06**
Weir invert (top of weir) = 31.58	
Weir length = 15 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 10.875 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.48 ft	
AquaDiamond Filters Inf. Slide Gate #2	**32.23**
Opening type = rectangular gate	
Opening diameter/width = 36 in	
Gate height = 45 in	
Invert = 29.58	
Number of gates = 1	
Flow through gate(s) = 10.875 mgd	
Total area of opening(s) = 11.25 ft^2	
Velocity through gate(s) = 1.5 ft/s	
AquaDiamond Filters Common Inf. Channel	**32.23**
User defined loss for flow split = 0 ft	
Total flow through flow split = 21.75 mgd	
Filter FSB to AquaDiamond Filters - Pipe	**32.99**
Pipe shape = Circular	
Diameter = 36 in	
Length = 64 ft	
Flow = 21.75 mgd	
Friction method = Hazen Williams	

Section Description	Water Surface Elevation
Friction factor = 120	
Total fitting K value = 1.75	
Pipe area = 7.07 ft^2	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 4.76 ft/s	
Friction loss = 0.14 ft	
Fitting loss = 0.62 ft	
Total loss = 0.75 ft	
Filter FSB Eff. Weir to AquaDiamond Filters	**35.28**
Weir invert (top of weir) = 34	
Weir length = 7 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 21.75 mgd	
Weir submergence = unsubmerged	
Head over weir = 1.28 ft	
Filter FSB Eff. Flow Split	**35.28**
User defined loss for flow split = 0 ft	
Total flow through flow split = 31.25 mgd	
Filter FSB Influent Channel Approximation	**35.28**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 50 ft	
Channel width/diameter = 15 ft	
Flow = 31.25 mgd	
Downstream channel invert = 23.83	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 171.72 ft^2	
Hydraulic radius = 4.531	
Normal depth = infinite	
Critical depth = 0.69 ft	
Depth downstream = 11.45 ft	
Bend loss = 0 ft	
Depth upstream = 11.45 ft	
Velocity = 0.28 ft/s	
Flow profile = Horizontal	
Filter FSB Slide Gate	**35.38**
Opening type = rectangular gate	
Opening diameter/width = 72 in	
Gate height = 60 in	
Invert = 26.58	

Section Description	Water Surface Elevation
Number of gates = 1	
Flow through gate(s) = 31.25 mgd	
Total area of opening(s) = 30 ft^2	
Velocity through gate(s) = 1.61 ft/s	
Filter Flow Splitter Box Inf. Flow Combination	
Clarifiers #1 and #2 Eff. Pipe 2	**35.81**
Pipe shape = Circular	
Diameter = 36 in	
Length = 240 ft	
Flow = 12.5 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.05	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 2.74 ft/s	
Friction loss = 0.18 ft	
Fitting loss = 0.24 ft	
Total loss = 0.42 ft	
Clarifier #3 Eff. Pipe 2	**35.52**
Pipe shape = Circular	
Diameter = 36 in	
Length = 170 ft	
Flow = 6.25 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 3.35	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 1.37 ft/s	
Friction loss = 0.04 ft	
Fitting loss = 0.1 ft	
Total loss = 0.13 ft	
AGS Reactors to Filter FSB - Pipe	**36.16**
Pipe shape = Circular	
Diameter = 36 in	
Length = 520 ft	
Flow = 12.5 mgd	
Friction method = Hazen Williams	

Section Description	Water Surface Elevation
Friction factor = 120	
Total fitting K value = 3.25	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 2.74 ft/s	
Friction loss = 0.4 ft	
Fitting loss = 0.38 ft	
Total loss = 0.78 ft	
Tee - AGS Reactors Eff Pipes	**36.23**
Tee type = run of tee	
Diameter of pipe run past tee = 36 in	
Flow through tee = 12.5 mgd	
Velocity through tee = 2.74 ft/s	
Total tee K value = 0.6	
Overall head loss = 0.07 ft	
Tee - AGS 1 & 2 Eff. Pipes	**36.23**
Tee type = run of tee	
Diameter of pipe run past tee = 36 in	
Flow through tee = 0 mgd	
Velocity through tee = 0 ft/s	
Total tee K value = 0.6	
Overall head loss = 0 ft	
AGS Reactors 1 & 2 Eff. Pipe	**36.23**
Pipe shape = Circular	
Diameter = 36 in	
Length = 110 ft	
Flow = 0 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 3.25	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 0 ft/s	
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
AGS Reactors 1 & 2 Eff. Pipes Flow Comb. at Tee	
AGS Reactor 1 Eff. Pipe	**Off-line**

