Report for
City of Ames, Iowa

Nutrient Reduction Facility Plan

Prepared by:

STRAND ASSOCIATES, INC.®
910 West Wingra Drive
Madison, WI 53715
www.strand.com

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SECTION 1
INTRODUCTION

1.01 BACKGROUND

The City of Ames (City) operates wastewater conveyance and treatment facilities that provide services to the residents, businesses, and industries in the City. Treatment facilities include one water pollution control facility (WPCF) and its associated separate sanitary sewer collection and conveyance systems. The WPCF was originally constructed in 1989 and has undergone upgrades and modifications over the years.

Liquid treatment at the WPCF consists of screening, influent pumping, flow equalization basins, grit removal, primary clarification, two-stage trickling filters, biological contact activated sludge, intermediate and secondary clarification, and ultraviolet (UV) disinfection. Effluent from the WPCF is discharged to the South Skunk River. Biosolids treatment consists of sludge co-thickening in the primary clarifiers, anaerobic digestion, and a sludge storage lagoon.

In this Nutrient Reduction Facility Plan (Plan), the current capacity and performance of treatment is evaluated, future flows and loadings for a 20-year planning period are projected, and capacity analyses of the processes are completed to assess the impact of anticipated future conditions on the WPCF. A summary of potential nutrient reduction treatment alternatives, preliminary treatment upgrade alternatives, and their fiscal impact are presented.

1.02 PURPOSE AND SCOPE

The Plan was prepared for the purpose of submission to the Iowa Department of Natural Resources (IDNR). A planning period of 20 years was established for this Plan, with a basis of design year of 2045. The scope of work for the Plan includes the following:

1. Evaluate and summarize existing wastewater treatment condition and overall performance. An evaluation of the collection and conveyance system is not included.

2. Evaluate and summarize existing and future flow, existing and future loading conditions, and regulatory constraints.

3. Summarize regulatory and permitting concerns that may impact the WPCF in the future.

4. Evaluate nutrient removal treatment process improvements and perform a cost-effective analysis for alternatives.

5. Evaluate screening and grit removal alternatives and perform a cost-effective analysis for alternatives.

6. Evaluate siting and phasing options for the selected alternatives.

7. Summarize fiscal and environmental impacts of the selected alternatives.

1.03 LOCATION OF STUDY

The City WPCF provides wastewater treatment for residential, commercial, industrial, and institutional users in the City. The study area for this Plan is the existing WPCF service area as well as any additional areas resulting from population growth as identified in the City's comprehensive plan, *Ames Plan 2040*.

1.04 RELATED STUDIES AND REPORTS

The following reports, drawings, and specifications were used in preparation of this study for background information, existing design criteria, and other information:

A. *Ames Plan 2040,* December 2021, prepared by the City of Ames.

B. *Water Pollution Control Facility - Combined Record Drawings,* May 1990, prepared by Rieke Carrol Muller Associates, Inc.

C. *Ames Nutrient Reduction Feasibility Study,* February 2019, prepared by HDR Engineering, Inc.

1.05 DEFINITIONS

The following definitions are provided as an aid to the reader:

μg/L	micrograms per liter
ACH	air changes per hour
aSRT	aerobic solids retention time
ADW	average dry weather
AGS	aerobic granular sludge
AWW	average wet weather
BMP	Best Management Practices
BOD	biochemical oxygen demand
BOD_5	five-day biochemical oxygen demand
BPR	biological phosphorus removal
C	Celsius
$CaCO_3$	calcium carbonate
cf	cubic feet
cfm	cubic feet per minute
cfu	colony forming units
City	City of Ames, Iowa
CMOM	capacity management operation and maintenance
COD	chemical oxygen demand
CPR	chemical phosphorus removal
CWA	Clean Water Act of 1972
DO	dissolved oxygen

E. coli	*Escherichia coli*
EQ	Equalization
F°	degrees Fahrenheit
ft	feet
fps	feet per second
GBT	gravity belt thickener
gpcd	gallons per capita per day
gpd/sf	gallons per day per square feet
gpm	gallons per minute
gpm/sq ft	gallons per minute per square foot
hp	horsepower
HRT	hydraulic retention time
HVAC	heating, ventilation, and air conditioning
Hz	hertz
I/I	infiltration/inflow
IDNR	Iowa Department of Natural Resources
IFAS	integrated fixed film activated sludge
in	inches
kV	kilovolt
lb VS/cf/day	pounds volatile solids per cubic feet per day
lb/day	pounds per day
lb/day/1,000 cf	pounds per day per 1,000 cubic feet
lb/sf/day	pounds per square foot per day
MG	million gallons
mg/L	milligrams per liter (parts per million in dilute solutions)
MGD	million gallons per day
mL	milliliter
ML	mixed liquor
MLSS	mixed liquor suspended solids
mm	millimeter
MWW	maximum wet weather
NFPA	National Fire Protection Agency
NH_3-N	ammonia nitrogen
NO_2-N	nitrite nitrogen
NPDES	National Pollutant Discharge Elimination System
NPW	nonpotable water
NTU	nephelometric turbidity unit
OPC	opinion of probable cost
OPCC	opinion of probable costs
PFAS	per- and polyfluoroalkyl substances
PHWW	peak hour wet weather
Plan	City of Ames Nutrient Reduction Facility Plan
PLC	programmable logic controller
PO_4-P	orthophosphate as phosphorus
PRS	primary sludge

psi	pounds per square inch
RAS	return activated sludge
RCP	reinforced concrete pipe
rpm	revolutions per minute
s.u.	standard units
SBR	sequencing batch reactors
SRT	solid retention time
SCADA	supervisory control and data acquisition
scfm	standard cubic feet per minute
sf	square feet
SNDN	simultaneous nitrification-denitrification
Strand	Strand Associates, Inc.®
TKN	total Kjeldahl nitrogen
TMDL	total maximum daily load
TN	total nitrogen
TP	total phosphorus
TS	total solids
TSS	total suspended solids
USEPA	United States Environmental Protection Agency
UV	Ultraviolet
VAC	volts alternating current
VFA	volatile fatty acids
VFD	variable frequency drive
VS	volatile solids
VSS	volatile suspended solids
WAS	waste activated sludge
WEF	Water Environment Federation
WPCF	water pollution control facility
WWWP	wastewater treatment plant

SECTION 2
EXISTING WASTEWATER TREATMENT FACILITIES

2.01 INTRODUCTION

The City owns and operates the WPCF located at 56797 280th Street that provides wastewater treatment for all of the customers in the City's service area. The WPCF is rated for an average dry weather (ADW) flow of 8.6 million gallons per day (MGD), an average wet weather (AWW) flow of 12.1 MGD, and a maximum wet weather (MWW) flow of 20.4 MGD. Influent flows up to the MWW flow receive full biological treatment. Flows in excess of the MWW flow are diverted to two 2.2 million gallons (MG) equalization basins after screening and returned to the treatment process after flows have decreased. The WPCF became operational in 1989. This section provides a narrative description and design criteria of the existing WPCF, a summary of influent flow and load data, and an overall summary of treatment performance.

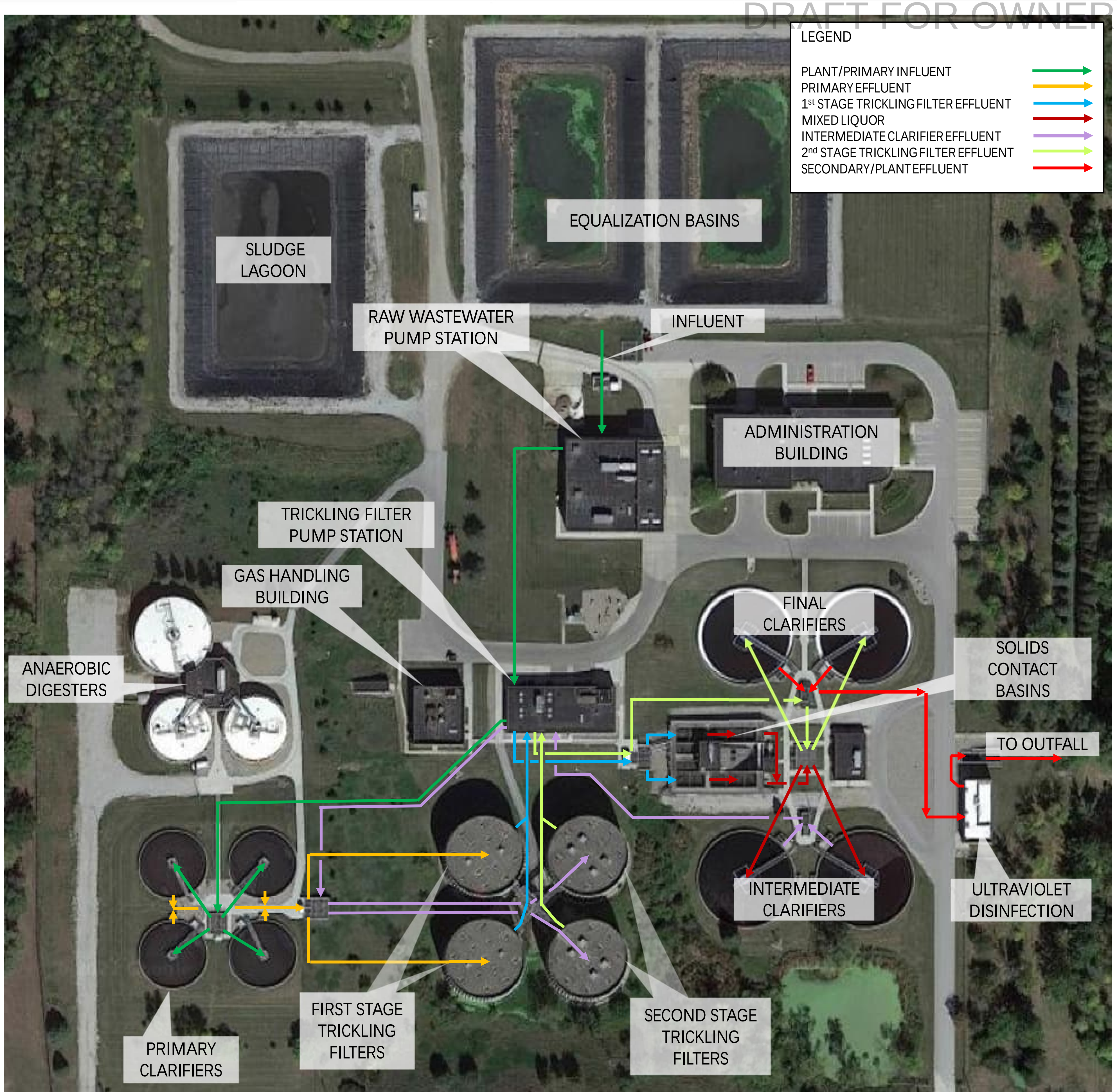
2.02 DESCRIPTION OF EXISTING FACILITIES

Table 2.02-1 provides a summary of the existing design flows and loads for the WPCF.

Parameter	Design Criteria
Wastewater Flow	
ADW Flow, MGD	8.6
AWW Flow, MGD	12.1
MWW Flow, MGD	20.4
Wastewater Load	
Five-Day Biochemical Oxygen Demand (BOD_5)	
Average Day, pounds per day (lb/day)	12,430
Maximum Month, lb/day	16,150
Maximum Day, lb/day	23,740
Total Suspended Solids (TSS)	
Average Day, lb/day	11,560
Maximum Month, lb/day	16,190
Maximum Day, lb/day	25,440
Total Kjeldahl Nitrogen (TKN)	
Average Day, lb/day	3,540
Maximum Month, lb/day	4,950
Maximum Day, lb/day	6,930
Ammonia Nitrogen (NH_3-N)	
Average Day, lb/day	1,970
Maximum Month, lb/day	2,750
Maximum Day, lb/day	3,850

Table 2.02-1 WPCF Design Flows and Loads

Table 2.02-2 summarizes the unit process capacities and tank sizes based on information provided by the City. A site plan and process flow schematic of the WPCF are presented in Figure 2.02-1. The following paragraphs describe each unit process and the flow through the WPCF.



SITE PLAN AND PROCESS FLOW SCHEMATIC

AMES WATER POLLUTION CONTROL FACILITY
CITY OF AMES, IOWA

STRAND ASSOCIATES®

FIGURE 2.02-1

Influent flow to the WPCF is conveyed to the Raw Wastewater Pumping Station by a 66-inch-diameter interceptor. Inside the Raw Wastewater Pump Station, the raw wastewater undergoes screening using two mechanically raked bar screens with 1/2-inch bar spacing and one newer mechanically raked bar screen with 3/8-inch bar spacing. The 3/8-inch bar screen has a screenings wash press installed downstream of the screen that washes and compacts the screenings before discharging them to a dumpster. Material captured on the 1/2-inch screens is discharged into grinders that grind the screenings, which are then discharged back to the influent flow downstream of the screens. The 1/2-inch screens are only operated during peak flow events or when the 3/8-inch screen is out of service.

The screened wastewater then enters the raw wastewater wet well with six vertical turbine pumps. Three pumps are used to pump the wastewater to the grit removal facilities. Two pumps are used to pump flows above the MWW flow to the equalization basins. One additional pump is used as a swing pump to pump flows either to grit removal or the equalization basins. Flows stored in the equalization basins are returned to the raw wastewater wet well after wet weather events have subsided.

Grit removal is achieved by four TeaCup® grit removal units in the Raw Wastewater Pump Station. Grit from the TeaCup units are nominally dewatered by two grit classifiers. The dewatered grit is carried by a conveyor belt to two grit hoppers. The grit is periodically removed from the hoppers and transported from the Raw Wastewater Pumping Building to a concrete pad outside of the building with a dump truck. Once on this pad, the grit is stabilized with lime sludge from the City's water treatment plant (WTP). This grit is periodically land applied on land owned by the City.

After grit removal, the wastewater flows to the first stage wet well of the Trickling Filter Pump Station. Four vertical turbine pumps lift the wastewater approximately 45 feet up to four 70-foot diameter primary clarifiers. The influent wastewater is blended with waste activated sludge (WAS) from the Sludge Pump Building in the primary clarifier splitter box. Primary effluent flows to the trickling filter splitter box.

Secondary treatment at the WPCF consists of four trickling filters, four intermediate/secondary clarifiers, and a suspended growth solids contact activated sludge system. The WPCF has flexibility to operate the secondary treatment process in several modes but has historically operated with two first-stage trickling filters for 5-day biochemical oxygen demand (BOD_5) removal followed by the solids contact activated sludge system with two of the clarifiers used as intermediate clarifiers. The effluent from the intermediate clarifiers is pumped to the two other trickling filters, operated as second-stage filters for nitrification, and the two remaining secondary clarifiers for final clarification. Other operating modes allow the solids contact process to be after the second stage trickling filters in the flow path, all of the clarifiers to be used as final clarifiers, all of the trickling filters to be operated in parallel, and several other modes that have not historically been used.

When operating in the typical mode, primary effluent is conveyed from the trickling filter splitter box to two first-stage 80-foot-diameter trickling filter towers. Trickling filter effluent flows back to the Trickling Filter Pump Station into the constant head box. A weir in the constant head box controls the water level at 9.75 feet, which allows a portion of the trickling filter effluent to be recycled back through the primary clarifiers and to the first-stage trickling filter via the trickling filter pumps. Trickling filter effluent that overflows the weir in the constant head box is conveyed to the solids contact basins.

Flow is split between two 182,000-gallon solids contact basins. Return activated sludge (RAS) from the intermediate and final clarifiers is pumped by three screw pumps into two RAS reaeration basins before blending with the first stage trickling filter effluent in the solids contact basins. Air is supplied by three centrifugal blowers in the Trickling Filter Pump Station.

Mixed liquor (ML) from the solids contact basins flows to two 100-foot-diameter intermediate clarifiers. Scum from the intermediate clarifiers is collected in a scum pit, which is pumped out by an air-operated diaphragm pump in the Sludge Pump Building. RAS is controlled by a telescoping valve and flows to the screw pump wet well back to the solids contact basins.

Intermediate clarifier effluent flows to the second stage wet well of the Trickling Filter Pump Station. Four vertical turbine pumps convey the flow to the two second-stage trickling filters, which also having weir and constant head box similar to the first-stage trickling filters. Second-stage trickling filter effluent flows to the final clarifiers through the solids contact splitter box.

The two 100-foot-diameter final clarifiers are set up like the intermediate clarifiers. Scum is pumped by a double-disc pump. RAS is controlled by a telescoping valve and flows to the screw pump wet well back to the solids contact basins.

Secondary effluent is disinfected with an UV disinfection system. The disinfected effluent flows down a cascade aerator and discharges to the Skunk River.

WAS is pumped out of the solids reaeration basins by three progressing cavity pumps in the Sludge Pump Building and conveyed to the primary clarifiers. Sludge removed by the primary clarifiers is pumped by five diaphragm sludge pumps to primary digesters. Scum from the clarifiers are also pumped to the primary digesters.

The WPCF has three anaerobic digesters, two 65-foot-diameter primary digesters and one 80-foot-diameter secondary digester. The primary digesters have fixed covers and are mixed with an internal draft tube with integral heat exchanger in each tank. The draft tube mixers were installed in 2013. Overflow from the primary digesters is directed to the secondary digester. The secondary digester has a floating cover and does not have a dedicated mixing system. The secondary digester is primarily used for storage of sludge and digester gas. Overflow from the secondary digester can be directed to the 1st stage trickling filter wet well or directed to the sludge lagoon for storage before land application.

Digester gas is used in two cogeneration engines and one boiler in the Gas Handling Building. Heat produced by the engines and boiler is used to heat the digesters. Excess gas is burned in the waste gas burner.

Table 2.02-2 Existing Facility Process Design Criteria

Parameter	Design Criteria
Screening	
Mechanically Raked	1
Bar Spacing, inches (in)	3/8
Capacity, MGD	13.3
Mechanically Raked	2
Bar Spacing, in	1/2
Capacity (each), MGD	13.3
Raw Wastewater Pumping	
Number of Pumps	3 + 1 standby
Type	Vertical Turbine
Capacity (each), MGD	7.9
Capacity (firm), MGD	20.4
Equalization Pumping	
Number of Pumps	2
Type	Vertical Turbine
Capacity (each), MGD	7.9
Capacity (total), MGD	13.6
Equalization Basins	
Number	2
Volume (each), MG	2.2
Grit Removal	
Number of Units	4
Type	Free Vortex Centrifugal
Capacity (total), MGD	20.4
Primary Clarification	
Number of Units	4
Feed type	Center Feed
Diameter, feet (ft)	70
Side Water Depth, ft	9
Surface Area, square feet (sf) per unit	3,848
Design Hydraulic Loading Rate, gallons per day per square feet (gpd/sf)	
Minimum Day	247
Average Dry Weather	559
Average Wet Weather	786
Maximum Wet Weather	1,325
Trickling Filter Pumping	
First-Stage Trickling Filter Pumps	
Number of Pumps	3 + 1 standby
Type	Vertical Turbine
Capacity (each), MGD	7.9
Capacity (total), MGD	20.4
Second-Stage Trickling Filter Pumps	

Number of Pumps	3 + 1 standby
Type	Vertical Turbine
Capacity (each), MGD	7.9
Capacity (total), MGD	23.4
Trickling Filters	
First-Stage Trickling Filters	
Number of Units	2
Diameter, ft	80
Media Depth, ft	26
Media	
Type	Plastic
Orientation	60 degree Cross Flow
Density, square feet per cubic feet (sf/cf)	30
Media Area (each), sf	3,920,000
Media Volume (each), cf	130,690
Hydraulic Loading, gpm/sf	
Minimum	0.5
Maximum	2.09
Organic Loading, lb/day/1,000 cf	
Average Annual	34.0
Average Day Maximum Month	46.3
Maximum Day	68.9
Peak 4-Hour	90.6
Hydraulic Application	
Type	Rotary Distributor
Application Rate per Distributor, gallons per minute (gpm)	
Minimum	2,500
Maximum	10,500
Second-Stage Trickling Filters	
Number of Units	2
Diameter, ft	80
Media Depth, ft	26
Media	
Type	Plastic
Orientation	60 deg Cross Flow
Density, sf/cf	50
Media Area (each), sf	6,530,000
Media Volume (each), cf	130,690
Hydraulic Loading, gpm/sf	
Minimum	1
Maximum	2.09
Organic Loading, lb/day/1,000 cf	
Average Annual	4.0
Average Day Maximum Month	7.7
Maximum Day	11.4
Peak 4-Hour	17.1
Hydraulic Application	
Type	Rotary Distributor
Application Rate per Distributor, gpm	
Minimum	5,000

Maximum	10,500
Solids Contact Process	
solids contact basins	
Number of Basins	2
Number of Cells per Basin	5
Cell Width, ft	18
Cell Length, ft	18
Side Water Depth, ft	15
Total Basin Volume, cf (gallons)	48,600 (364,000)
Hydraulic Retention Time, minutes	
Average Dry Weather	61
Average Wet Weather	43
Maximum Wet Weather	26
Aeration Equipment	
Type	Fine Bubble
Sludge reaeration basins	
Number of Basins	2
Basin Width, ft	14
Basin Length, ft	28
Side Water Depth, ft	15
Total Basin Volume, cf (gallons)	11,760 (88,000)
Hydraulic Retention Time, minutes	
Average Dry Weather (35% of 8.6 MGD)	42
Average Wet Weather (35% of 12.1 MGD)	30
Maximum Wet Weather (35% of 20.4 MGD)	18
Aeration Equipment	
Type	Fine Bubble
Aeration Blowers	
Number of Blowers	2 +1 standby
Type	Centrifugal
Capacity (each), standard cubic feet per minute (scfm)	1,300
Capacity (total), scfm	3,300
Motor Size, horsepower (hp)	100
Final Clarifiers	
Number of Units	4
Type	Flocculation
Feed Type	Center Feed
Diameter, ft	100
Side Water Depth, ft	14
Surface Area, sf per unit	7,854
Design Hydraulic Loading Rate, gpd/sf	
Four Intermediate or Four Final Clarifiers	
Average Dry Weather	274
Average Wet Weather	385
Maximum Wet Weather	649
Two Intermediate and Two Final Clarifiers	
Average Dry Weather	547
Average Wet Weather	770
Maximum Wet Weather	1,299

Solids Loading, lb/day/sf	
Two Intermediate Clarifiers (Solids Contact Basin Upstream)	
MWW, Mixed Liquor Suspended Solids (MLSS)=2,900 milligrams per liter (mg/L), RAS=12.1 MGD	50
Sludge Collector	
Type	Suction Header
Control	Telescoping valve
Waste Sludge Pumping	
Number of Units	2 + 1 Standby
Type	Centrifugal (two), Air-operated Diaphragm (one)
Capacity (each), gpm	55 to 550
Capacity (total), gpm	1,500
Return Sludge Pumping	
Number of Units	2 + 1 Standby
Type	Screw
Capacity (each), gpm	4,200
Capacity (firm), gpm	8,400
Lift, ft	22.92
Screw Diameter, in	54
Disinfection	
Type	UV
Orientation	Horizontal Parallel Flow
Number of Banks	2
Capacity, MGD	25
Effluent Reaeration Structure	
Number of Units	1
Type	Cascade
Solids Handling	
Primary Anaerobic Digesters	
Number	2
Cover Type	Fixed
Diameter, ft	65
Side Water Depth, ft	29
Volume (each), cf (without cone)	96,000
Volume (each), gallons (without cone)	720,000
Hydraulic Detention Time, days	
Annual Average	27
Maximum Month	20
Solids Loading Rate, pounds per volatile solids per cubic feet per day (lb VS/cf/day)	
Annual Average	0.08
Maximum Month	0.10
Digester Mixing	
Type	Draft Tubes
Digester Heating	
Type	Draft Tube Heating Jackets
Number of Units per Digester	1

Digester Operating Temperature, degrees Fahrenheit (F°)	95
Hot Water Recirculation Pumps	
Type	Centrifugal
Number of Units	2
Capacity, gpm	350
Secondary Anaerobic Digester	
Number	1
Cover Type	Floating Gasholder
Diameter, ft	80
Side Water Depth, ft	24.6
Volume Each, cf (without cone)	124,000
Volume Each, gallons (without cone)	925,000
Hydraulic Detention Time, days	
Annual Average	17
Maximum Month	13
Gasholder	
Depth of Usable Storage, ft	7.4
Storage Volume, cf	36,000
Vertical Movement	Spiral-guided
Digested Sludge Pumps	
Type	Progressing Cavity
Number	2
Capacity (each), gpm	600
Sludge Storage Lagoon	
Number	1
Minimum Depth, ft	2
Length, ft x Width, ft at 2 ft	80 x 160
Maximum Liquid Depth, ft	17
Freeboard, ft	3
Sides Slopes, Horizontal: Vertical	3:1
Volume, cf	415,000
Volume gallons	3,100,000

2.03 INFLUENT FLOWS

A. Plant Influent Flows

Plant influent flow to the WPCF from January 2017 through December 2021 (24-hour total flow) is presented in Figure 2.03-1, along with the WPCF design ADW flow (8.6 MGD) and MWW Flow (20.4 MGD). This data is also presented in Table 2.03-1. The minimum and maximum values presented in Table 2.03-1 represent the lowest and highest total daily (24-hour average) flow during that month, respectively.

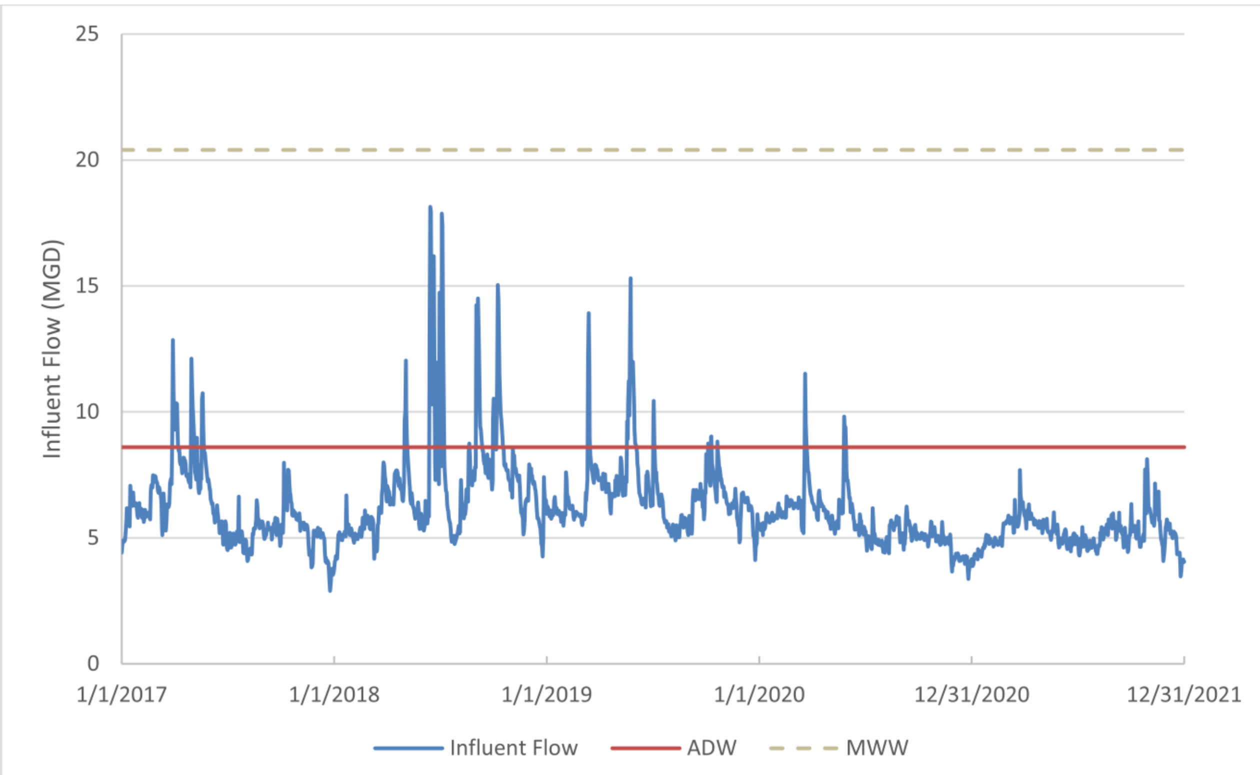


Figure 2.03-1 Plant Influent Flow

Table 2.03-1 Plant Influent Flow Summary

	Influent Flow (MGD)														
	2017			2018			2019			2020			2021		
	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
January	5.83	4.41	7.06	5.02	3.78	6.69	6.01	5.48	6.63	5.67	5.11	6.00	4.52	3.88	5.13
February	6.34	5.63	7.48	5.32	4.80	6.08	6.19	5.72	7.60	6.16	5.78	6.65	5.01	4.65	5.65
March	6.87	5.11	12.85	5.91	4.17	7.99	7.59	5.51	13.93	6.91	5.19	11.51	5.90	5.20	7.69
April	8.30	7.00	10.35	6.92	6.32	7.68	7.00	5.96	7.55	6.16	5.62	6.88	5.73	5.37	6.33
May	8.36	6.78	12.11	7.03	5.35	12.04	8.92	6.68	15.30	6.35	5.16	9.81	5.30	4.62	6.02
June	5.75	4.72	6.93	9.08	5.29	18.14	7.13	6.20	9.31	5.78	5.10	7.29	4.93	4.46	5.35
July	4.96	4.38	6.63	7.63	4.76	17.88	6.61	5.25	10.44	4.92	4.49	6.17	4.76	4.29	5.42
August	5.13	4.08	6.50	6.72	5.16	8.74	5.40	4.90	5.91	5.23	4.38	5.86	5.18	4.36	5.98
September	5.32	4.68	5.80	9.14	6.91	14.51	6.33	5.11	7.14	5.28	4.53	6.25	5.18	4.44	6.00
October	6.20	4.80	7.99	9.26	6.89	15.03	7.62	6.42	9.03	5.11	4.65	5.65	5.60	4.64	8.12
November	5.11	3.83	5.98	6.84	5.14	8.51	6.18	4.82	6.99	4.78	3.66	5.63	5.56	4.09	7.16
December	4.43	2.90	5.40	6.44	4.26	7.92	5.94	4.12	6.80	4.12	3.36	4.39	4.77	3.48	5.74
Annual Average	**6.05**	**--**	**--**	**7.11**	**--**	**--**	**6.75**	**--**	**--**	**5.54**	**--**	**--**	**5.20**	**--**	**--**

Notes:
Avg=Average
Min=Minimum
Max=Maximum

Minimum and maximum 24-hour average flows at 30-, 7-, and 1-day intervals for January 2017 through December 2021 are presented in Table 2.03-2.

	2017	2018	2019	2020	2021	2017 to 2021
Minimum Day	2.90	3.78	4.12	3.36	3.48	2.90
Minimum Week (7-day)	3.45	3.52	4.83	3.83	3.85	3.45
Minimum Month (30-day)	4.40	4.16	5.36	4.10	4.08	4.08
Average Day	6.05	7.11	6.75	5.54	5.20	6.13
Maximum Month (30-day)	8.64	11.29	9.28	7.03	6.12	11.29
Maximum Week (7-day)	10.45	14.86	12.12	8.67	6.80	14.86
Maximum Day	12.85	18.14	15.30	11.51	8.12	18.14

Note: All values in MGD.

Table 2.03-2 Minimum and Maximum 24-Hour Average Flow Summary

As seen in Table 2.03-2, the average influent flow increased in 2018 and decreased in 2019, 2020,and 2021. The maximum day flow over the 5-year period evaluated for this Plan was 18.14 MGD on June 15, 2018. On this day, the City recorded approximately 4.5 inches of rain, which greater than a 10-year recurrence interval for rain intensity in central Iowa (climatic section 5) within a 24-hour period as indicated in Table 2B-2.06 in Section 2B-2 of the *Iowa Statewide Urban Design and Specifications Design Manual.*

The 30-day and 7-day rolling average of flow to treatment are presented in Figures 2.03-2 and 2.03-3, respectively. The maximum 30-day rolling average over the 5-year period evaluated for this Plan was 11.29 MGD, which is less than the current WPCF design AWW flow of 12.1 MGD, while the maximum 7-day rolling average reached as high as 14.86 MGD.

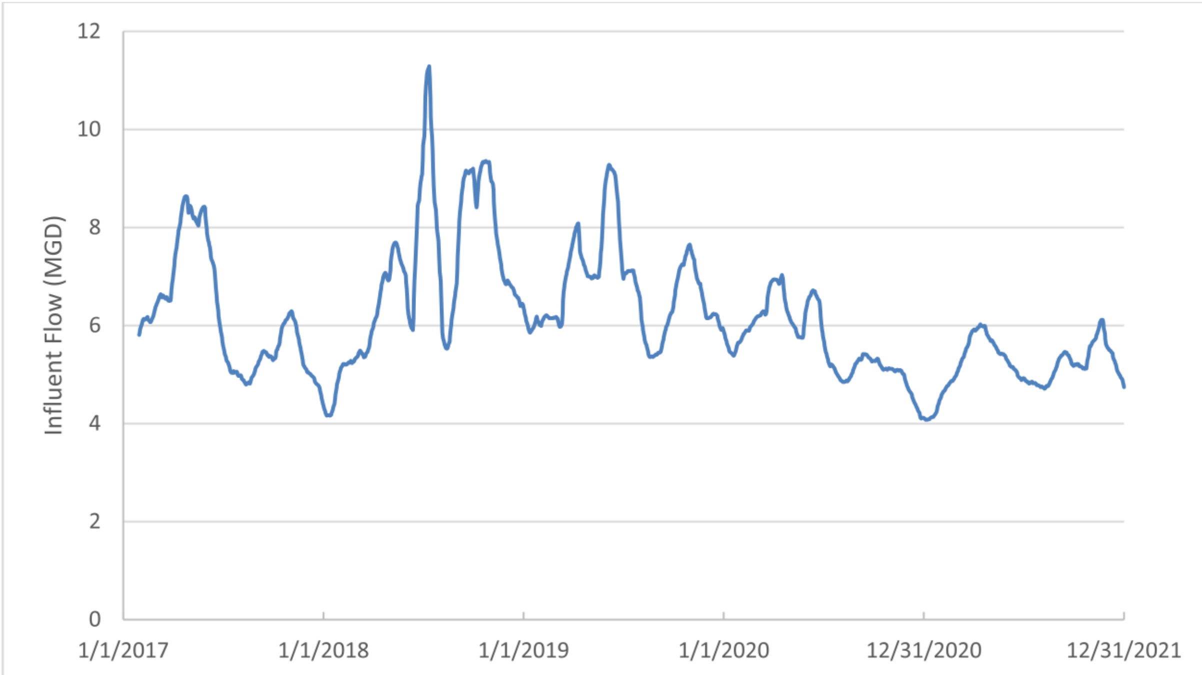


Figure 2.03-2 Plant Influent Flow 30-Day Rolling Average

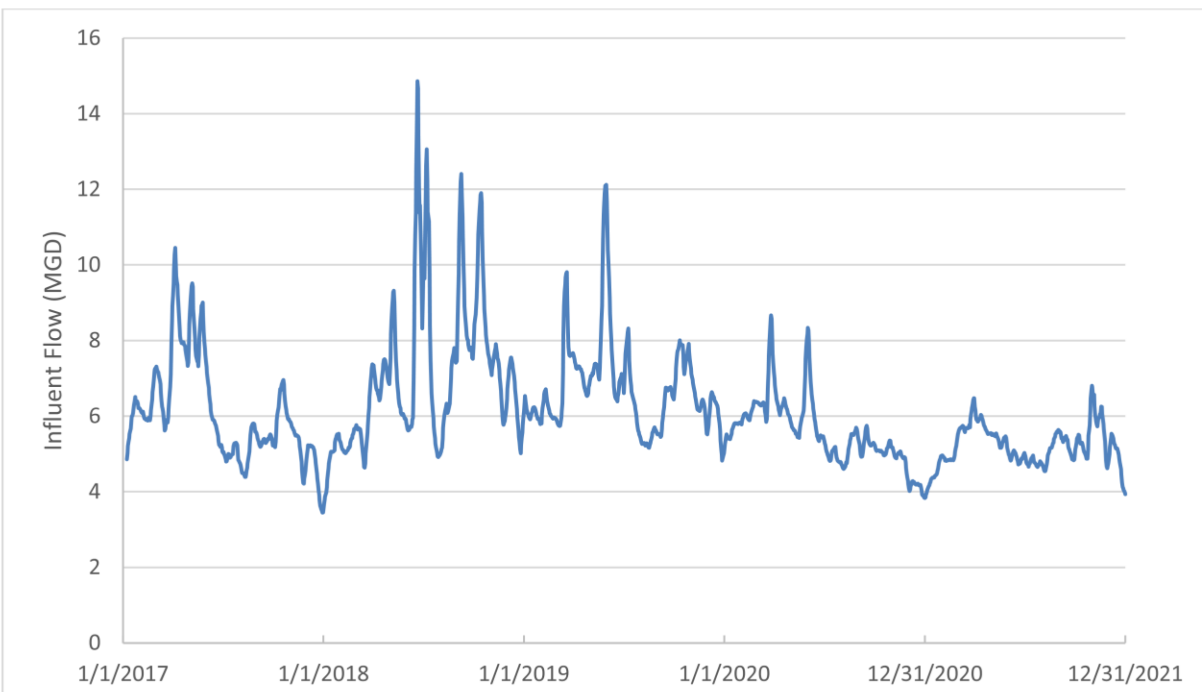


Figure 2.03-3 Plant Influent Flow 7-Day Rolling Average

B. Excess Flows

When influent flow exceeds 20.4 MGD, flow is diverted to the equalization basins. This occurred 18 times during the 5-year period evaluated for this Plan, with an average of 1.228 MGD and maximum of 5.586 MGD diverted to the equalization basins. A summary of these events in presented in Table 2.03-3.

Date	Flow (MGD)
6/14/2018	4.240
6/15/2018	0.686
7/5/2018	5.586
7/6/2018	0.255
5/24/2019	3.612
5/25/2019	0.091
2/25/2021	0.282
4/6/2021	0.824
4/7/2021	0.860
6/13/2021	0.255
7/14/2021	0.333
8/12/2021	1.146
8/13/2021	1.069
8/26/2021	1.071
9/19/2021	0.331
9/28/2021	0.132
11/4/2021	0.264
11/17/2021	1.072

Table 2.03-3 Excess Flow Events

C. Peak Flow Evaluation

The City's current Supervisory Control and Data Acquisition (SCADA) system only records Instantaneous flow data for 1 year. Because 2021 and the beginning of 2022 have been relatively dry compared to previous years, collection of peak instantaneous historical flow data during historical high flow events via the SCADA system's data historian was not possible for this Plan. However, the City does manually record instantaneous influent flow data every 3 hours on its daily reports, with data available back to 2016. A review of these daily reports for the five highest flow events between 2016 and 2021 was conducted to estimate peak flows. The highest recorded influent flow based on ten recorded instantaneous values taken at regular intervals each day during this period was approximately 30.8 MGD measured on July 6, 2018. Based on the 2018 annual average flow of 7.11 MGD, this corresponds to a peak flow to annual average peaking factor of approximately 4.3.