Section Description	**Water Surface Elevation**
AGS Reactor 1 Eff. Weir	**Off-line**
AGS Reactor 1	**Off-line**
Headworks to AGS Reactor 1 - Pipe	**Off-line**
AGS Reactor 2 Eff. Pipe	**Off-line**
AGS Reactor 3 Eff. Pipe	**38.79**

Pipe shape = Circular
Diameter = 20 in
Length = 60 ft
Flow = 9.5 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 2.94
Pipe area = 2.18 ft^2
Pipe hydraulic radius = 0.417
Age factor = 1
Solids factor = 1
Velocity = 6.74 ft/s
Friction loss = 0.49 ft
Fitting loss = 2.07 ft
Total loss = 2.56 ft

AGS Reactor 3 Eff. Weir	**42.52**

Weir invert (top of weir) = 42.2
Weir length = 24 ft
Weir 'C' coefficient = 3.33
Flow over weir = 9.5 mgd
Weir submergence = unsubmerged
Head over weir = 0.32 ft

AGS Reactor 3	**43.66**

2nd degree polynomial
Flow = 6.25 mgd
Overall head loss = 1.14 ft

Headworks to AGS Reactor 3 - Pipe	**49.47**

Pipe shape = Circular
Diameter = 20 in
Length = 500 ft
Flow = 9.5 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 2.5
Pipe area = 2.18 ft^2

Section Description	Water Surface Elevation
Pipe hydraulic radius = 0.417 Age factor = 1 Solids factor = 1 Velocity = 6.74 ft/s Friction loss = 4.04 ft Fitting loss = 1.76 ft Total loss = 5.81 ft	
AGS Reactor 2 Eff. Weir	**Off-line**
AGS Reactor 2	**Off-line**
Headworks to AGS Reactor 2 - Pipe	**Off-line**
Clarifier #3 Eff. Pipe 1 Pipe shape = Circular Diameter = 30 in Length = 30 ft Flow = 6.25 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 3.5 Pipe area = 4.91 ft² Pipe hydraulic radius = 0.625 Age factor = 1 Solids factor = 1 Velocity = 1.97 ft/s Friction loss = 0.02 ft Fitting loss = 0.21 ft Total loss = 0.23 ft	**35.74**
Clarifier #3 Eff. Launder Launder invert = 36.08 Launder length = 172.79 ft Launder width = 2 ft Launder slope = 0 ft/ft Flow through launder = 6.25 mgd Critical depth = 0.9 ft Downstream depth = 0.9 ft Upstream depth = 1.56 ft	**37.64**
Clarifier #3 V-notch Weir Invert of V notch = 38.17 Angle of V notch = 90 degrees Number of notches = 660 Total flow over weir = 6.25 mgd Weir submergence = unsubmerged	**38.3**

Section Description	Water Surface Elevation
Head over weir = 0.13 ft	
Clarifier FSB to Clarifier #3	**38.45**
Pipe shape = Circular	
Diameter = 36 in	
Length = 120 ft	
Flow = 9.375 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.48	
Pipe area = 7.07 ft^2	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 2.05 ft/s	
Friction loss = 0.05 ft	
Fitting loss = 0.1 ft	
Total loss = 0.15 ft	
Clarifier FSB Weir Gate #3	**39.9**
Weir invert (top of weir) = 39.25	
Number of contracted sides = 2	
Weir length = 8 ft	
Flow over weir = 8.594 mgd	
Submergence = unsubmerged	
Head over weir = 0.65 ft	
Tee - Clarifiers #1 and #2 to Filter FSB	**36.03**
Main line diameter = 36 in	
Branch diameter = 30 in	
Main line flow = 6.25 mgd	
Branch flow = 6.25 mgd	
Tee head loss = 0.22 ft	
Tee - Eff. Pipes of Clarifiers #1 and #2	
Clarifier #1 Eff. Pipe 1	**36.25**
Pipe shape = Circular	
Diameter = 30 in	
Length = 164 ft	
Flow = 6.25 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 2.25	
Pipe area = 4.91 ft^2	
Pipe hydraulic radius = 0.625	
Age factor = 1	
Solids factor = 1	