2.04 INFLUENT LOADS

Influent sampling data from January 2017 through December 2021 was used in the evaluation of existing influent loads to the WPCF. A summary of the influent loads for typical design parameters is presented in this section.

A. BOD$_5$

Influent samples are analyzed for BOD$_5$ 5 days per week by the WPCF. Measured influent BOD$_5$ concentrations and loads from January 2017 through December 2021 are presented in Table 2.04-1. One BOD$_5$ load outlier (21,058 lb/day on May 6, 2018) was identified using Walsh's outlier test and was therefore excluded from the dataset. This data point was approximately 21 percent greater than any other datapoints in the dataset.

	Influent BOD$_5$									
	2017		2018		2019		2020		2021	
	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)
January	210	10,390	250	10,480	210	10,480	210	9,820	260	9,870
February	200	10,420	270	12,150	210	10,930	210	10,950	260	10,770
March	190	10,770	220	10,860	190	11,750	170	9,460	220	10,710
April	170	11,620	220	12,690	210	12,170	190	9,960	230	11,160
May	140	9,610	190	10,560	160	11,310	180	9,500	230	10,260
June	190	8,860	130	8,050	160	9,600	190	9,140	250	10,420
July	180	7,580	160	8,560	160	8,690	210	8,520	220	8,770
August	220	9,450	160	9,080	220	9,860	220	9,520	230	9,900
September	220	9,790	150	11,200	210	10,820	240	10,650	260	11,200
October	210	10,230	160	11,470	170	10,680	230	9,700	210	9,580
November	220	9,560	200	11,170	210	10,570	240	9,870	220	10,350
December	260	9,570	200	10,860	190	9,330	220	7,660	210	8,660
Annual Average	**200**	**9,820**	**190**	**10,590**	**190**	**10,500**	**210**	**9,540**	**230**	**10,140**

Note: Conc.=Concentration

Table 2.04-1 Influent BOD$_5$ Load Summary

The average BOD$_5$ concentration and load from this period are approximately 204 mg/L and 10,120 lb/day. BOD$_5$ loads have remained relatively consistent over the past few years, with the highest loading occurring in 2018. Because of the high transient student population from Iowa State University, the influent loads are significantly reduced in the summer compared to the rest of the year. The 7-day and 30-day rolling averages were created to approximate maximum week and maximum month conditions. The 7-day and 30-day rolling averages are presented in Table 2.04-2.

	BOD$_5$ Load (lb/day)					
	2017	2018	2019	2020	2021	2017 to 2021
Average	9,820	10,590	10,500	9,540	10,140	10,120
Maximum Month (30-day)	12,370	13,410	12,650	11,590	12,310	13,410
Maximum Week (7-day)	13,310	14,680	14,840	12,320	13,340	14,840
Maximum Day	15,220	17,340	16,680	14,220	17,130	17,340

Table 2.04-2 Maximum Influent BOD$_5$ Load Summary

B. TSS

Influent samples are analyzed for TSS 5 days per week. Measured influent TSS concentrations and loads from January 2017 through December 2021 are presented in Table 2.04-3.

	Influent TSS									
	2017		2018		2019		2020		2021	
	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)
January	280	13,690	240	10,400	220	11,160	250	11,840	260	10,060
February	220	11,410	270	12,290	280	14,430	240	12,350	270	10,940
March	230	13,140	220	10,910	210	13,210	180	9,720	180	9,090
April	210	14,530	230	13,300	200	11,700	220	11,390	180	8,540
May	170	11,360	220	12,340	210	14,770	170	8,610	210	9,040
June	260	12,330	190	12,500	190	11,360	200	9,810	240	9,710
July	230	9,330	190	11,120	200	10,970	220	8,970	230	9,070
August	280	12,120	160	9,200	250	11,630	240	10,470	250	10,780
September	280	12,490	190	14,370	210	11,140	260	11,280	280	11,920
October	240	11,860	160	11,840	180	11,610	210	8,890	150	7,260
November	260	10,930	260	14,900	240	12,380	240	9,530	250	11,640
December	320	11,860	220	11,590	180	9,060	210	7,120	210	8,520
Annual Average	**250**	**12,080**	**210**	**12,030**	**210**	**11,910**	**220**	**9,980**	**220**	**9,720**

Table 2.04-3 Influent TSS Load Summary

The average TSS concentration and load from this period are approximately 220 mg/L and 11,140 lb/day. TSS loadings have been generally declining with each successive year. One potential explanation is that the recent work on the collection system has reduced solids infiltration into the sanitary sewer system. 7-day and 30-day rolling averages were created to approximate maximum week and maximum month conditions. The 7-day and 30-day rolling averages are presented in Table 2.04-4.

	TSS Load (lb/day)					
	2017	2018	2019	2020	2021	2017 to 2021
Average	12,080	12,030	11,910	9,980	9,720	11,140
Maximum Month (30-day)	16,400	14,980	15,500	13,440	12,420	16,400
Maximum Week (7-day)	19,330	17,980	19,660	14,250	15,970	19,660
Maximum Day	34,110	30,880	29,370	26,350	21,950	34,110

Table 2.04-4 Maximum Influent TSS Load Summary

C. NH_3-N and TKN

Influent samples are analyzed for NH_3-N five days per week. Measured influent NH_3-N concentrations and loads from January 2017 through December 2021 are presented in Table 2.04-5.

	Influent NH_3-N									
	2017		2018		2019		2020		2021	
	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)
January	27.5	1,350	34.6	1,460	24.4	1,230	27.6	1,310	30.7	1,170
February	26.5	1,390	33.3	1,470	27.0	1,400	31.0	1,610	32.7	1,360
March	23.0	1,310	26.3	1,290	21.4	1,300	23.0	1,260	26.1	1,290
April	20.3	1,410	25.1	1,450	22.6	1,330	19.7	1,010	27.8	1,330
May	14.8	1,020	17.7	1,000	15.4	1,060	19.2	1,000	25.0	1,100
June	18.6	890	13.9	890	15.3	900	18.6	900	25.3	1,040
July	21.2	870	12.1	650	16.2	850	21.5	890	25.7	1,010
August	28.7	1,260	21.1	1,200	24.2	1,110	25.4	1,110	30.6	1,320
September	33.4	1,480	17.0	1,260	27.9	1,480	28.0	1,230	31.1	1,340
October	31.5	1,570	18.3	1,370	24.6	1,540	34.0	1,460	32.4	1,500
November	31.9	1,390	21.3	1,240	30.2	1,560	31.2	1,260	30.1	1,410
December	31.7	1,190	20.4	1,100	27.3	1,370	29.7	1,020	27.4	1,110
Annual Average	**25.7**	**1,260**	**21.7**	**1,200**	**23.0**	**1,260**	**25.7**	**1,170**	**28.7**	**1,250**

Table 2.04-5 Influent NH_3-N Load Summary

The average influent NH_3-N concentration and load from this period are approximately 25 mg/L and 1,230 lb/day. NH_3-N loads have remained relatively constant throughout the years. As was noted with the influent BOD_5 loadings, the influent NH3-N loadings are significantly lower during the summer when the student population of the service area is reduced. The 7-day and 30-day rolling averages were created to approximate maximum week and maximum month conditions. The 7-day and 30-day rolling averages are presented in Table 2.04-6.

	NH_3-N Load (lb/day)					
	2017	2018	2019	2020	2021	2017 to 2021
Average	1,260	1,200	1,260	1,170	1,250	1,230
Maximum Month (30-day)	1,590	1,590	1,650	1,620	1,580	1,650
Maximum Week (7-day)	1,740	1,730	1,880	1,750	1,710	1,880
Maximum Day	1,910	1,960	2,240	1,900	1,790	2,240

Table 2.04-6 Maximum Influent NH_3-N Load Summary

Influent samples are analyzed for TKN once per month. Because the dataset for influent NH_3-N is larger than the influent TKN dataset, an evaluation of the historical ratio of influent NH_3-N to TKN was conducted to estimate influent TKN for days that NH_3-N was analyzed but not TKN. The measured influent NH_3-N to TKN ratio for January 2017 through December 2021, based on days when both parameters were analyzed, is presented in Figure 2.04-1. During this period, the ratio was in the range of 0.46 to 0.98, with an average value of 0.66.

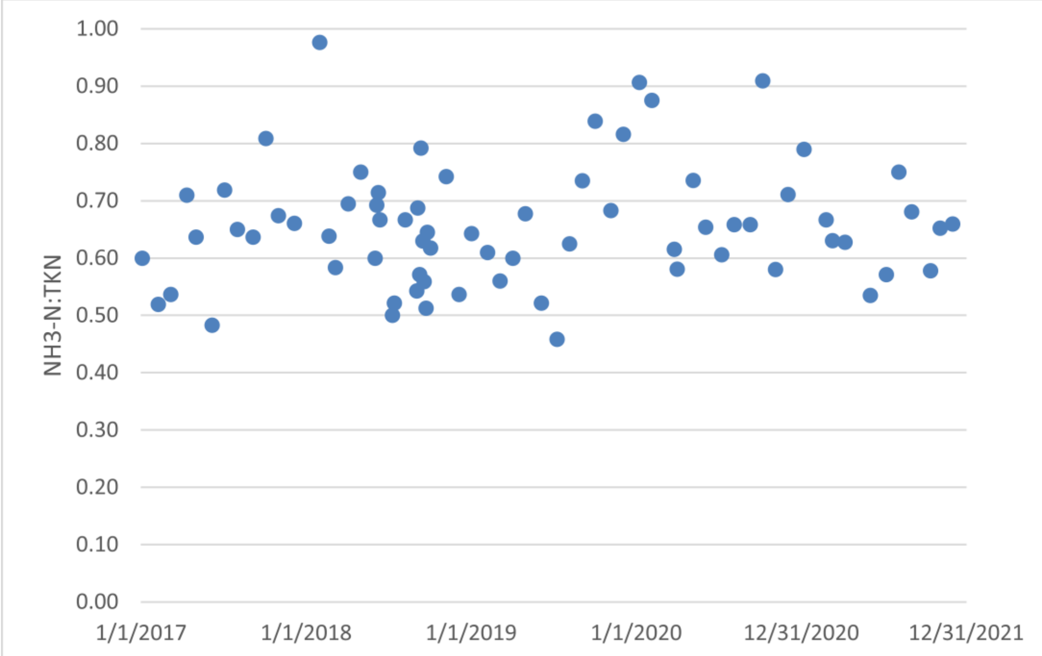


Figure 2.04-1 Influent NH_3-N:TKN

Influent TKN was estimated for days that it was not measured using the measured NH_3-N and the average NH_3-N:TKN ratio of 0.66 and added to the dataset of directly measured TKN data. Influent TKN concentrations and loads from January 2017 through December 2021 are presented in Table 2.04-7.

	Influent TKN									
	2017		2018		2019		2020		2021	
	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)
January	41.9	2,060	51.5	2,180	37.1	1,860	41.2	1,960	46.1	1,760
February	40.7	2,140	50.5	2,240	41.1	2,130	46.3	2,400	49.5	2,060
March	35.2	2,000	40.1	1,970	32.8	1,990	34.9	1,920	39.6	1,950
April	30.7	2,130	37.9	2,190	34.3	2,020	30.0	1,550	42.2	2,010
May	22.4	1,540	26.6	1,500	23.3	1,610	28.9	1,510	37.9	1,670
June	28.6	1,360	20.9	1,350	23.5	1,370	28.2	1,370	38.7	1,590
July	32.0	1,320	18.7	1,010	24.9	1,310	32.7	1,350	39.2	1,550
August	43.6	1,910	32.0	1,820	36.8	1,690	38.5	1,680	46.1	1,990
September	50.6	2,250	26.5	1,960	42.0	2,230	42.4	1,870	47.0	2,030
October	47.2	2,370	27.8	2,090	36.9	2,300	50.7	2,180	49.4	2,280
November	48.3	2,100	32.1	1,860	45.6	2,350	47.5	1,930	45.5	2,140
December	48.1	1,810	31.3	1,690	40.9	2,060	44.9	1,540	41.5	1,680
Annual Average	39.0	1,910	32.9	1,820	34.8	1,910	38.8	1,760	43.5	1,890

Table 2.04-7 Influent TKN Load Summary

The average influent TKN concentration and load from this period are approximately 38 mg/L and 1,860 lb/day. The 7-day and 30-day rolling averages were created to approximate table maximum week and maximum month conditions. The seven-day and 30-day rolling averages are presented in Table 2.04-8.

	TKN Load (lb/day)					
	2017	2018	2019	2020	2021	2017 to 2021
Average	1,910	1,820	1,910	1,760	1,890	1,860
Maximum Month (30-day)	2,410	2,370	2,500	2,460	2,390	2,500
Maximum Week (7-day)	2,640	2,560	2,810	2,660	2,590	2,810
Maximum Day	2,900	2,970	3,390	2,880	2,720	3,390

Table 2.04-8 Maximum Influent TKN Load Summary

D. Total Phosphorus

Influent samples are analyzed for total phosphorus (TP) once per month. Measured TP concentrations and loads from January 2017 through December 2021 are presented in Table 2.04-9.

	2017		2018		2019		2020		2021	
	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)
January	5.6	230	4.6	200	4.8	250	4.7	220	6.4	230
February	5.3	250	3.0	140	5.4	300	4.9	250	5.8	270
March	4.8	270	6.2	300	5.6	270	3.1	200	5.2	250
April	3.8	250	4.6	260	4.2	260	3.8	200	5.3	270
May	2.6	220	3.8	310	2.0	120	4.4	210	--	--
June	4.2	210	3.7	170	2.1	150	4.3	240	7.2	300
July	4.4	180	3.0	170	3.1	180	4.4	180	5.4	220
August	4.9	200	1.4	80	4.1	180	5.3	200	5.0	180
September	6.7	290	3.6	260	7.0	320	5.4	260	5.9	270
October	6.6	290	2.6	220	3.9	270	5.0	210	4.5	210
November	6.5	320	4.2	270	4.8	260	6.1	250	5.7	280
December	6.7	300	4.2	270	4.6	260	6.0	210	6.2	300
Annual Average	**5.2**	**250**	**3.6**	**230**	**4.3**	**240**	**4.8**	**220**	**5.7**	**250**

Table 2.04-9 Influent TP Load Summary

The average influent TP concentration and load from this period are approximately 4.5 mg/L and 235 lb/day. As TP samples are analyzed only once per month, 7-day and 30-day rolling averages were not calculated for TP.

E. Influent Load Summary

Table 2.04-10 presents the WPCF influent loads compared to year 2010 design capacity as reported in *1988 Water Pollution Control Facility Combined Record Drawings* prepared by Rieke, Caroll, Muller Associates Inc. The annual averages presented are the highest annual average from the five years of data evaluated for this Plan. Based on the design criteria, the WPCF is operating approximately 15 to 17 percent below design load for BOD_5, slightly above the design load for TSS, and approximately 40 percent below design load for NH_3-N and TKN.

Parameter	Influent Load	Basis of Design	Percent of Design Capacity
	(lb/d)	(lb/d)	
BOD_5			
Average Annual	10,590	12,430	85%
Maximum Month	13,410	16,150	83%
Maximum Day	17,340	23,740	73%
TSS			
Average Annual	12,080	11,560	104%
Maximum Month	16,400	16,190	101%
Maximum Day	34,110	25,440	134%
NH_3-N			
Average Annual	1,260	1,970	64%
Maximum Month	1,650	2,750	60%
Maximum Day	2,240	3,850	58%
TKN			
Average Annual	1,910	3,540	54%
Maximum Month	2,500	4,950	51%
Maximum Day	3,390	6,930	49%

Table 2.04-10 Existing Facility Design Load Summary

2.05 BIOSOLIDS MANAGEMENT

Waste sludge from the intermediate and final clarifiers are pumped to the primary clarifiers for co-thickening. Primary sludge is then pumped to the anerobic digesters. Primary sludge is analyzed for total solids (TS) and VS once per week. Primary sludge data from January 2017 through December 2021 is presented in Table 2.05-1. Over this period, an average of 15,800 gallons per day (gpd) of primary sludge at 5.3 percent TS, or approximately 6,560 lb/day, was pumped to the anaerobic digesters. At an average VS content of 80.3 percent, this corresponds to approximately 5,230 lb/day of primary sludge VS.

	2017	2018	2019	2020	2021	Average
Flow, gpd	19,000	17,500	16,400	11,700	14,600	15,800
Percent Total Solids	4.9	5.8	5.6	5.0	4.9	5.3
Percent Volatile	79.7	76.5	80.0	82.5	82.9	80.3
TS, lb/day	7,360	7,940	7,200	4,810	5,520	6,560
VS, lb/day	5,840	6,060	5,740	3,970	4,560	5,230

Table 2.05-1 Primary Sludge Summary

The anaerobic digesters at the WPCF are continuously fed primary sludge 7 days per week. Digested sludge is analyzed for percent TS and percent VS twice a week, while supernatant is analyzed for percent TS and percent VS once a week. Digested sludge data from January 2017 through December 2021 is presented in Table 2.05-2. Based on the average VS content of the digester feed solids (80.3 percent) and digested sludge (65.6 percent), the anaerobic digesters currently achieve approximately 53 percent VS reduction.

	2017	2018	2019	2020	2021	Average
Flow, MGD	0.019	0.018	0.016	0.012	0.015	0.016
Percent TS						
Primary Digester No. 1	2.08	2.78	3.18	2.64	1.74	2.56
Primary Digester No. 2	2.40	2.65	2.87	1.85	2.45	2.49
Average	2.58	2.70	3.13	2.54	2.23	2.57
Percent VS						
Primary Digester No. 1	72.0	68.4	72.1	73.3	71.5	71.3
Primary Digester No. 2	71.5	71.8	70.7	77.5	74.6	72.7
Average	73.9	69.9	71.9	73.8	73.7	72.2
Digested Sludge	65.5	63.7	61.0	65.8	69.4	65.6

Table 2.05-2 Digested Sludge Summary

2.06 WASTEWATER TREATMENT PERFORMANCE

A. Overall WPCF Performance

The WPCF effluent limits for Outfall 001 are presented in Table 2.06-1. A copy of the City's National Pollutant Discharge Elimination System (NPDES) permit is included in Appendix A.

Table 2.06-1 WPCF NPDES Permit Limits

Parameter	Effluent Limits		
	Limit Type	**Concentration Limit**	**Mass Limit**
$CBOD_5$			
	Monthly Average	20 mg/L	2,018 lb/day
	Weekly Average	30 mg/L	3,027 lb/day
TSS			
	Monthly Average	30 mg/L	3,027 lb/day
	Weekly Average	45 mg/L	4,541 lb/day
Ammonia Nitrogen			
January	Monthly Average	3.4 mg/L	343.6 lb/day
January	Daily Maximum	15.2 mg/L	1,532.7 lb/day
February	Monthly Average	4.0 mg/L	398.8 lb/day
February	Daily Maximum	14.2 mg/L	1,432.7 lb/day
March	Monthly Average	3.4 mg/L	343.6 lb/day
March	Daily Maximum	14.7 mg/L	1,482 lb/day
April	Monthly Average	1.5 mg/L	153.8 lb/day
April	Daily Maximum	15.7 mg/L	1,584 lb/day
May	Monthly Average	1.7 mg/L	175.4 lb/day
May	Daily Maximum	15.2 mg/L	1,532.7 lb/day
June	Monthly Average	1.3 mg/L	131 lb/day
June	Daily Maximum	11.5 mg/L	1,161 lb/day
July	Monthly Average	1.0 mg/L	101.4 lb/day
July	Daily Maximum	8.5 mg/L	858 lb/day
August	Monthly Average	1.0 mg/L	96.3 lb/day
August	Daily Maximum	10.0 mg/L	1,009 lb/day
September	Monthly Average	1.1 mg/L	106.6 lb/day
September	Daily Maximum	14.0 mg/L	1,382.5 lb/day
October	Monthly Average	1.6 mg/L	157.0 lb/day
October	Daily Maximum	15.7 mg/L	1,584 lb/day
November	Monthly Average	2.3 mg/L	234.1 lb/day
November	Daily Maximum	14.7 mg/L	1,482 lb/day
December	Monthly Average	2.5 mg/L	249.7 lb/day
December	Daily Maximum	16.0 mg/L	1,610.8 lb/day
pH			
	Daily Minimum	6.5 s.u.	
	Daily Maximum	9.0 s.u.	
E. Coli			
	Geometric Mean	126 #/100 mL	March through November
Dissolved Oxygen (DO)			
	Daily Minimum	5.0 mg/L	

Note: s.u.=standard units
#/100 mL=E. Coli per 100 mL

A summary of WPCF performance for 5-day carbonaceous biological oxygen demand ($CBOD_5$), TSS, and NH_3-N are presented in Tables 2.06-2 through 2.06-4. These tables present monthly average plant influent, primary effluent, first stage trickling filter effluent, intermediate clarifier effluent, second stage trickling filter effluent, and final effluent data. During this period, there was no exceedances of the monthly average effluent limits.

Table 2.06-2 WPCF Performance Summary: BOD_5/$CBOD_5$

	Influent BOD_5	Primary Effluent $cBOD_5$	First-Stage Trickling Filter $cBOD_5$	Intermediate Clarifier Effluent $cBOD_5$	Second-Stage Trickling Filter $cBOD_5$	Plant Effluent $cBOD_5$	
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(lb/day)
January 2017	213	94	97	10	5.2	4.1	202
February 2017	198	93	70	9.0	5.4	3.9	203
March 2017	190		85	9.3	7.3	4.7	278
April 2017	167	84	102	11	6.4	5.0	347
May 2017	143	59	53	6.7	5.1	4.0	275
June 2017	185	80	89	6.8	5.4	4.2	203
July 2017	185	90	124	10	6.5	4.7	191
August 2017	217	92	75	13	8.7	4.3	183
September 2017	220	94	99	18	14.1	5.3	234
October 2017	205	92	80	11	7.2	5.2	262
November 2017	221	81	57	10	6.6	5.3	231
December 2017	259	105	75	11	6.3	4.5	168
January 2018	250	86	71	10	7.7	5.4	229
February 2018	272	113	94	12	11.0	7.1	314
March 2018	220	97	79	11	10.0	6.1	309
April 2018	219	114	82	11	8.9	6.4	373
May 2018	193	109	100	10	8.1	5.6	325
June 2018	127	61	60	7.3	8.3	4.8	358
July 2018	155	69	56	8.2	6.8	4.3	274
August 2018	161	68	89	9.4	7.4	4.3	243
September 2018	153	68	63	9.1	7.7	4.6	350
October 2018	155	66	77	8.4	6.7	4.6	366
November 2018	196	72	84	8.9	6.3	4.5	258
December 2018	204	132	92	12	8.1	5.6	302
January 2019	208	79	73	10	7.7	5.5	275
February 2019	210	125	102	14	10.3	7.5	385
March 2019	190	90	97	12	10.4	8.2	513
April 2019	207	81	102	8.8	8.6	5.3	314
May 2019	162	82	115	8.8	7.9	5.8	440
June 2019	163	75	133	9.3	8.1	4.8	286
July 2019	162	61	75	7.6	7.1	4.2	230
August 2019	216	78	119	7.9	5.8	3.7	170
September 2019	205	176	72	10	9.3	4.0	215
October 2019	170	93	76	8.1	7.4	4.2	268
November 2019	206	94	80	10	7.3	4.4	223
December 2019	189	86	67	9.1	6.0	4.4	223
January 2020	206	85	68	8.8	6.6	4.9	232
February 2020	212	95	83	10	9.5	5.2	268
March 2020	172	73	54	8.8	6.7	4.8	266
April 2020	194	71	75	8.7	6.6	4.5	235
May 2020	183	85	87	8.4	6.9	4.7	252
June 2020	188	73	77	6.6	5.1	4.1	199
July 2020	206	85	86	10	6.8	3.9	159
August 2020	218	92	93	7.5	5.9	3.9	168
September 2020	241	94	81	10	6.9	6.0	267
October 2020	226	104	76	10	6.2	4.6	197

	Influent BOD_5	Primary Effluent $cBOD_5$	First-Stage Trickling Filter $cBOD_5$	Intermediate Clarifier Effluent $cBOD_5$	Second-Stage Trickling Filter $cBOD_5$	Plant Effluent $cBOD_5$	
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(lb/day)
November 2020	245	105	68	10	7.6	4.7	193
December 2020	225	99	72	10	6.1	4.3	149
January 2021	258	104	68	10	7.3	5.2	199
February 2021	260	107	78	13	8.3	6.9	286
March 2021	216	89	85	11	7.9	5.8	287
April 2021	233	112	128	12	9.0	5.8	277
May 2021	232	97	100	16	12.6	6.5	287
June 2021	254	96	107	11	9.0	5.0	207
July 2021	222	85	88	11	7.3	4.9	193
August 2021	230	89	100	9.0	7.0	5.0	216
September 2021	259	93	103	17	11.9	5.7	247
October 2021	205	85	63	11	8.2	5.5	255
November 2021	221	99	88	9.0	6.4	4.4	206
December 2021	215	97	102	8.9	6.5	4.5	184
2017 Average	**200**	**87**	**84**	**10**	**7.0**	**4.6**	**231**
2018 Average	**192**	**88**	**78**	**10**	**8.1**	**5.3**	**308**
2019 Average	**190**	**95**	**93**	**10**	**8.0**	**5.1**	**294**
2020 Average	**210**	**88**	**77**	**9**	**6.7**	**4.6**	**215**
2021 Average	**234**	**96**	**94**	**12**	**8.5**	**5.4**	**237**
2017 to 2021 Average	**205**	**91**	**85**	**10**	**7.7**	**5.0**	**257**

Table 2.06-3 WPCF Performance Summary: TSS

	Influent	Primary Effluent	First-Stage Trickling Filter	Intermediate Clarifier Effluent	Second-Stage Trickling Filter	Plant Effluent	
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(lb/day)
January 2017	277	85	164	8	9	5.4	265
February 2017	216	76	115	8	8	5.0	265
March 2017	226	-	223	9	9	5.3	307
April 2017	208	77	280	10	12	6.1	429
May 2017	171	40	63	5	6	4.6	311
June 2017	257	80	348	9	11	6.1	297
July 2017	226	97	367	21	19	6.6	271
August 2017	276	93	199	35	26	9.2	393
September 2017	281	86	188	61	68	18.4	822
October 2017	240	80	165	18	22	8.4	407
November 2017	257	70	122	14	14	6.9	299
December 2017	321	72	114	12	12	6.3	232
January 2018	243	58	85	11	13	6.7	282
February 2018	275	99	134	12	17	8.0	355
March 2018	221	67	150	9	15	6.3	308
April 2018	228	117	160	9	10	5.2	303
May 2018	215	96	369	11	18	7.8	449
June 2018	190	68	151	10	19	7.0	494
July 2018	194	75	189	17	16	6.8	457
August 2018	164	65	322	14	13	6.8	393
September 2018	194	61	111	17	18	9.5	696
October 2018	161	52	161	11	13	7.3	586
November 2018	262	78	213	12	12	7.1	407
December 2018	216	119	157	12	13	7.6	401
January 2019	221	70	105	10	12	6.6	336
February 2019	278	157	158	14	16	9.2	477
March 2019	211	97	163	15	16	9.9	613
April 2019	199	64	203	10	14	6.2	363
May 2019	209	107	367	11	13	9.0	708
June 2019	192	100	854	14	20	7.9	473
July 2019	196	60	222	13	20	6.7	376
August 2019	254	64	306	12	18	7.0	321
September 2019	213	62	119	24	32	8.4	447
October 2019	184	70	107	17	17	6.0	381
November 2019	240	76	148	17	17	7.0	361
December 2019	184	66	96	13	14	6.3	312
January 2020	249	63	114	10	11	6.2	293
February 2020	239	69	207	10	15	6.7	346
March 2020	176	57	70	9	13	6.5	356
April 2020	221	60	162	11	14	7.2	370
May 2020	170	69	239	11	15	5.8	304
June 2020	203	47	207	13	10	5.5	264
July 2020	215	67	163	18	19	7.9	317
August 2020	242	63	212	13	11	5.9	260
September 2020	256	73	135	27	24	10.5	463
October 2020	207	74	117	15	17	6.2	266
November 2020	237	77	100	14	18	9.0	364

	Influent	Primary Effluent	First-Stage Trickling Filter	Intermediate Clarifier Effluent	Second-Stage Trickling Filter	Plant Effluent	
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(lb/day)
December 2020	209	70	125	10	12	5.6	190
January 2021	263	71	90	10	11	5.7	217
February 2021	265	74	102	15	12	8.3	346
March 2021	181	67	88	17	12	6.0	296
April 2021	177	79	230	13	17	6.7	319
May 2021	205	61	124	27	27	9.6	422
June 2021	236	66	191	29	26	9.1	374
July 2021	230	56	172	32	25	9.3	368
August 2021	250	76	239	15	17	7.6	326
September 2021	277	98.0	249	37	43.1	14.4	624
October 2021	152	61	86	17	14	7.3	341
November 2021	248	98	166	17	15	6.9	329
December 2021	209	73	267	12	15	5.6	232
2017 Average	**246**	**78**	**202**	**17**	**18**	**7.3**	**356**
2018 Average	**213**	**79**	**191**	**12**	**14**	**7.2**	**427**
2019 Average	**214**	**84**	**253**	**14**	**17**	**7.5**	**429**
2020 Average	**218**	**66**	**154**	**13**	**15**	**6.8**	**316**
2021 Average	**224**	**73**	**171**	**20**	**20**	**8.0**	**350**
2017 to 2021 Average	**223**	**76**	**194**	**15**	**17**	**7.4**	**376**

Table 2.06-4 WPCF Performance Summary: NH_3-N

	Influent	Primary Effluent	First-Stage Trickling Filter	Intermediate Clarifier Effluent	Second-Stage Trickling Filter	Plant Effluent	
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(lb/day)
January 2017	27.5	19.6	11.0	4.4	0.2	0.2	10.2
February 2017	26.5	22.4	14.2	6.9	0.3	0.2	8.9
March 2017	23.0	-	7.7	3.5	0.2	0.2	13.7
April 2017	20.3	14.4	6.6	2.6	0.1	0.1	9.0
May 2017	14.8	9.4	2.5	0.7	0.1	0.1	8.8
June 2017	18.6	12.0	4.1	0.7	0.1	0.1	7.0
July 2017	21.2	16.3	6.7	0.9	0.2	0.2	6.4
August 2017	28.7	18.0	8.2	1.8	0.1	0.2	7.0
September 2017	33.4	22.2	12.7	4.7	0.2	0.2	8.2
October 2017	31.5	20.7	11.3	4.0	0.1	0.1	7.3
November 2017	31.9	23.1	12.4	6.2	0.8	0.4	15.2
December 2017	31.7	22.8	11.8	4.2	0.2	0.1	4.9
January 2018	34.6	22.9	13.5	5.4	0.5	0.4	15.9
February 2018	33.3	27.9	18.0	10.0	1.4	0.9	40.2
March 2018	26.3	20.9	11.3	6.6	0.2	0.2	9.4
April 2018	25.1	17.6	11.2	7.1	0.2	0.2	10.7
May 2018	17.7	10.6	3.6	1.8	0.1	0.2	9.8
June 2018	13.8	9.3	2.2	0.7	0.2	0.1	10.9
July 2018	12.1	7.6	2.0	0.9	0.1	0.1	8.2
August 2018	21.1	14.6	8.9	3.7	0.3	0.2	11.9
September 2018	17.0	12.1	6.2	3.1	0.1	0.1	11.4
October 2018	18.3	14.6	9.4	5.1	0.1	0.2	13.3
November 2018	21.3	17.0	13.2	5.2	0.2	0.2	9.3
December 2018	20.4	13.0	6.9	3.0	0.1	0.1	5.9
January 2019	24.4	16.7	8.8	4.9	0.2	0.2	10.4
February 2019	27.0	22.3	14.6	9.2	0.3	0.2	10.0
March 2019	21.4	15.7	8.8	5.8	0.2	0.2	16.3
April 2019	22.5	13.9	6.1	4.1	0.1	0.1	6.3
May 2019	15.4	11.5	5.8	4.2	0.1	0.2	12.7
June 2019	15.3	11.7	4.9	2.7	0.1	0.1	7.4
July 2019	16.2	8.4	2.4	0.8	0.1	0.1	6.6
August 2019	24.2	14.9	7.4	2.2	0.1	0.1	5.8
September 2019	27.9	19.6	10.0	2.8	0.1	0.1	6.4
October 2019	24.6	20.0	9.4	6.8	0.4	0.2	15.0
November 2019	30.2	22.6	9.6	4.3	0.2	0.2	10.4
December 2019	27.3	18.4	6.8	3.4	0.1	0.1	7.1
January 2020	27.5	17.1	8.8	5.1	0.2	0.2	11.3
February 2020	31.0	21.6	11.8	7.4	0.2	0.1	7.1
March 2020	23.0	15.4	6.4	2.8	0.2	0.1	5.9
April 2020	19.7	12.1	3.8	0.9	0.1	0.1	5.5
May 2020	19.2	10.4	2.4	0.5	0.1	0.1	5.8
June 2020	18.6	9.8	2.2	0.2	0.1	0.1	5.9
July 2020	21.5	12.4	2.9	0.3	0.1	0.1	4.5
August 2020	25.4	16.6	6.5	1.5	0.1	0.1	4.9
September 2020	28.0	17.6	7.2	1.9	0.1	0.1	4.8
October 2020	34.0	23.0	8.8	2.5	0.1	0.1	5.2
November 2020	31.2	20.1	8.7	3.2	0.2	0.1	5.3

	Influent	Primary Effluent	First-Stage Trickling Filter	Intermediate Clarifier Effluent	Second-Stage Trickling Filter	Plant Effluent	
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(lb/day)
December 2020	29.7	17.1	6.6	2.6	0.1	0.1	3.9
January 2021	30.7	19.0	9.0	4.7	0.2	0.2	8.4
February 2021	32.7	21.8	11.8	7.5	0.1	0.2	8.8
March 2021	26.1	16.1	8.3	4.8	0.1	0.1	5.6
April 2021	27.8	16.4	9.2	5.3	0.1	0.1	5.5
May 2021	25.0	15.2	5.6	2.1	0.1	0.1	5.2
June 2021	25.3	14.4	4.4	0.8	0.1	0.1	4.9
July 2021	25.7	14.9	4.8	0.5	0.1	0.1	4.6
August 2021	30.6	17.8	7.2	1.5	0.1	0.2	7.7
September 2021	31.0	20.3	9.2	2.4	0.1	0.1	4.7
October 2021	32.4	23.9	10.6	3.5	0.2	0.1	7.1
November 2021	30.0	22.1	10.7	4.6	0.2	0.2	8.2
December 2021	27.4	19.8	9.0	3.0	0.1	0.1	4.9
2017 Average	**25.7**	**18.0**	**8.8**	**3.3**	**0.2**	**0.2**	**8.9**
2018 Average	**21.7**	**15.9**	**8.3**	**4.3**	**0.3**	**0.2**	**12.9**
2019 Average	**23.0**	**16.3**	**7.6**	**4.3**	**0.2**	**0.2**	**9.5**
2020 Average	**25.7**	**16.2**	**6.2**	**2.4**	**0.1**	**0.1**	**5.8**
2021 Average	**28.7**	**18.3**	**8.1**	**3.4**	**0.1**	**0.1**	**6.3**
2017 to 2021 Average	**25.0**	**16.9**	**7.8**	**3.6**	**0.2**	**0.2**	**8.7**

The 30-day rolling averages of intermediate clarifier effluent; second-stage trickling filter effluent; and final effluent $cBOD_5$, TSS, and NH_3-N are presented in Figures 2.06-1 through 2.06-3. As shown, the intermediate clarifier effluent has historically been below the effluent $CBOD_5$ limit of 20 mg/L but above the effluent NH_3-N limits, demonstrating the need for the second-stage trickling filters for nitrification.