Section Description	Water Surface Elevation
Velocity = 1.97 ft/s Friction loss = 0.09 ft Fitting loss = 0.14 ft Total loss = 0.22 ft	
Clarifier #2 Eff. Pipe 1	**36.14**
Pipe shape = Circular Diameter = 30 in Length = 18 ft Flow = 6.25 mgd Friction method = Hazen Williams Friction factor = 120 Total fitting K value = 1.75 Pipe area = 4.91 ft² Pipe hydraulic radius = 0.625 Age factor = 1 Solids factor = 1 Velocity = 1.97 ft/s Friction loss = 0.01 ft Fitting loss = 0.11 ft Total loss = 0.11 ft	
Clarifier #2 Eff. Launder	**37.64**
Launder invert = 36.08 Launder length = 172.79 ft Launder width = 2 ft Launder slope = 0 ft/ft Flow through launder = 6.25 mgd Critical depth = 0.9 ft Downstream depth = 0.9 ft Upstream depth = 1.56 ft	
Clarifier #2 V-notch Weir	**38.3**
Invert of V notch = 38.17 Angle of V notch = 90 degrees Number of notches = 660 Total flow over weir = 6.25 mgd Weir submergence = unsubmerged Head over weir = 0.13 ft	
Clarifier FSB to Clarifier #2	**38.45**
Pipe shape = Circular Diameter = 36 in Length = 120 ft Flow = 9.375 mgd Friction method = Hazen Williams Friction factor = 120	

Section Description	Water Surface Elevation
Total fitting K value = 1.48	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 2.05 ft/s	
Friction loss = 0.05 ft	
Fitting loss = 0.1 ft	
Total loss = 0.15 ft	
Clarifier FSB Weir Gate #2	**39.9**
Weir invert (top of weir) = 39.25	
Number of contracted sides = 2	
Weir length = 8 ft	
Flow over weir = 8.594 mgd	
Submergence = unsubmerged	
Head over weir = 0.65 ft	
Clarifier #1 Eff. Launder	**37.64**
Launder invert = 36.08	
Launder length = 172.79 ft	
Launder width = 2 ft	
Launder slope = 0 ft/ft	
Flow through launder = 6.25 mgd	
Critical depth = 0.9 ft	
Downstream depth = 0.9 ft	
Upstream depth = 1.56 ft	
Clarifier #1 V-notch Weir	**38.3**
Invert of V notch = 38.17	
Angle of V notch = 90 degrees	
Number of notches = 660	
Total flow over weir = 6.25 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.13 ft	
Clarifier FSB to Clarifier #1	**38.45**
Pipe shape = Circular	
Diameter = 36 in	
Length = 120 ft	
Flow = 9.375 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.48	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	

Section Description	Water Surface Elevation
Solids factor = 1	
Velocity = 2.05 ft/s	
Friction loss = 0.05 ft	
Fitting loss = 0.1 ft	
Total loss = 0.15 ft	
Clarifier FSB Weir Gate #1	**39.9**
Weir invert (top of weir) = 39.25	
Number of contracted sides = 2	
Weir length = 8 ft	
Flow over weir = 8.594 mgd	
Submergence = unsubmerged	
Head over weir = 0.65 ft	
Clarifier FSB Flow Split	**39.9**
User defined loss for flow split = 0 ft	
Total flow through flow split = 25.781 mgd	
Clarifier FSB Approximation	**39.9**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 16 ft	
Channel width/diameter = 5 ft	
Flow = 28.125 mgd	
Downstream channel invert = 23.25	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 83.25 ft^2	
Hydraulic radius = 2.174	
Normal depth = infinite	
Critical depth = 1.33 ft	
Depth downstream = 16.65 ft	
Bend loss = 0 ft	
Depth upstream = 16.65 ft	
Velocity = 0.52 ft/s	
Flow profile = Horizontal	
Pipe - Anx/Aer Basin 1 to Clarifier FSB	**40.22**
Pipe shape = Circular	
Diameter = 42 in	
Length = 440 ft	
Flow = 14.061 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.52	
Pipe area = 9.62 ft²	
Pipe hydraulic radius = 0.875	