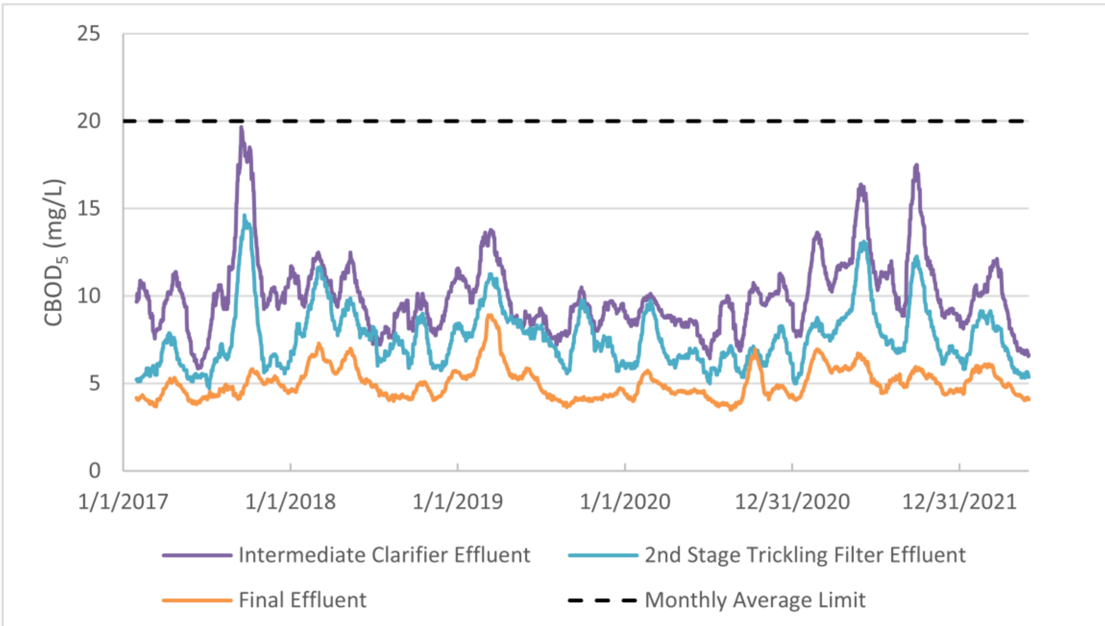


Figure 2.06-1 Intermediate Clarifier, Second-Stage Trickling Filter, and Final Effluent $CBOD_5$ Concentration 30-Day Rolling Average

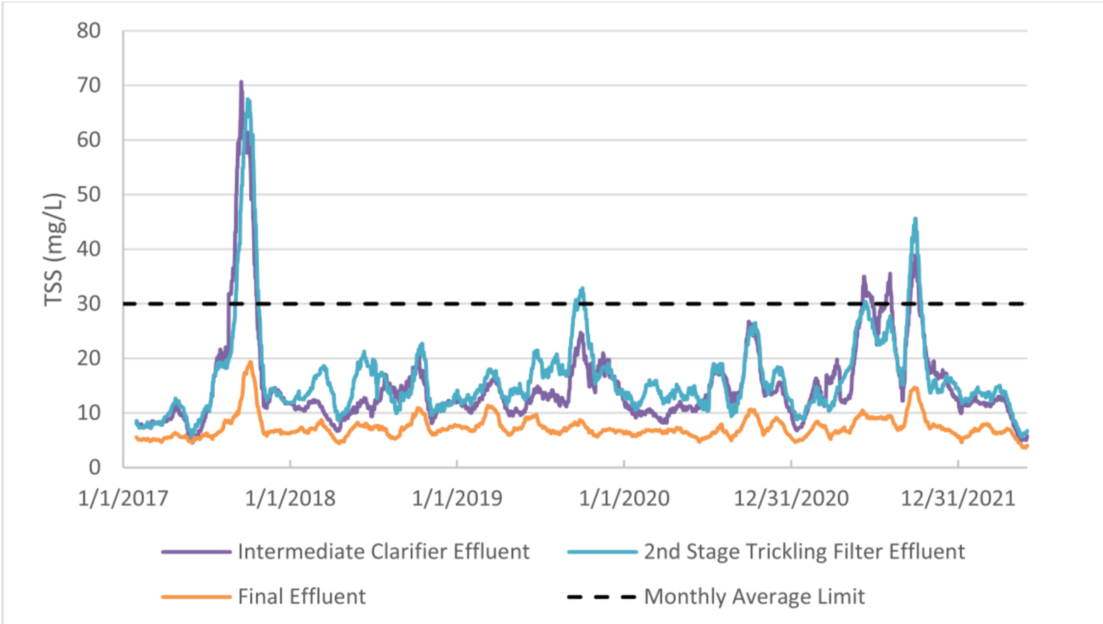


Figure 2.06-2 Intermediate Clarifier, Second Stage Trickling Filter, and Final Effluent TSS Concentration 30-Day Rolling Average

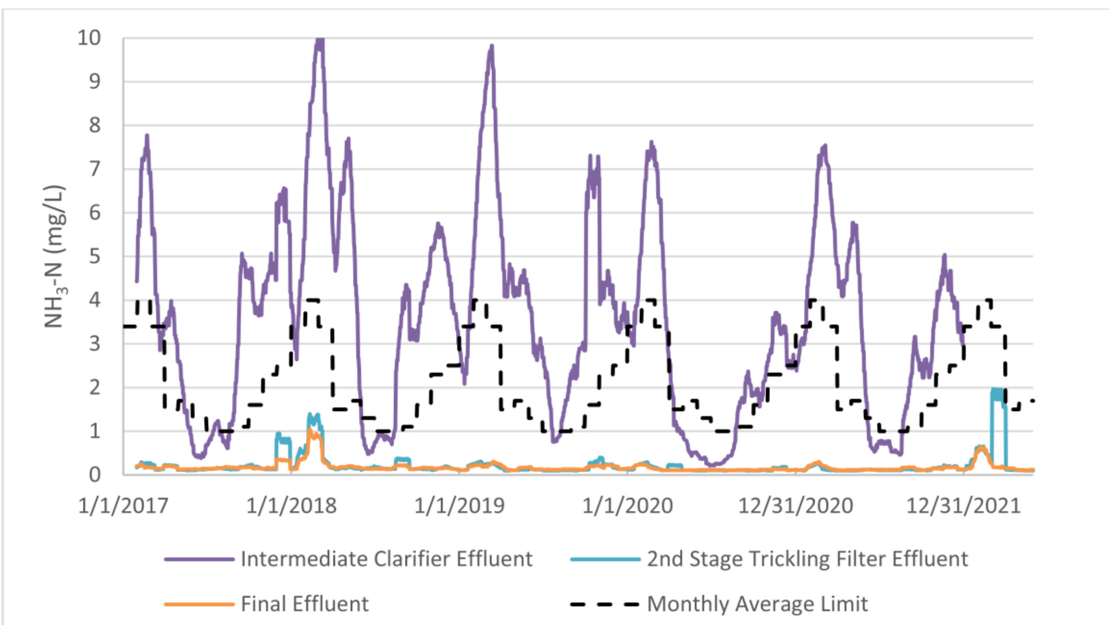


Figure 2.06-3 Intermediate Clarifier, Second Stage Trickling Filter, and Final Effluent NH_3-N Concentration 30-Day Rolling Average

While the City does not currently have total nitrogen (TN) and TP limits, effluent samples are analyzed for TN and TP once per week. Table 2.06-5 and 2.06-6 present monthly average TN and TP sample results, respectively. Over the five-year period evaluated for this Plan, the average effluent TN concentration and load were 25 mg/L and 1,270 lb/day , respectively, and the average effluent TP concentration and load were 3.8 mg/L and 196 lb/day , respectively.

	2017		2018		2019		2020		2021	
	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)	Conc. (mg/L)	Load (lb/day)
January	28	1,140	33	1,470	21	1,100	21	980	24	860
February	35	1,640	35	1,580	28	1,550	25	1,290	32	1,490
March	23	1,300	33	1,590	31	1,500	17	1,090	29	1,400
April	22	1,450	25	1,440	24	1,460	22	1,180	22	1,120
May	16	1,350	24	1,940	27	1,680	26	1,230	--	--
June	21	1,050	22	1,080	24	1,670	15	850	21	870
July	26	1,080	10	580	18	1,060	21	870	20	820
August	22	900	18	980	26	1,170	24	910	21	760
September	29	1,230	21	1,510	27	1,230	23	1,130	28	1,290
October	30	1,310	20	1,670	23	1,600	22	940	32	1,510
November	36	1,760	23	1,500	22	1,170	28	1,150	25	1,250
December	31	1,370	26	1,680	25	1,420	33	1,170	33	1,580
Annual Average	27	1,300	24	1,420	25	1,380	23	1,070	26	1,180

Table 2.06-5 Effluent TN Summary

	2017		2018		2019		2020		2021	
	Conc. (mg/L)	Load (lb/d)	Conc. (mg/L)	Load (lb/d)	Conc. (mg/L)	Load (lb/d)	Conc. (mg/L)	Load (lb/d)	Conc. (mg/L)	Load (lb/d)
January	4.1	170	4.8	210	2.7	140	3.6	170	4.8	170
February	4.5	210	2.4	110	3.5	190	3.7	190	4.7	220
March	3.6	200	4.9	240	3.6	170	2.1	130	4.5	220
April	3.4	220	3.3	190	2.9	180	2.9	160	4.6	230
May	2.2	190	3.8	310	2.6	160	4.2	200	--	--
June	3.2	160	3.7	170	3.8	260	2.1	120	4.0	170
July	4.7	190	1.2	60	2.0	120	3.7	150	4.3	180
August	4.0	160	1.4	80	3.5	160	4.4	170	4.4	160
September	5.5	230	2.9	210	4.6	210	5.1	250	4.9	230
October	5.7	250	2.7	220	3.9	270	4.9	210	5.0	240
November	5.2	250	3.3	210	4.2	220	5.4	220	4.3	210
December	4.9	220	3.1	200	4.1	230	4.6	160	5.2	250
Annual Average	4.3	210	3.0	190	3.5	190	3.9	180	4.6	210

Table 2.06-6 Effluent TP Load Summary

Table 2.05-7 presents a summary of the TN and TP removal performance of the WPCF. The existing WPCF is not designed for nutrient removal, but some removal occurs during BOD_5 removal for cell synthesis of both the attached growth (trickling filter) and suspended growth (solids contact) biomass. Under current plant operation, the WPCF provides approximately 33 percent TN removal and 18 percent TP removal. Not surprisingly, this is significantly less than the target goals of the Iowa Nutrient Reduction Strategy.

	TN			TP		
	Influent[a]	**Effluent**	**% Removal**	**Influent**	**Effluent**	**% Removal**
2017	1,975	1,299	34	250	205	18
2018	1,836	1,418	23	225	186	17
2019	1,949	1,384	29	235	194	18
2020	1,703	1,066	37	221	178	20
2021	1,981	1,176	41	253	206	19
2017 to 2021 Average	**1,889**	**1,269**	**33**	**237**	**194**	**18**

[a]Influent TN not measured. Influent TKN used to approximate influent TN.

Table 2.06-7 Nutrient Reduction Summary

SECTION 3
EXISTING COLLECTION AND CONVEYANCE FACILITIES

3.01 BACKGROUND

The City owns, operates, and maintains a sanitary collection and conveyance system that serves the users of the City. The City's overall collection system consists of laterals, force mains, trunk sewers, and interceptors with pipe sizes ranging from 4 inches to 66 inches. The collection system generally conveys flow to the large interceptors that run to the City's southeast boundary. A 66-inch interceptor conveys all of the wastewater from the City to the WPCF location approximately 4.1 miles to southeast of the City. Because of the topography of the tributary area, the City owns and operates four lift stations with a fifth lift station currently under construction. The collection system boundary is shown in Figure 3.01-1.

3.02 INFILTRATION/INFLOW (I/I) EVALUATION

Infiltration and inflow (I/I) are terms that are used to describe groundwater (infiltration) or stormwater (inflow) that enter the collection and conveyance system, mainly through deteriorated pipes or manholes and cross connections. A simplistic evaluation of existing I/I levels in the City collection system was conducted for this Plan. The I/I components were estimated based on flow records from January 2017 through December 2021. The dry weather flow (which still contains dry weather I/I) for each year was determined using the 30-day-minimum total influent flow. Wet weather I/I values were then calculated by subtracting total maximum influent flows from the 30-day-minimum total influent flow. Table 3.02-1 summarizes the 30-day maximum, 7-day maximum, and maximum day I/I for 2017 through 2021.

	2017	2018	2019	2020	2021	2017 to 2021 Average
30-day Minimum Flow (MGD)	4.40	4.16	5.36	4.10	4.08	4.42
30-day Maximum Flow (MGD)	8.64	11.29	9.28	7.03	6.12	8.47
7-day Maximum Flow (MGD)	10.45	14.86	12.12	8.67	6.80	10.58
Maximum Day Flow (MGD)	12.85	18.14	15.30	11.51	8.12	13.19
30-day Maximum I/I (MGD)	4.23	7.13	3.92	2.92	2.04	4.05
7-day Maximum I/I (MGD)	6.05	10.70	6.77	4.56	2.73	6.16
Maximum Day I/I (MGD)	8.44	13.98	9.95	7.41	4.04	8.76

Table 3.02-1 I/I Summary

United States Environmental Protection Agency (USEPA) documents identify excessive infiltration as dry weather per capita flows greater than 120 gallons per capita per day (gpcd) and excessive inflow as wet weather (defined as a maximum day flow) per capita flows greater than 275 gpcd.

Per capita flow rates were projected to determine whether excessive I/I exists in the collection system. Table 3.02-2 summarizes the evaluation of per capita I/I using the 2020 United States Census population of 66,427.

	2017	2018	2019	2020	2021	2017 to 2021 Average
Approximate Service Area Population	66,427	66,427	66,427	66,427	66,427	66,427
Dry Weather Flow						
30-day Minimum Flow (MGD)	4.40	4.16	5.36	4.10	4.08	4
Dry Weather Per Capita Flow (gpcd)	66	63	81	62	61	67
Wet Weather Flow						
30-day Maximum Flow (MGD)	8.64	11.29	9.28	7.03	6.12	8
30-day Maximum Per Capita Flow (gpcd)	130	170	140	106	92	128
7-day Maximum Flow (MGD)	10.45	14.86	12.12	8.67	6.80	11
7-day Maximum Per Capita Flow (gpcd)	157	224	182	130	102	159
Maximum Day Flow (MGD)	12.85	18.14	15.30	11.51	8.12	13
Maximum Day Per Capita Flow (gpcd)	193	273	230	173	122	198

Table 3.02-2 Per Capita Flow Summary

Based on this evaluation, the current dry weather and wet weather I/I are less than the USEPA standards for excessive I/I of 120 gpcd and 275 gpcd, respectively. While the dry weather flow values are likely impacted by the high transient student population (low flows occurring when students are not on campus), the City's dry weather I/I values are significantly less than the USEPA standard of 120 gpcd such that even with a reduced population (excluding some students) the City would not exceed the standard for excessive I/I. This is further evidenced by the wet weather per capita flow values (which are more likely to occur when students are on campus) being less than the USEPA standard for excessive I/I.

SECTION 4
LOAD AND FLOW FORECASTS

4.01 INTRODUCTION

This section presents wastewater flow and load projections for evaluating future WPCF capacity needs. Data from current conditions have been used together with population forecasts to project flows and loads for the City through the year 2045.

4.02 PLANNING AND SEWER SERVICE AREA

The City provides wastewater conveyance and treatment services to residential, commercial, industrial, and institutional users within the City boundaries. The planning area for this study consists of the existing service area and any additional areas that may be added to accommodate projected population growth.

4.03 POPULATION PROJECTION

The *2019 Nutrient Reduction Study* included population projections for the WPCF service area to the year 2040, based on methodology used in the City's *2012 Long Range Facility Plan*. In general, the *2019 Nutrient Reduction Study* assumed a growth rate of approximately 400 people per year starting from the 2016 census estimate. The City's *2021 Comprehensive Plan* also included population projections for land use planning, assuming a 1.5 percent annual growth rate with the addition of a student population equal to the student population in 2017. Table 4.03-1 and Figure 4.03-1 present a summary of the population projections, including further projections to the year 2045 using the same methodology as the *2019 Nutrient Reduction Study* and *2021 Comprehensive Plan*. For the purposes of this Facility Plan, the *2021 Comprehensive Plan* projected population of 83,850 for year 2045 will be used for the development of design criteria for a growth of approximately 17,423 persons from the 2020 census.

Year	Historical Census	*2019 Nutrient Reduction Study*	*2021 Comprehensive Plan*
2000	50,731	50,731	
2010	58,965	58,965	
2016	66,191	66,191	
2020	66,427	67,790	66,182
2025		69,790	69,210
2030		71,790	72,575
2033		72,990	
2035		73,790	75,987
2040		75,790	79,772
2045		77,790[a]	83,850[a]

Notes: [a] Projection extrapolated to year 2045

Table 4.03-1 Historical and Projected Population Projections

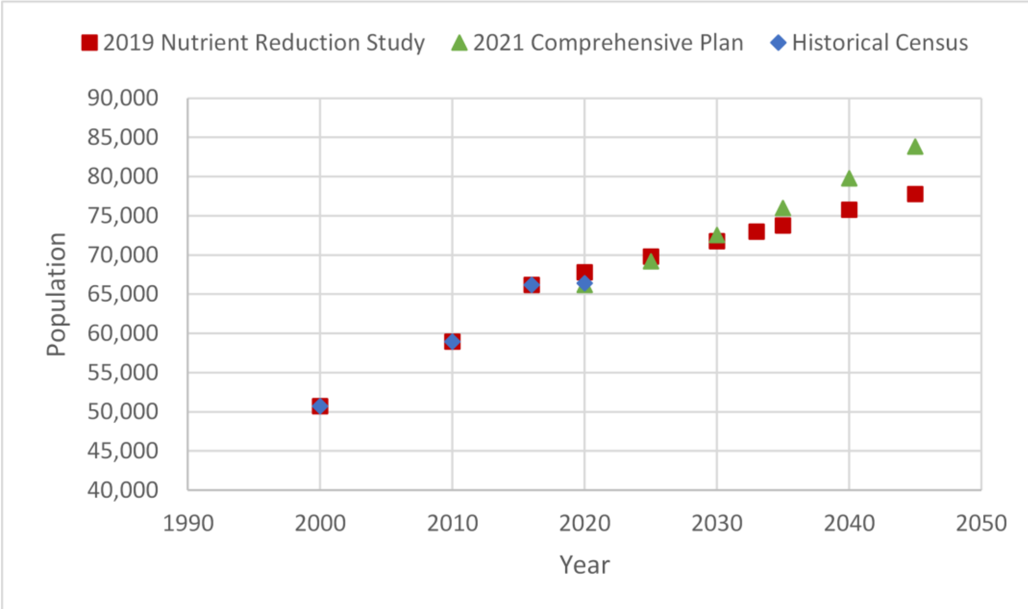


Figure 4.03-1 Historical Population and Projected Growth

4.04 FLOW FORECASTS

Wastewater management planning requires forecasting of various flows through the determination of existing base and peak flows and then projecting additional flows from growth.

A. Current Flows

A detailed evaluation of existing influent flows is presented in Section 2. A summary of influent flows for 2017 through 2021 is presented in Table 4.04-1 along with the total precipitation measured in the City (as reported by the City). According to the National Oceanic and Atmospheric Administration (NOAA), the annual average precipitation for the City is 35.8 inches, which was exceeded in both 2018 and 2019.

	2017	2018	2019	2020	2021	2017 to 2021
Minimum Day	2.90	3.78	4.12	3.36	3.48	2.90
Minimum Week (7-day)	3.45	3.52	4.83	3.83	3.85	3.45
Minimum Month (30-day)	4.40	4.16	5.36	4.10	4.08	4.08
Average Day	6.05	7.11	6.75	5.54	5.20	6.13
Maximum Month (30-day)	8.64	11.29	9.28	7.03	6.12	11.29
Maximum Week (7-day)	10.45	14.86	12.12	8.67	6.80	14.86
Maximum Day	12.85	18.14	15.30	11.51	8.12	18.14
Precipitation (in)	32.05	55.17	39.33	25.37	28.39	-

Note: All Values in MGD.

Table 4.04-1 Minimum and Maximum 24-Hour Average Flow Summary

B. Per Capita Flows

Influent flow to the WPCF consists of residential, commercial, institutional, and minor industrial sources in addition to I/I. A dry weather per capita flow was determined by identifying a 30-day period of low influent flow to the WPCF. Using the City's 2020 census population of 66,427, this results in an ADW per capita flows of 67 gpcd for 2017 through 2021. This flow also includes dry weather I/I. Repeating this method for the annual average and AWW influent flows results in annual average per capita flows of 92 gpcd and 128 gpcd, respectively. Along with low I/I, the large transient student population in the service area results in relatively low gpcd values. Based on this data, an ADW per capita flow of 81 gpcd and annual average per capita flow of 107 gpcd will be used for new growth in this Plan. A summary of the existing per capita flows is presented in Table 4.04-2.

	2017	2018	2019	2020	2021	2017 to 2021 Average
Average Dry Weather Flow						
30-day Minimum Flow (MGD)	4.40	4.16	5.36	4.10	4.08	4.42
Dry Weather Per Capita Flow (gpcd)	66	63	81	62	61	67
Annual Average Flow						
Average Influent Flow (MGD)	6.05	7.11	6.75	5.54	5.20	6.13
Average Per Capita Flow (gpcd)	91	107	102	83	78	92
Average Wet Weather Flow						
30-day Maximum Flow (MGD)	8.64	11.29	9.28	7.03	6.12	8.47
Wet Weather Per Capita Flow (gpcd)	130	170	140	106	92	128

Table 4.04-2 Average Per Capita Flow Summary

C. Wet Weather Flow Peaking Factors

Historical maximum flows presented in Table 4.04-1 were used to develop maximum day, maximum week, and maximum month peaking factors (based on average annual flow), as presented in Table 4.04-3. For purposes on this Plan, the maximum peaking factors over the five-year period evaluated are used for new residential growth to provide conservative design peak flows.

	2017	2018	2019	2020	2021	Value used for Future Growth
Maximum Month	1.4	1.6	1.4	1.3	1.2	1.6
Maximum Week	1.7	2.1	1.8	1.6	1.3	2.1
Maximum Day	2.1	2.6	2.3	2.1	1.6	2.6

Table 4.04-3 Influent Flow Peaking Factor Summary

D. Peak Instantaneous Flow Evaluation

As discussed in Section 2, historical daily reports from peak flow events between 2016 and 2021 were reviewed to identify the highest manually recorded instantaneous influent flow measurement during this period. The highest recorded instantaneous influent flow was approximately 30.8 MGD on July 6, 2018. This corresponds to a peak flow to annual average flow peaking factor of approximately 4.3. For the purposes of projecting future flows in this Plan, 30.8 MGD will be used as the current peak hourly flow and a peaking factor of 4.3 will be used to project future peak hourly flows from growth.

E. Flow Projections Summary

Flow projections were developed using the current average and peak flows and estimated flow addition from population growth. A reserve capacity of 1.5 MGD is also included for potential future industrial growth above the commercial and industrial increases associated with population growth. A summary of the flow projections is presented in Table. 4.04-4. The projected ADW flow is less than the current ADW flow of 8.6 MGD while the projected AWW flow is greater than the current AWW design flow of 12.1 MGD.

Design Condition	Current Flow[a] (MGD)	Additional Flow from Growth (MGD)	Reserve Capacity for Industrial Growth (MGD)	Total Flow (MGD)
Average Dry Weather	5.4	1.4[b]	1.5	8.3
Annual Average	7.1	1.9[c]	1.5	10.5
Average Wet Weather	11.3	3.0[d]	1.5	15.8
Maximum Week	14.9	3.9[e]	1.5	20.3
Maximum Wet Weather	18.1	4.8[f]	1.5	24.5
Peak Hourly Wet Weather	30.8	8.0[g]	1.5	40.3

[a]Using highest value from 2017 to 2021
[b]17,423 persons at 81 gpcd
[c]17,423 persons at 107 gpcd
[d]AWW to annual average peaking factor=1.6
[e]Maximum week to annual average peaking factor=2.1
[f]Maximum wet weather to annual average peaking factor=2.6
[g]Peak hourly flow to annual average peaking factor=4.3

Table 4.04-4 Flow Projection Summary

4.05 PROJECTED FACILITY LOADINGS

The development of projected loadings considers existing and future per capita loadings.

A. Existing Per Capita Loads and Peaking Factors

Existing per capita loads (pounds per capita per day [pcd]) were determined using current loads and the City's 2020 census population of 66,427, as presented in Table 4.05-1.

	2017	2018	2019	2020	2021	2017 to 2021 Average
Population Served	66,427	66,427	66,427	66,427	66,427	66,427
Influent BOD_5 Load (lb/day)	9,820	10,590	10,500	9,540	10,140	10,120
Per Capita BOD_5 Load (pcd)	0.15	0.16	0.16	0.14	0.15	0.15
Influent TSS Load (lb/day)	12,080	12,030	11,910	9,980	9,720	11,144
Per Capita TSS Load (pcd)	0.18	0.18	0.18	0.15	0.15	0.17
Influent TKN Load (lb/day)	1,910	1,820	1,910	1,760	1,860	1,860
Per Capital TKN Load (pcd)	0.029	0.027	0.029	0.026	0.028	0.028
Influent NH_3-N Load (lb/day)	1,260	1,200	1,260	1,170	1,250	1,228
Per Capita NH_3-N Load (pcd)	0.019	0.018	0.019	0.018	0.019	0.018
Influent TP Load (lb/day)	250	230	240	220	250	238
Per Capita TP Load (pcd)	0.0038	0.0035	0.0036	0.0033	0.0038	0.0036

Table 4.05-1 Average Influent Per Capita Load Summary

A comparison of the per capita loads (2017 through 2021 average) and typical per capita loads are presented in Table 4.05-2. As shown, the average loads to the WPCF are slightly lower than the values indicated in the *Iowa Wastewater Facilities Design Standards*. This is likely also influenced by the transient student population in the service area. For the purposes of this study, per capita loads of 0.17 pcd for BOD_5, 0.20 pcd for TSS will be used to project loading form growth to match the *Iowa Wastewater Facilities Design Standards* value closest to the historical per capita loads. In addition, per capita loads of 0.028 pcd for TKN, 0.018 pcd for NH_3-N, and 0.0036 pcd for TP will be used based on historical data for these parameters that are not included in the *Iowa Wastewater Facilities Design Standards*.

Parameter	Per Capita Loads (pcd)				
	2017 to 2021 Average	*Iowa Wastewater Facilities Design Standards* (without garbage grinders)	Ten States Standards (without garbage grinders)	Ten States Standards (with garbage grinders)	*Wastewater Engineering: Treatment and Reuse** (without garbage grinders)
BOD_5	0.15	0.17	0.17	0.22	0.22
TSS	0.17	0.20	0.20	0.25	0.25
TKN	0.028	-	0.036	0.046	0.032
NH_3-N	0.018	-	-	-	0.019
TP	0.0036	-	-	-	0.0076

**Wastewater Engineering: Treatment and Reuse,* Metcalf and Eddy, 2013

Table 4.05-2 Influent Per Capita Load Summary

B. Influent Load Peaking Factors

Existing influent load peaking factors are presented in Table 4.05-3. These peaking factors were calculated using the average and maximum values presented in Table 2.04-8. As noted, the NH_3-N peaking factors were used for TP because TP is only measured once per month.

	BOD_5	TSS	TKN	NH_3-N	TP
Maximum 30-day	1.3	1.4	1.4	1.3	1.3
Maximum Day	1.7	2.8	1.8	1.8	1.8

Table 4.05-3 Influent Load Peaking Factor Summary

C. Future Load Projections

Future loads to the WPCF were projected using the current loads (presented in Table 4.05-1), service area populations projection (presented in Table 4.03-1), and per capita values indicated earlier. The current average values used in these projections are based on the maximum annual average load over the 5-year period evaluated. Reserve capacity for industrial growth was also included at a population equivalent of 15,000 persons (corresponding with 1.50 MGD at 100 gpcd). Table 4.05-4 presents the projected 2045 average loads for BOD_5, TSS, TKN, NH_3-N and TP as well as the maximum month and maximum day loads using the peaking factors in Table 4.05-3.

	BOD_5 (lb/day)	TSS (lb/day)	TKN (lb/day)	NH_3-N (lb/day)	TP (lb/day)
Current Average[a]	10,590	12,080	1,910	1,260	250
Projected Residential Growth	2,960[b]	3,480[c]	490[d]	310[e]	60[f]
Reserve Capacity for Industrial Growth[g]	2,550[b]	3,000[c]	420[d]	270[e]	50[f]
Projected Average	**16,100**	**18,560**	**2,820**	**1,840**	**360**
Maximum Month Peaking Factor	1.3	1.4	1.4	1.3	1.3
Projected Maximum Month	20,930	25,980	3,950	2,390	470
Maximum Day Peaking Factor	1.7	2.8	1.8	1.8	1.8
Projected Maximum Day	27,370	51,970	5,080	3,310	650

[a]Maximum annual average from 2017 to 2021.
[b]Additional load at 0.17 pcd.
[c]Additional load at 0.20 pcd.
[d]Additional load at 0.028 pcd.
[e]Additional load at 0.018 pcd.
[f]Additional load at 0.0036 pcd.
[g]Industrial reserve loading based on population equivalency of 15,000.

Table 4.05-4 Projected 2045 Loads

4.06 SUMMARY OF PROJECTED FLOWS AND LOADS

A summary of the proposed 2045 design flows and loads are presented in Table 4.06-1. As noted earlier, the projected ADW flow is less than the current design ADW flow of 8.6 MGD. Therefore, the existing design ADW flow of 8.6 MGD is maintained in the proposed 2045 design criteria. While the projected 2045 TKN and NH3-N loadings are less than the current design loadings for these parameters, the projected 2045 loadings are used in the proposed 2045 design criteria rather than the existing design criteria to avoid oversizing equipment and the associated unit processes. Projected flows and loads for 2025, 2030, 2035, 2040, and 2045 are presented in Table 4.06-2 based on the *2021 Comprehensive Plan* population projections presented in Table 4.03-1 and the future industrial reserve load phased in over the 20-year planning period to provide flow and load targets for implementing improvements in phases.

Parameter	2045 Projection	Current Basis of Design	2045 Basis of Design
Flow, MGD			
ADW Flow	8.3	8.6	8.6
AWW Flow	15.8	12.1	15.8
Maximum Wet Weather Flow	24.5	20.4	24.5
Peak Hourly Flow	40.3	34.0	40.3
BOD_5, lb/day			
Average Annual	16,100	12,430	16,100
Maximum Month	20,580	16,150	20,580
Maximum Day	26,710	23,740	26,710
TSS, lb/day			
Average Annual	18,560	11,560	18,560
Maximum Month	25,470	16,190	25,470
Maximum Day	52,250	25,440	52,250
NH_3-N, lb/day			
Average Annual	1,840	1,970	1,840
Maximum Month	2,400	2,750	2,400
Maximum Day	3,430	3,850	3,430
TKN, lb/day			
Average Annual	2,820	3,540	2,820
Maximum Month	3,780	4,950	3,780
Maximum Day	5,330	6,930	5,330
TP, lb/day			
Average Annual	360	-	360
Maximum Month	480	-	480
Maximum Day	740	-	740

Table 4.06-1 Existing and Proposed Design Flow and Load Summary

Table 4.06-2 5-Year Increment Projected Flow and Load Summary

		2025			2030			2035			2040			2045		
	Current	Residential/ Commercial Growth	Industrial Reserve	Total	Residential/ Commercial Growth	Industrial Reserve	Total	Residential/ Commercial Growth	Industrial Reserve	Total	Residential/ Commercial Growth	Industrial Reserve	Total	Residential/ Commercial Growth	Industrial Reserve	Total
Population	66,427			69,210			72,575			75,987			79,772			83,850
Flow, MGD																
Minimum Month	5.4	0.2	0.5	6.1	0.5	1.0	6.9	0.8	1.0	7.1	1.1	1.5	7.9	1.4	1.5	8.3
Average Annual	7.1	0.3	0.5	7.9	0.7	1.0	8.8	1.0	1.0	9.1	1.4	1.5	10.0	1.9	1.5	10.5
Maximum Month	11.3	0.5	0.5	12.3	1.1	1.0	13.3	1.6	1.0	13.9	2.3	1.5	15.1	3.0	1.5	15.8
Maximum Day	18.1	0.8	0.5	19.4	1.7	1.0	20.9	2.7	1.0	21.8	3.7	1.5	23.4	4.8	1.5	24.5
Peak Hourly	30.8	1.3	0.5	32.6	2.8	1.0	34.6	4.4	1.0	36.2	6.1	1.5	38.4	8.0	1.5	40.3
BOD_5, lb/day																
Average Annual	10,590	470	850	11,910	1,050	1,700	13,340	1,630	1,700	13,920	2,270	2,550	15,410	2,960	2,550	16,100
Maximum Month	13,410	611	1,110	15,131	1,370	2,210	16,990	2,120	2,210	17,740	2,950	3,320	19,680	3,850	3,320	20,580
Maximum Day	17,340	799	1,450	19,589	2,330	2,890	22,560	2,770	2,890	23,000	3,860	4,340	25,540	5,030	4,340	26,710
TSS, lb/day																
Average Annual	12,080	560	1,000	13,640	1,230	2,000	15,310	1,910	2,000	15,990	2,670	3,000	17,750	3,480	3,000	18,560
Maximum Month	16,400	780	1,400	18,580	1,720	2,800	20,920	2,670	2,800	21,870	3,740	4,200	24,340	4,870	4,200	25,470
Maximum Day	34,110	1,570	3,920	39,600	4,820	5,600	44,530	5,350	5,600	45,060	7,480	8,400	49,990	9,740	8,400	52,250
NH_3-N, lb/day																
Average Annual	1,260	50	90	1,400	110	180	1,550	170	180	1,610	240	270	1,770	310	270	1,840
Maximum Month	1,650	70	120	1,840	140	230	2,020	220	230	2,100	310	350	2,310	400	350	2,400
Maximum Day	2,240	90	220	2,550	250	410	2,900	310	410	2,960	430	630	3,300	560	630	3,430
TKN, lb/day																
Average Annual	1,910	80	140	2,130	170	280	2,360	270	280	2,460	370	420	2,700	490	420	2,820
Maximum Month	2,500	110	200	2,810	240	390	3,130	380	390	3,270	520	590	3,610	690	590	3,780
Maximum Day	3,390	140	360	3,890	430	700	4,520	490	700	4,580	670	1,060	5,120	880	1,060	5,330
TP, lb/day																
Average Annual	250	10	20	280	20	40	310	30	40	320	50	50	350	60	50	360
Maximum Month	330	10	30	370	30	50	410	40	50	420	70	70	470	80	70	480
Maximum Day	440	20	50	510	50	90	580	50	90	580	90	130	660	110	130	680

SECTION 5
REGULATORY REVIEW

Permit limits and regulatory standards are revised as society's understanding of its environmental impact grows. Implementation of new permit limits and regulatory standards can require substantial changes in WPCF operations and treatment facility needs. New regulations affect effluent limits and the disposal of biosolids, among other things. In this section, several national and state regulatory initiatives are reviewed and how they might apply to the WPCF. This section also discusses considerations that should be included in any proposed WPCF modifications to address these future regulatory concerns.

5.01 NPDES PERMIT REQUIREMENTS

The current permit limits form the basis of the WPCF's regulatory obligations; however, this section will identify additional/more stringent limits that may affect the WPCF over the next 20 years. The NPDES flows and monthly average permit effluent limits were presented in Table 2.06-1. The current NPDES permit is included in Appendix A. The City's current permit expires on February 28, 2027.

5.02 IOWA NUTRIENT REMOVAL STRATEGY

In December 2000, the USEPA published recommended regional water quality criteria with the goal of reducing the impact of excess nutrient discharges to the nation's waterbodies. The parameters represent both causal criteria (TP and TN), as well as physical/biological responses (chlorophyll *a* and turbidity). The goal was for the USEPA to work with the states to adopt the recommended criteria or to develop more regionally specific water quality criteria for nutrients. States were expected to adopt or revise water quality standards by 2004, but this schedule was revised to allow states more time to develop rules. This is partly because many states are not able to show direct correlations between nutrient concentrations and impaired conditions. As of this writing, most states, including Iowa, are still in the data collection phase and have not developed new water quality standards for all regulated parameters.

The City WPCF discharges to the South Skunk River, which is located in Ecoregion VI defined by the USEPA. The USEPA's baseline water quality criteria for rivers in this ecoregion are presented in Table 5.02-1. Note that a criterion is the allowable concentration of a substance in the waterbody. Permit limits will typically be higher than a criterion because consideration can be given to dilution of the effluent with the receiving water body. However, in the case where the receiving water's background concentration is higher than the criterion, the permit limit may be set at the criterion.

Parameter	Nutrient Criteria
TP	76.25 μg/L
TN	2.18 mg/L
Chlorophyll *a*	2.7 μg/L
Turbidity	6.36 NTU

Notes:
μg/L=micrograms per liter
NTU=nephelometric turbidity unit

Table 5.02-1 USEPA Recommended Nutrient Criteria for Rivers in Ecoregion VI

The *Iowa Nutrient Reduction Strategy* has been developed by the IDNR in collaboration with the Iowa Department of Agriculture and Iowa State University in an effort to develop water quality standards for nutrients in the state. The *Iowa Nutrient Reduction Strategy* was originally developed in 2012 as a framework to assess and reduce nutrient load to waters of the state and the Gulf of Mexico. This strategy includes assessments of both point- and nonpoint-source nutrient reductions using available technologies and best management practices (BMPs). Based on these assessments, nutrient reduction goals were developed for wastewater treatment plants (WWTPs) in the state. For plants treating typical domestic wastewater, these effluent goals for TN and TP are 10 mg/L and 1.0 mg/L, respectively. For WWTPs with higher-than-typical strength influent wastewater, defined as influent TN concentrations above 35 mg/L or TP concentrations above 8 mg/L, goals of at least 66 percent reduction in nitrogen and 75 percent reduction in phosphorus are proposed.

The data collected from January 2017 to December 2021 (as summarized in Section 2) indicate the average influent TN concentration was approximately 38 mg/L (approximated by influent TKN because TN is not measured) and the average influent TP concentration was approximately 4.7 mg/L. Based on these results and the language in the City's NPDES permit, the effluent nutrient reduction targets would include a 12.5 mg/L goal for TN (66 percent reduction) and a 1.0 mg/L goal for TP. The nutrient reduction goals for TN and TP are presented in Table 5.02-2.

Parameter	Average Influent (mg/L)	Effluent Goal (mg/L)
TN	38	12.5
TP	4.7	1.0

Table 5.02-2 Nutrient Effluent Goals

The City completed a *Nutrient Reduction Feasibility Study* in February 2019 in anticipation of future nutrient removal requirements and concerns regarding the remaining life of the trickling filter media. As part of its current NPDES permit, the City is required to complete an update to the *Nutrient Reduction Feasibility Study* that includes an update on progress toward completing projects in the previous study, update on nonpoint source nutrient reduction efforts, a description of any changes from the previously approved study, and a schedule for implementing changes or improvements necessary to achieve the goals above. This schedule will then be incorporated into the NPDES permit. Nutrient limits will be imposed in a future permit after completion of the WWTP modifications and will be based on one year of operating data following a six-month optimization period.

5.03 AMMONIA REGULATIONS

The current state and federal water quality standards for ammonia are based primarily on toxicity to fish. The USEPA recently developed more stringent ammonia criteria for surface waters that have the ability to support mussels and snails that are sensitive to ammonia. The new ammonia standards were released in August 2013. This includes both acute and chronic criteria, affecting maximum day, weekly average, and monthly average limits. The schedule for the IDNR adoption of these criteria and for subsequent state implementation is unknown, but it seems likely this initiative will result in more stringent effluent limits for many WWTPs within the planning period. In general, the new chronic water quality criteria are less than one-half of the existing water quality criteria, which would result in significantly lower effluent limits when they are implemented. The new acute water quality criteria are also lower than the previous criteria and are highly dependent on receiving stream temperature and pH.

5.04 IMPAIRED WATERS AND TOTAL MAXIMUM DAILY LOAD (TMDL) IMPACTS

The Clean Water Act (CWA) provides special authority for restoring polluted or impaired waters. For water bodies that appear on the list of impaired waters [303(d) list], the CWA mandated development of the maximum amount of a specific pollutant that a waterbody can receive and still meet water quality standards, referred to as the TMDL. A TMDL also allocates the maximum amount of each identified pollutant of concern that can be contributed from both NPDES permitted discharges and nonpoint (surface runoff) sources.

The location of the WPCF outfall delineates a break between two segments of the South Skunk River (IA 03-SSK-931 and IA-03-SSK-932). The upstream segment (IA-03-SSK-932) is not included on the 2022 303(d) list, with the IDNR's water quality assessment database indicating that there is insufficient data to determine whether designated uses are met. The following excerpt is cited from the IDNR's water quality assessment database and is based on the water quality assessment developed for this river segment:

> "Prior to the 2008 Section 305(b) cycle, this stream segment was designated only for Class B(LR) aquatic life uses. Due to changes in Iowa's surface water classification that were approved by U.S. EPA in February 2008 and due to results of an Use Attainability Analysis, this segment is now designated for Class A1 (primary contact recreation) uses. The stream remains designated for aquatic life uses (now termed Class B(WW2) aquatic life uses)."