Section Description	Water Surface Elevation
Age factor = 1	
Solids factor = 1	
Velocity = 2.26 ft/s	
Friction loss = 0.2 ft	
Fitting loss = 0.12 ft	
Total loss = 0.32 ft	
Anx/Aer Eff Sluice Gate #1	**40.4**
Opening type = circular gate	
Opening diameter/width = 42 in	
Gate height = 42 in	
Invert = 24.08	
Number of gates = 1	
Flow through gate(s) = 12.5 mgd	
Total area of opening(s) = 9.62 ft^2	
Velocity through gate(s) = 2.01 ft/s	
Anx/Aer Basin 1 Eff. Box	**40.4**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 15 ft	
Channel width/diameter = 6 ft	
Flow = 14.061 mgd	
Downstream channel invert = 23.08	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 103.92 ft^2	
Hydraulic radius = 2.557	
Normal depth = infinite	
Critical depth = 0.74 ft	
Depth downstream = 17.32 ft	
Bend loss = 0 ft	
Depth upstream = 17.32 ft	
Velocity = 0.21 ft/s	
Flow profile = Horizontal	
Eff. Box flow combination	
Anx/Aer Basin 1 Eff. Weir Gate	**42.79**
Weir invert (top of weir) = 42.2	
Number of contracted sides = 2	
Weir length = 15 ft	
Flow over weir = 14.061 mgd	
Submergence = unsubmerged	
Head over weir = 0.59 ft	
Anx/Aer Basin 1 Port	**42.92**

Section Description **Water Surface Elevation**

Opening type = rectangular orifice
Opening diameter/width = 57 in
Opening height = 57 in
Invert = 30.92
Number of openings = 1
Flow through opening(s) = 26.061 mgd
Total area of opening(s) = 22.56 ft^2
Velocity through opening(s) = 1.79 ft/s

Anx/Aer Basin 1 Inf. Sluice Gate **43.34**

Opening type = circular gate
Opening diameter/width = 36 in
Gate height = 36 in
Invert = 30.92
Number of gates = 1
Flow through gate(s) = 14.061 mgd
Total area of opening(s) = 7.07 ft^2
Velocity through gate(s) = 3.08 ft/s

36-inch DI from Headworks to Anoxic/Aerobic Basin 1 **43.53**

Pipe shape = Circular
Diameter = 36 in
Length = 60 ft
Flow = 14.061 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 0.95
Pipe area = 7.07 ft^2
Pipe hydraulic radius = 0.75
Age factor = 1
Solids factor = 1
Velocity = 3.08 ft/s
Friction loss = 0.06 ft
Fitting loss = 0.14 ft
Total loss = 0.2 ft

30-inch DI from Headworks to Anoxic/Aerobic Basin 1 **44.79**

Pipe shape = Circular
Diameter = 30 in
Length = 375 ft
Flow = 14.061 mgd
Friction method = Hazen Williams
Friction factor = 120
Total fitting K value = 1.25
Pipe area = 4.91 ft^2
Pipe hydraulic radius = 0.625
Age factor = 1

Section Description	Water Surface Elevation
Solids factor = 1	
Velocity = 4.43 ft/s	
Friction loss = 0.87 ft	
Fitting loss = 0.38 ft	
Total loss = 1.25 ft	
Headworks Eff. Weir Gate 1	**52.72**
Weir invert (top of weir) = 51.62	
Number of contracted sides = 2	
Weir length = 6 ft	
Flow over weir = 14.061 mgd	
Submergence = unsubmerged	
Head over weir = 1.1 ft	
Pipe - connecting Anx/Aer Basins Eff. Boxes	**40.4**
Pipe shape = Circular	
Diameter = 48 in	
Length = 9.67 ft	
Flow = 0 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.23	
Pipe area = 12.57 ft^2	
Pipe hydraulic radius = 1	
Age factor = 1	
Solids factor = 1	
Velocity = 0 ft/s	
Friction loss = 0 ft	
Fitting loss = 0 ft	
Total loss = 0 ft	
Pipe - Anx/Aer Basin 2 to Clarifier FSB	**40.22**
Pipe shape = Circular	
Diameter = 42 in	
Length = 440 ft	
Flow = 14.061 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.52	
Pipe area = 9.62 ft^2	
Pipe hydraulic radius = 0.875	
Age factor = 1	
Solids factor = 1	
Velocity = 2.26 ft/s	
Friction loss = 0.2 ft	
Fitting loss = 0.12 ft	
Total loss = 0.32 ft	