The South Skunk River segment just downstream of the WPCF outfall (IA 03-SSK-931) is included on the 303(d) list for Class A1 impairment due to levels of *E. coli* above the state water quality criteria.

5.05 BIOSOLIDS REGULATIONS

A. <u>Nutrient Management</u>

Many states have been considering making phosphorus the limiting nutrient for land application of biosolids instead of TN. There has been some discussion of restricting biosolids application to the amount of available TP required for plant growth. In Wisconsin, for example, farms are now required to develop nutrient management plans that may restrict phosphorus application. This restriction is intended to reduce the amount of phosphorus runoff from agricultural land into surface waters. In the future, the increased concern over nutrients in surface water may result in a lower biosolids application rate, more careful selection of land application sites, and possibly installation of BMPs at biosolids application sites to reduce soil erosion and phosphorus runoff. This will likely result in additional available acres, longer required hauling distances, and overall higher costs for land application of the City's biosolids during the planning period.

One of the alternatives that may be applicable in the future is the recovery, or "harvesting," of nutrients from biosolids side streams. The most likely form of harvesting would be as struvite crystals, since this would also reduce nuisance struvite formation in downstream piping and equipment at the WPCF. This process is usually used with anaerobic digestion. As of 2012, struvite is on the list of standard fertilizer materials from the Association of American Plant Food Control Officials.

B. Changing Weather Patterns and Farming Practices

Changing weather patterns and farming practices have made land application of biosolids more challenging for many Midwestern WPCFs. Wet conditions can narrow the window for spring planting and fall harvests, which can also narrow the window of time when farmers would prefer biosolids be applied (typically the fall). Wet soil conditions can also exacerbate soil compaction by land-application vehicles. These types of concerns are leading some WPCF to consider changing their biosolids volume reduction and storage practices. More effective biosolids dewatering, biosolids drying, and additional biosolids storage capacity may need to be considered to maintain a more flexible and viable land application program.

5.06 MICROCONSTITUENTS INCLUDING PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) AND OTHER EMERGING ISSUES

According to the Water Environment Federation (WEF) Government Affairs Committee, the main issues emerging at the national level are sustainability, nutrients, and microconstituents. Nutrient regulations are probably the most imminent issue affecting the WPCF and were discussed previously in this section.

Microconstituents are also known as “compounds of emerging concern.” They include pharmaceuticals, personal care products, and other compounds that are currently not specifically regulated in wastewater. Eventually, advanced oxidation processes or membrane treatment may be required to treat microconstituents. The City has taken a pollution prevention approach and has implemented a drug take-back program to help reduce the concentrations of pharmaceuticals in its wastewater.

PFAS have been a prominent concern in the news in recent years. These compounds are pervasive and bioaccumulating in the environment and are believed to be harmful to human health. Some states have convened a PFAS Technical Advisory Group to explore the concerns and consider potential regulations associated with these compounds. Several states have implemented drinking water, groundwater, or surface water standards. Some states have imposed biosolids land application moratoriums while reviewing the need for better controls. At this time, it is too soon to predict whether PFAS regulations will have a major impact during the 20-year planning period, but it appears likely there will be some impact. There are few economical options for treatment of PFAS in wastewater. Granular activated carbon filtration, anion exchange, or reverse osmosis are technically feasible but come with concerns related to cost and residuals management. The best approach would appear to be source identification and control. Local limits for PFAS compounds could be incorporated in the City’s existing pretreatment program, and associated surcharges potentially imposed, if warranted. Maintaining flexibility and multiple outlets in the City’s biosolids management program is also advisable.

5.07 ANTIDEGRADATION ANALYSIS

Within the USEPA’s framework of water quality criteria, the nation’s water bodies are to be protected through compliance with water quality standards. All water quality standards are comprised of the following:

1. Designated uses.

2. Instream water quality criteria (both numeric and narrative) required to support the designated uses.

3. An antidegradation policy intended to prevent waterbodies that do meet water quality criteria from deteriorating beyond their current condition.

For the 20-year design period considered in this Plan, the projected AWW is greater than the current design AWW flow. Therefore, it is anticipated that an antidegradation alternative analysis report will be prepared and submitted to the IDNR before submittal of the Plan.

5.08 CONCLUSIONS

This review identified four major initiatives that may affect wastewater management during the 20-year planning period:

1. Effluent limits for TP and TN will be included in future NPDES permits based on the schedule included in the City's *Nutrient Reduction Feasibility Study* or subsequent updates.

2. New ammonia-nitrogen standards related to mussel and snail toxicity have been developed by the USEPA and will likely be adopted by the State of Iowa in the future. This would likely result in more stringent effluent ammonia limits for the WPCF.

3. PFAS and other compounds of emerging concern may affect the City's pretreatment program scope in the short term and may require tertiary treatment and/or changes to biosolids disposal in the long term.

4. Programs and regulations related to phosphorus and nitrogen in surface waters may reduce the allowable biosolids application rate or may make land application site criteria more restrictive. This may result in the need for more land and/or longer hauling distances. With longer hauling distances and potential future PFAS regulations, dewatering and/or drying may become increasingly desirable. The cost of biosolids management will likely increase as well.

SECTION 6
EVALUATION OF EXISTING WASTEWATER TREATMENT FACILITIES

6.01 INTRODUCTION

An assessment of the capacity of treatment processes at the WPCF to treat the projected future flows and loads while meeting the anticipated future NPDES requirements is presented in this section. Based on this assessment, capacity deficiencies and potential improvements are identified.

6.02 EVALUATION OF EXISTING LIQUID TREATMENT PROCESSES

In this section, the existing liquid treatment processes are evaluated based on their performance and ability to treat the projected flows and loads presented in Section 4.

A. Preliminary Treatment and Influent Pumping

Influent flow to the WPCF is conveyed to the Raw Wastewater Pump Station by a 66-inch interceptor. Influent flow is measured using a Parshall Flume with a 3-foot throat width nested inside of a 5-foot Parshall Flume. The 3-foot Parshall Flume is rated to measure flow up to 32 MGD, while a 5-foot Parshall Flume is rated to measure flow up to 55 MGD if the flumes were to free discharge. Both the 3- and 5-foot flumes are submerged and do not provide a reliable flow measurement when flows exceed 7,500 gpm. Therefore, the existing Parshall Flume does not have adequate capacity for the future peak hour wet weather (PHWW) flow of 40.3 MGD. Potential influent flow measurement modifications are evaluated in more detail in Section 9.

Inside the Raw Wastewater Pump Station, the raw wastewater undergoes screening using two mechanically raked bar screens with 1/2-inch bar spacing and one mechanically raked bar screen with 3/8-inch bar spacing. Following screening, wastewater flows to the wet well containing six vertical turbine pumps. Three pumps are used to pump the wastewater to the grit removal facilities. Two pumps are used to pump flows above the MWW flow (nominally the capacity of the secondary treatment process of 20.4 MGD) to the equalization basins. One additional pump is used as a swing pump to pump flows either to grit removal or the equalization basins. Grit removal is achieved by four TeaCup® grit removal units in the Raw Wastewater Pump Station. Grit from each of the TeaCup units is washed by one of the two grit classifiers (Grit Snails®).

The existing screens and grit removal units are beyond their useful lives and do not have adequate capacity for the future design flows. Furthermore, the existing 1/2-inch screens do not provide adequate protection of future downstream nutrient removal technologies. A detailed condition assessment of the Raw Wastewater Pump Station and evaluation of alternatives to replace the existing screening and grit removal facilities are presented in Section 8. An evaluation of the hydraulic impacts of new grit removal facilities on the capacity of the existing influent pumps and the potential need for additional pumping capacity is also presented in Section 8.

B. Flow Equalization

Peak flow equalization is provided by two 2.2-MG equalization basins located on the north side of the WPCF site. When influent flows exceed the peak forward flow capacity of the WPCF, flow is pumped from the Raw Wastewater Pump Station wet well to the equalization basins. Under current operations, this occurs when influent flows exceed 20.4 MGD. As part of the proposed project in this plan, the maximum forward flow through full treatment is proposed to increase to the projected 2045 MWW flow of 24.5 MGD. This results in a maximum instantaneous peak flow of approximately 15.8 MGD to the equalization basins. A detailed discussion of the influent pumping and flow equalization facilities is presented in Section 9.

C. Primary Treatment Facilities and Performance

Primary treatment is provided by four 70-foot-diameter primary clarifiers. Each clarifier has a side water depth of 9 feet and a weir length of approximately 200 feet. As discussed in Section 2, grit separation tank effluent flows to the first stage wet well of the Trickling Filter Pump Station where the effluent from the grit process along with a portion of the first stage trickling filter effluent is pumped approximately 45 feet up to the Primary Clarifier Splitter Box where it is blended with the WAS. Therefore, the total flow to the clarifiers is the sum of the grit separation tank effluent, first stage trickling filter recirculation, and WAS.

Figure 6.02-1 Primary Clarifier

Primary influent (including recirculation flow and WAS) is sampled approximately twice per week and are analyzed for BOD_5, TSS, and NH_3-N. A summary of primary clarifier flows, overflow rates, and performance for BOD_5 and TSS is presented in Table 6.02-1. The 5-year average TSS and BOD_5 removal through the primary clarifiers has been approximately 59 and 48 percent, respectively, at an average overflow rate of approximately 665 gpd/sf. The daily surface overflow rate compared to the measured BOD_5 and TSS percent removal are presented in Figures 6.02-2 and 6.02-3. As indicated, the percent BOD_5 removal has historically remained greater than 35 percent, even at surface overflow rates greater than 1,000 gpd/sf. The BOD_5 removal may be positively impacted by the addition of WAS to the primary clarifiers, providing additional BOD_5 removal through oxidation or bioflocculation.

	2017	2018	2019	2020	2021	2017 to 2021
Average Primary Effluent Flow, MGD	9.7	11.1	10.9	10.2	9.4	10.2
Average Surface Overflow Rate, gpd/sf	632	721	706	660	608	665
Average Percent Removal:						
TSS	58%	51%	53%	59%	62%	59%
BOD_5	48%	47%	46%	46%	51%	48%

Table 6.02-1 Primary Clarifier Performance Summary

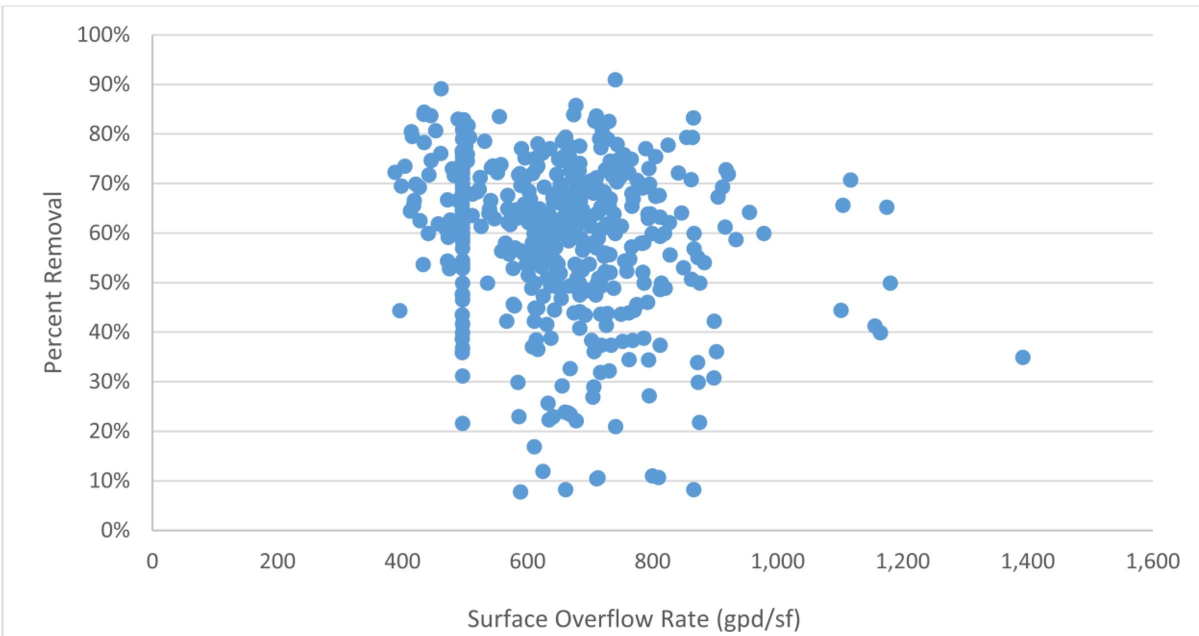


Figure 6.02-2 Primary Clarifier TSS Removal

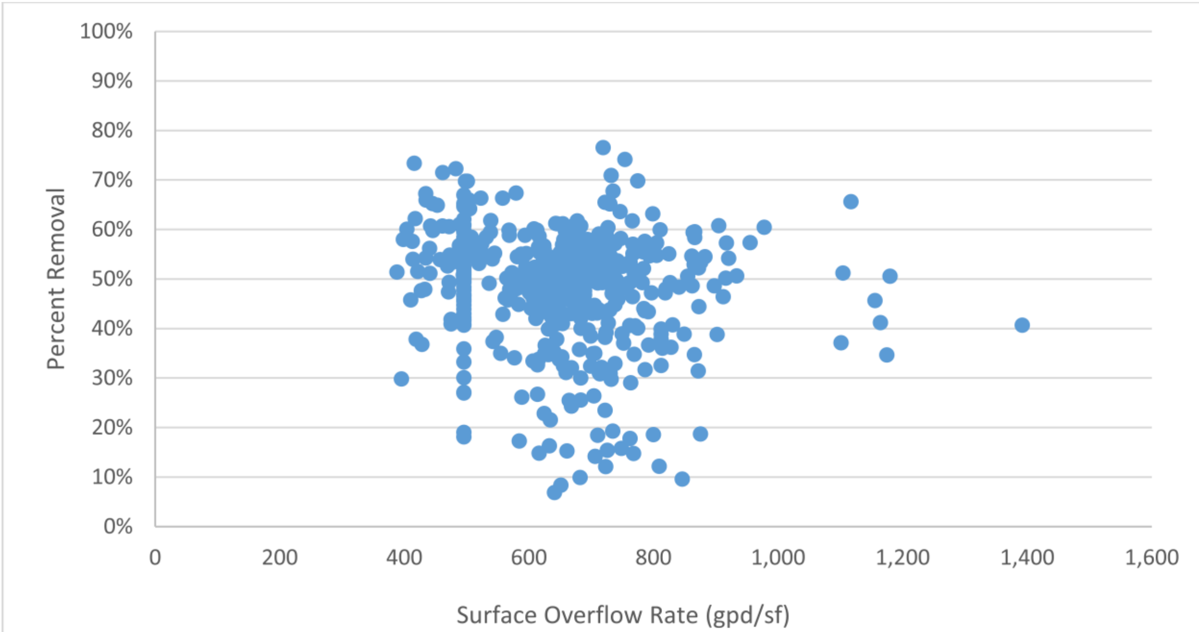


Figure 6.02-3 Primary Clarifier BOD_5 Removal

At the proposed maximum flow through full treatment (which is also the MWW flow) of 24.5 MGD, the surface overflow rate of the existing clarifiers is approximately 1,592 gpd/sf. At the proposed AWW flow of 15.8 MGD, the surface overflow rate of the existing primary clarifiers is approximately 1,026 gpd/sf. Iowa Wastewater Facility Design Standards indicate a recommended maximum surface overflow rate of 1,000 gpd/sf at AWW flows and 1,500 gpd/sf for PHWW flows. While these values are slightly exceeded at the proposed AWW flow with the existing clarifiers, historical primary clarifier performance (as presented in Figures 6.02-1 and 6.02-2) suggest that high removal efficiencies are maintained at high overflow rates. Based on this data, it is assumed that 35 percent BOD removal and 50 percent TSS removal will be provided by the existing primary clarifiers at the proposed AWW flow and no additional primary clarifiers are required for the proposed conditions.

As discussed in greater detail in Section 7, the City could consider eliminating primary clarification once the trickling filters are no longer used to avoid the energy and costs associated with pumping up to the primary clarifiers. However, this would also impact the viability of anaerobic digestion and may impact the required size of the biological nutrient removal (BNR) process that replaces the trickling filters (depending on which nutrient removal alternative is selected).

D. Secondary Treatment Facilities

Figure 6.02-4 Trickling Filters

Secondary treatment at the WPCF consists of four trickling filters, four intermediate/secondary clarifiers, and a suspended growth solids contact activated sludge system. The trickling filters are abovegrade filters with plastic crossflow media, as presented in Figure 6.02-4. As discussed in the 2019 *Nutrient Reduction Feasibility Study*, the existing trickling filters are not amenable to nutrient removal because they remove influent carbon sources that are vital for BNR. Condition assessments of the trickling filters completed as part of the 2019 *Nutrient Reduction Feasibility Study* also indicate that the structural condition has diminished and the media is near the end of its useful life. The existing solids contact activated sludge system (see Figure 6.02-5) is designed to supplement the performance of the trickling filters, and therefore, does not alone provide adequate treatment capacity without the trickling filters in operation. For these reasons, the proposed project includes the replacement of the trickling filters with a nutrient removal process and an evaluation of the capacity of the existing secondary treatment facilities was not conducted for this Plan.

While the existing solids contact basin does not provide adequate treatment capacity on its own, it could potentially be repurposed as part of a new BNR activated sludge system at the WPCF. This would require demolition or replacement of existing aeration equipment and blowers along with potential structural modifications to the tanks. The use of the existing solids contact basins as part of the nutrient removal alternatives is discussed in more detail in Section 7.

Figure 6.02-5 Solids Contact Basin

Secondary clarification is provided by four 100-foot-diameter circular clarifiers. As discussed in Section 7, these clarifiers would continue to be used as final clarifiers for two of the BNR alternatives evaluated in this Plan. With a total surface area of approximately 31,416 sf, the surface overflow rate of the existing clarifiers (assuming all four are used as secondary clarifiers for a new BNR activated sludge system) is approximately 503 gpd/sf and 780 gpd/sf at the AWW flow of 15.8 MGD and the MWW flow of 24.5 MGD (also maximum sustained flow to the clarifiers), respectively. The clarifier weir loading rate at the AWW flow is approximately 13,450 gpd/sf. Therefore, the existing clarifiers will be substantially below the Iowa Wastewater Design Standards requirements of a surface overflow rate less than 1,000 gpd/sf at peak hour flow for final clarifiers following a nitrifying activated sludge system and a weir loading rate less than 15,000 gpd/sf. Since the flow rate of the secondary clarifiers at MWW will be a sustained peak flow, being reasonably below 1,000 gpd/sf is recommended.

At the AWW flow of 15.8 MGD, RAS flow of 15.8 MGD, and a MLSS concentration of 3,600 mg/L, the solids loading rate on the existing clarifiers is approximately 30 pounds per square foot per day (lb/sf/day). At the maximum flow through full treatment of 24.5 MGD, RAS flow of 15.8 MGD, and a MLSS concentration of 3,600 mg/L, the solids loading rate on the existing clarifiers is approximately 39 lb/sf/day. These do not exceed the maximum solids loading rate values of 30 lb/sf/day (at AWW flow) and 50 lb/sf/day (at peak hourly flow) indicated in the Iowa Wastewater Design Standards.