Section Description	Water Surface Elevation
Anx/Aer Eff. Sluice Gate #2	**40.45**
Opening type = circular gate	
Opening diameter/width = 42 in	
Gate height = 42 in	
Invert = 24.08	
Number of gates = 1	
Flow through gate(s) = 14.061 mgd	
Total area of opening(s) = 9.62 ft^2	
Velocity through gate(s) = 2.26 ft/s	
Anx/Aer Basin 2 Eff. Box	**40.45**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 15 ft	
Channel width/diameter = 6 ft	
Flow = 14.063 mgd	
Downstream channel invert = 23.08	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 104.21 ft^2	
Hydraulic radius = 2.558	
Normal depth = infinite	
Critical depth = 0.74 ft	
Depth downstream = 17.37 ft	
Bend loss = 0 ft	
Depth upstream = 17.37 ft	
Velocity = 0.21 ft/s	
Flow profile = Horizontal	
Anx/Aer Basin 2 Eff. Box Flow Split	**40.45**
User defined loss for flow split = 0 ft	
Total flow through flow split = 14.063 mgd	
Anx/Aer Basin 2 Eff. Weir Gate	**42.79**
Weir invert (top of weir) = 42.2	
Number of contracted sides = 2	
Weir length = 15 ft	
Flow over weir = 14.061 mgd	
Submergence = unsubmerged	
Head over weir = 0.59 ft	
Anx/Aer Basin 2 Port	**42.92**
Opening type = rectangular orifice	
Opening diameter/width = 57 in	
Opening height = 57 in	
Invert = 30.92	

Section Description	Water Surface Elevation
Number of openings = 1	
Flow through opening(s) = 26.061 mgd	
Total area of opening(s) = 22.56 ft^2	
Velocity through opening(s) = 1.79 ft/s	
Anx/Aer Basin 2 Inf. Sluice Gate	**43.34**
Opening type = circular gate	
Opening diameter/width = 36 in	
Gate height = 36 in	
Invert = 30.92	
Number of gates = 1	
Flow through gate(s) = 14.061 mgd	
Total area of opening(s) = 7.07 ft^2	
Velocity through gate(s) = 3.08 ft/s	
36-inch DI from Headworks to Anoxic/Aerobic Basin 2	**43.53**
Pipe shape = Circular	
Diameter = 36 in	
Length = 55 ft	
Flow = 14.061 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 0.95	
Pipe area = 7.07 ft²	
Pipe hydraulic radius = 0.75	
Age factor = 1	
Solids factor = 1	
Velocity = 3.08 ft/s	
Friction loss = 0.05 ft	
Fitting loss = 0.14 ft	
Total loss = 0.19 ft	
30-inch DI from Headworks to Anoxic/Aerobic Basin 2	**44.65**
Pipe shape = Circular	
Diameter = 30 in	
Length = 320 ft	
Flow = 14.061 mgd	
Friction method = Hazen Williams	
Friction factor = 120	
Total fitting K value = 1.25	
Pipe area = 4.91 ft²	
Pipe hydraulic radius = 0.625	
Age factor = 1	
Solids factor = 1	
Velocity = 4.43 ft/s	
Friction loss = 0.74 ft	
Fitting loss = 0.38 ft	

Section Description	Water Surface Elevation
Total loss = 1.12 ft	
Headworks Eff. Weir Gate 2	**52.72**
Weir invert (top of weir) = 51.62	
Number of contracted sides = 2	
Weir length = 6 ft	
Flow over weir = 14.061 mgd	
Submergence = unsubmerged	
Head over weir = 1.1 ft	
Headworks Eff. Splitter Box Flow Split	**52.72**
User defined loss for flow split = 0 ft	
Total flow through flow split = 37.622 mgd	
Headcell Eff. Channel	**52.72**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 40 ft	
Channel width/diameter = 8 ft	
Flow = 40.625 mgd	
Downstream channel invert = 47.92	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 38.41 ft^2	
Hydraulic radius = 2.182	
Normal depth = infinite	
Critical depth = 1.24 ft	
Depth downstream = 4.8 ft	
Bend loss = 0 ft	
Depth upstream = 4.8 ft	
Velocity = 1.64 ft/s	
Flow profile = Horizontal	
Headworks Eff. Channel	
HeadCell Grit Unit 1 Effluent Weir	**54.01**
Weir invert (top of weir) = 53.42	
Weir length = 16 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 15.625 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.59 ft	
HeadCell Grit Unit 2 Effluent Weir	**54.01**
Weir invert (top of weir) = 53.42	
Weir length = 16 ft	
Weir 'C' coefficient = 3.33	

Section Description	Water Surface Elevation
Flow over weir = 15.625 mgd	
Weir submergence = unsubmerged	
Head over weir = 0.59 ft	
Headcell Grit Unit 2	**55.07**
2nd degree polynomial	
Flow = 15.625 mgd	
Overall head loss = 1.06 ft	
Headcell Grit Unit 1	**55.07**
2nd degree polynomial	
Flow = 15.625 mgd	
Overall head loss = 1.06 ft	
Headworks Eff. Box Flow Split	**55.07**
User defined loss for flow split = 0 ft	
Total flow through flow split = 31.25 mgd	
Screen Eff, Channel	**55.07**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 31 ft	
Channel width/diameter = 6 ft	
Flow = 31.25 mgd	
Downstream channel invert = 47.92	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 42.88 ft^2	
Hydraulic radius = 2.113	
Normal depth = infinite	
Critical depth = 1.26 ft	
Depth downstream = 7.15 ft	
Bend loss = 0 ft	
Depth upstream = 7.15 ft	
Velocity = 1.13 ft/s	
Flow profile = Horizontal	
AFS Channel 1 Baffle	**57.66**
Weir invert (top of weir) = 56.17	
Weir length = 4 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 15.625 mgd	
Weir submergence = unsubmerged	
Head over weir = 1.49 ft	
AFS Channel 2 Baffle	**57.66**
Weir invert (top of weir) = 56.17	

Section Description	Water Surface Elevation
Weir length = 4 ft	
Weir 'C' coefficient = 3.33	
Flow over weir = 15.625 mgd	
Weir submergence = unsubmerged	
Head over weir = 1.49 ft	
AFS Channel 2	**57.67**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 20 ft	
Channel width/diameter = 4 ft	
Flow = 15.625 mgd	
Downstream channel invert = 55.5	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 8.65 ft^2	
Hydraulic radius = 1.039	
Normal depth = infinite	
Critical depth = 1.04 ft	
Depth downstream = 2.16 ft	
Bend loss = 0 ft	
Depth upstream = 2.17 ft	
Velocity = 2.8 ft/s	
Flow profile = Horizontal	
AFS Channel 1	**57.67**
Channel shape = Rectangular	
Manning's 'n' = 0.012	
Channel length = 20 ft	
Channel width/diameter = 4 ft	
Flow = 15.625 mgd	
Downstream channel invert = 55.5	
Channel slope = 0 ft/ft	
Channel side slope = not applicable	
Area of flow = 8.65 ft^2	
Hydraulic radius = 1.039	
Normal depth = infinite	
Critical depth = 1.04 ft	
Depth downstream = 2.16 ft	
Bend loss = 0 ft	
Depth upstream = 2.17 ft	
Velocity = 2.8 ft/s	
Flow profile = Horizontal	
Automatic Fine Screen 2	**58.66**
Linear	
Flow = 15.625 mgd	

Section Description	Water Surface Elevation
Overall head loss = 0.99 ft	
Automatic Fine Screen 1	**58.66**
Linear	
Flow = 15.625 mgd	
Overall head loss = 0.99 ft	
Headworks Influent Channel	**58.66**
User defined loss for flow split = 0 ft	
Total flow through flow split = 31.25 mgd	