RAS from each clarifier is controlled by a telescoping valve and flows to a screw pump wet well at the solids contact basins. This does not provide precise control of sludge withdrawal from the clarifiers and screw pumps introduce air into RAS that is detrimental to BNR. Therefore, a new RAS pumping station with RAS pumps controlled with variable frequency drives (VFDs) and piped directly to the clarifier sludge withdrawal piping is included in the nutrient removal alternatives in which the secondary clarifiers remain in service.

E. Disinfection

Secondary effluent is disinfected with an UV disinfection system. This system was installed in 2012 and has a rated peak capacity of 25 MGD. Therefore, the existing UV system has adequate capacity to treat the proposed maximum flow through full treatment of 24.5 MGD.

The disinfected effluent flows down a cascade aerator and discharges to the Skunk River.

6.03 EVALUATION OF EXISTING BIOSOLIDS MANAGEMENT PROCESSES

In this section, the existing biosolids management processes are evaluated based on performance and ability to handle the anticipated biosolids production associated with the projected flows and loads presented in Section 4.

A. Primary Sludge Pumping

Primary sludge is pumped from the primary clarifiers to the primary anaerobic digesters using five air-operated diaphragm pumps located in Digester Complex (see Figure 6.03-1). These pumps have a capacity of 180 gpm each, given adequate compressed air is available. Based on the anticipated future maximum primary sludge (PRS) production of approximately 31,350 pounds (60 percent TSS removal of maximum day TSS load) and an assumed PRS solids content of 4 percent, this equates to a maximum PRS flow of approximately 65 gpm. Therefore, the existing primary sludge pumps have adequate capacity for the 2045 design conditions. Primary sludge is pumped directly to the primary anaerobic digesters.

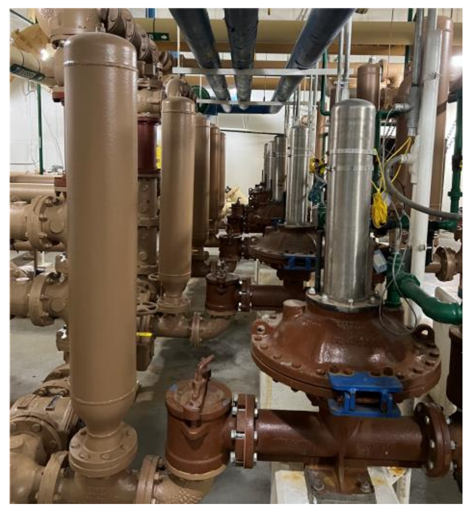


Figure 6.03-1 PRS Pumps

B. WAS Pumping and Thickening

The City can pump WAS from either the RAS piping or solids contact basins using two centrifugal pumps and one air-operated diaphragm pump located in the Sludge Pumping Building (see Figure 6.03-2). The City indicated, that under current operations, WAS is pumped directly from the solids contact basins. From the Sludge Pumping Building, the City can pump WAS to either the primary clarifier splitter box for co-thickening, the sludge lagoon, or the anaerobic digesters.

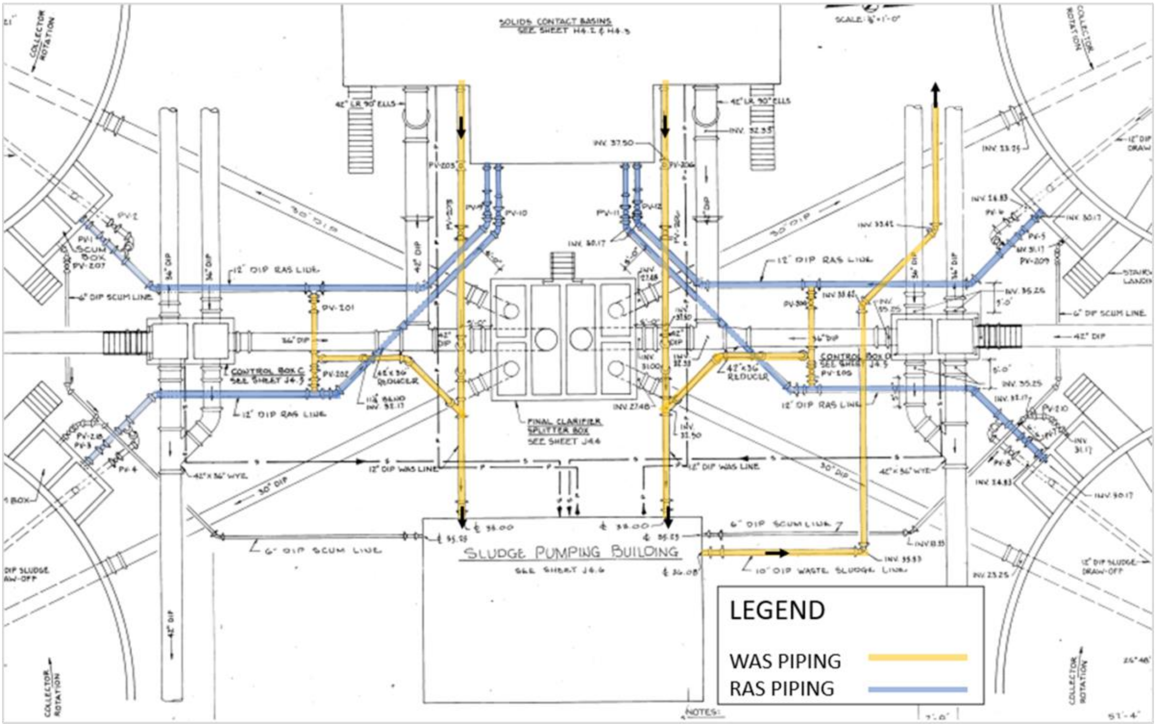


Figure 6.03-2 Existing RAS and WAS Piping

The City currently co-thickens its WAS in the primary clarifiers. Co-thickening of WAS in primary clarifiers is not ideal for BNR because stored phosphorus in the WAS can be released in the clarifiers, reducing phosphorous removal performance. Therefore, co-thickening of WAS in the primary clarifiers is not recommended as part of the proposed project once biological phosphorus removal (BPR) is implemented at the WPCF. There are many mechanical means of thickening sludge, including rotary drum thickeners, gravity belt thickeners (GBTs), disc thickeners, and thickening centrifuges. Because the solids production and handling requirements vary for each nutrient reduction alternative, changes to WAS pumping and sludge thickening are discussed in the evaluation of each alternative in Section 7.

C. Anaerobic Digestion

Biosolids stabilization is provided by an anaerobic digestion system consisting of two primary digesters, each with a volume of 720,000 gallons, and one secondary digester with a volume of 925,000 gallons.

The Iowa Wastewater Design Standards indicates a maximum volumetric VS loading rate of 80 lb VS/1,000 cf/day for anaerobic digestion systems operating at mesophilic temperatures that are well mixed and a minimum sludge retention time of 15 days. Based on the total primary digester capacity of 1,440,000 gallons (195,513 cf), the existing digesters have a VS loading capacity of approximately 15,401 lb VS/day. At the current VS load of approximately 5,230 lb VS/day, the existing digesters are at approximately 34 percent of their design capacity.

The amount of anticipated future sludge production is dependent on the future nutrient removal alternative employed at the WPCF. Based on the process modeling presented in Section 7, volatile solids loading to the digesters (PRS plus WAS) between 12,500 and 13,000 lb/day is anticipated at the projected annual average 2045 loadings. This equates to a volumetric loading rate of approximately 64 to 66 lb VS/1,000 cf/day, which is less than the maximum value indicated in the *Iowa Wastewater Design Standards*. Assuming a digester feed solids content of 4 percent, the total sludge feed to the digesters is approximately 57,000 gpd. With a total volume of approximately 1,440,000 gallons in the two primary digesters, this results in an solid retention time (SRT) of greater than 25 days. At a projected 2045 maximum month sludge production of approximately 78,000 gpd at 4 percent solids, the SRT in the existing digesters is approximately 18 days. Therefore, the existing digesters have adequate capacity for the projected sludge loads and types of secondary treatment evaluated.

D. Biosolids Storage and Disposal

Digested biosolids are discharged from the secondary digester to the 3.1-MG sludge lagoon (see Figure 6.03-3). The digested sludge is stored in the sludge lagoon until it is land applied. The City occasionally decants from the sludge lagoon to thicken the sludge, with the decant flow returning to the wet well at the Raw Wastewater Pump Station.

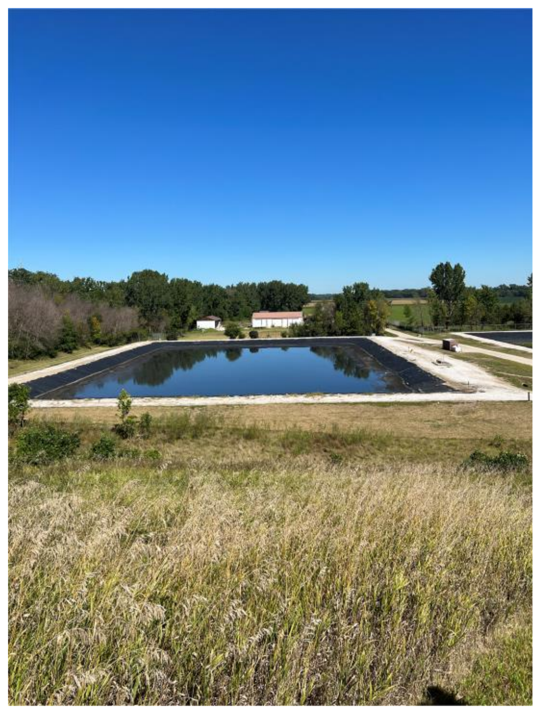


Figure 6.03-3 Sludge Lagoon

Based on the anticipated solids production from the nutrient removal alternatives presented in Section 7, an average of approximately 10,000 lb/day of digested sludge is projected for the design conditions. This corresponds to a digested sludge volume of approximately 24,000 gpd based on a lagoon total solids content of 5 percent. Therefore, the existing sludge lagoon is anticipated to provide approximately 130 days of storage at the 2045 design average conditions. IDNR recommends that a minimum of 6 months of biosolids storage is provided. However, as long as land is available to the City to apply its biosolids routinely and no new regulations prevent future land application, no change from the current biosolids thickening and disposal processes are needed. If the existing sludge storage volume proves to be inadequate based on future liquid land application site availability and weather patterns, the City could consider constructing additional sludge storage volume or implement further measures to reduce sludge volume, such as dewatering or drying.

6.04 SUMMARY OF DEFICIENCIES

As presented in this section, the following deficiencies of the existing treatment processes were identified and will be considered in the evaluation of alternatives later in this Plan:

- The existing screening and grit removal equipment have reached the end of their service lives and do not have adequate capacity for future flows.
- The trickling filter media is reaching the end of its anticipated service life.
- The existing secondary treatment processes (trickling filters and solids contact activated sludge) is not amenable to BNR.
- Co-thickening of WAS in primary clarifiers is not recommended with BPR because it can result in phosphorus release from the WAS, diminishing BPR performance.

SECTION 7
NUTRIENT REDUCTION ALTERNATIVES EVALUATION

7.01 INTRODUCTION

In the City's 2019 *Nutrient Reduction Feasibility Study*, several potential nutrient reduction technologies were evaluated and shortlisted. The technologies evaluated included conventional BNR activated sludge, simultaneous nitrification-denitrification (SNDN) activated sludge, membrane aerated biofilm reactors (MABRs), integrated fixed film activated sludge (IFAS), and aerobic granular sludge (AGS). In the 2019 study, three alternatives were shortlisted for future evaluation: conventional BNR activated sludge, SNDN activated sludge, and AGS. Based on feedback from the City in Workshop 2a conducted as part of the development of this Plan, the same shortlisted nutrient reduction technologies will be used for this Plan. In this section, these three alternatives are evaluated in greater detail, including process modeling and the development of opinions of probable costs (OPCs).

7.02 INFLUENT CHARACTERIZATION

The City conducted a special sampling regimen in July and August 2022 to better characterize the influent components for use in process modeling and the evaluation of biological processes. 24-hour composite samples were taken of the WPCF influent, primary effluent, first stage trickling filter effluent, intermediate clarifier effluent, and final effluent. Average values of the special sampling analyses based on seven samples are presented in Table 7.02-1. One day of sampling (August 4, 2022) was excluded from the analysis because of apparent sample contamination with methanol that was used to clean the sample carboys. The full dataset from the special sampling regimen is presented in Appendix B.

Parameter	Influent	Primary Effluent	First Stage Trickling Filter Effluent	Intermediate Clarifier Effluent	Final Effluent
COD, mg/L	411	226			28.4
BOD_5, mg/L	194	86	43	8.0	5.0
$CBOD_5$, mg/L	192	79	72	10.0	4.3
1.2-micron-filtered COD, mg/L	134	113			
Flocculated and filtered COD, mg/L	96	69			14.0
VFA, mg/L	51	26			
TSS, mg/L	204	72	115	15.6	5.9
VSS, mg/L	180	62			
TP, mg/L	4.8	4.9			3.9
PO_4-P, mg/L	2.3	3.0			3.7
NH_3-N, mg/L	31.0	20.0	7.2	2.1	0.1
TKN, mg/L	43.4	29.6			0.6
NO_3-N + NO_2-N, mg/L	<2	1.9			23.3
Alkalinity, mg/L as $CaCO_3$	261	214	123	84	72
pH, s.u.	7.2	7.0	7.0	6.7	7.6

Note: COD=chemical oxygen demand
VFA=volatile fatty acids
NO_2-N=nitrite nitrogen
$CaCO_3$=calcium carbonate
PO_4-P=orthophosphate as phosphorus
s.u.=standard units

Table 7.02-1 Special Sampling Summary

One key metric for estimating the performance of BNR facilities is the amount of readily biodegradable COD (rbCOD) that is present in the wastewater. This portion of the COD consists of VFAs along with other soluble and biodegradable organic compounds that can be easily fermented into VFAs in an anaerobic zone and used by phosphorus accumulating organisms (PAOs) in the BPR system. This rbCOD is also readily available for denitrification under anoxic conditions. The rbCOD is calculated as the influent soluble COD (measured as the flocculated and filtered COD [ffCOD] to exclude colloidal COD in the analysis) less the effluent ffCOD, which is taken as the unbiodegradable portion of the influent soluble COD. The average influent rbCOD concentration during the special sampling was approximately 82 mg/L (96 mg/L less 14 mg/L) and the influent rbCOD:TP ratio was approximately 17:1. The *Water Environment Federation Manual of Practice No. 34: Nutrient Removal* indicates a minimum rbCOD:TP ratio of 15:1 for successful BPR. While the WPCF influent is greater than this ratio, the influent does not include recycle loads (mainly digester supernatant) and the amount of phosphorus in the return flows is anticipated to increase if BPR is implemented. The amenability of the WPCF influent to BNR using this special sampling data is evaluated with process modeling later in this section.

In addition to the composite samples presented in Table 7.02-1, grab samples were taken of the digester supernatant on five occasions during this sampling period. A summary of the average composition of this supernatant for several parameters is presented in Table 7.02-2.

Parameter	Value
TP, mg/L	400
Ammonia, mg/L	1,100
TKN, mg/L	1,800
COD, mg/L	18,700
$cBOD_5$, mg/L	1,090
TSS, mg/L	17,800
VSS, mg/L	12,000

Table 7.02-2 Digester Supernatant Sampling Summary

7.03 EVALUATION OF ALTERNATIVES

The three shortlisted BNR alternatives are described and evaluated in this section based on the 2045 design year flows and loads presented in Section 4. Each alternative includes infrastructure required to phase in the BNR alternative, allowing a portion of the BNR system to be implemented in earlier phases while the trickling filters remain in operation. In these earlier phases, the BNR system is configured to treat a portion of the influent or primary effluent flow and operate in parallel to the existing trickling filters. As described in this section, some alternatives also include flexibility to operate in series with the existing second stage trickling filters. The present worth costs presented in this section assume that the improvements are implemented in three phases. Phasing considerations and an evaluation of the potential components to be included in the initial phase for the selected alterative are discussed in greater detail in Section 11.

A. Alternative BNR1–Conventional BNR Activated Sludge

In this alternative, a conventional BNR activated sludge system is constructed to replace the trickling filters. This activated sludge system is described as “conventional” because it includes distinct anaerobic, anoxic, and aerobic zones and would typically operate at dissolved oxygen concentrations greater than 1.0 mg/L. There are many BNR activated sludge configurations that have been successfully used for decades, including the A^2/O process, the University of Cape Town (UCT) process, the modified UCT process, and several others. These configurations all include dedicated anaerobic zones for BPR, anoxic zones for nitrogen removal via denitrification, and aerated zones for BOD_5 removal and nitrification, but they vary in the number and type of internal recycle flows as well as the location that RAS is returned to the activated sludge system. Some of these configurations have benefits for specific wastewater characteristics (such as the modified UCT process for relatively weak wastewaters), but they also vary in complexity and capital cost based on the number of recycle streams. Schematics of a few common BNR configurations are presented in Figure 7.03-1.

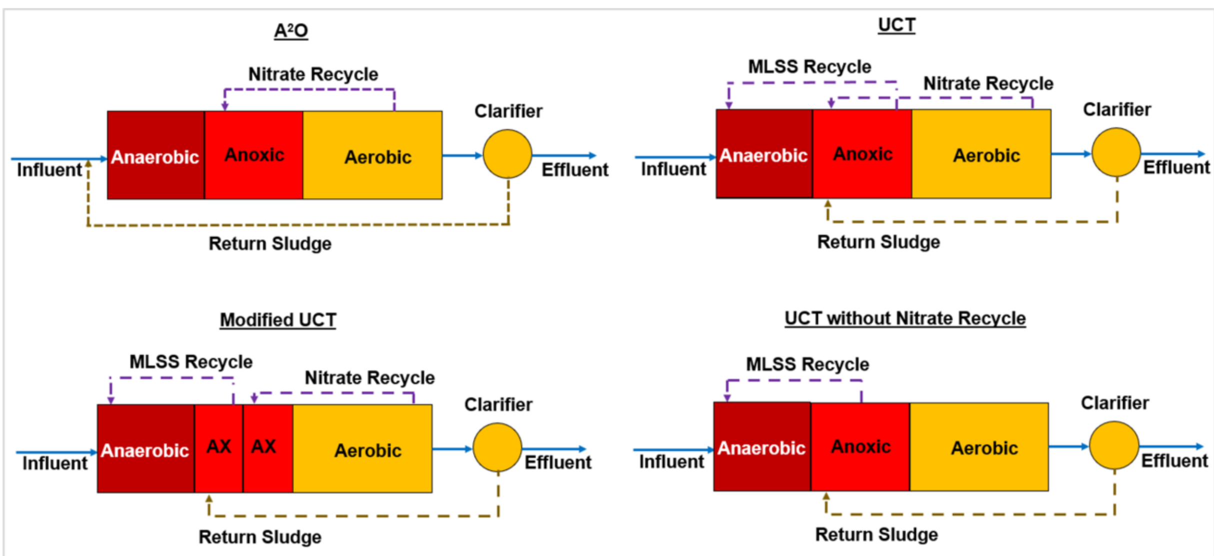


Figure 7.03-1 Common BNR Activated Sludge Configurations

While conventional BNR activated sludge systems have been used for decades, there are advancements in these systems that have shown to improve treatment performance, nutrient removal, and energy efficiency. One such advancement is the emergence of sidestream enhanced biological phosphorus removal (S2EBPR) in the past 5 to 10 years.

S2EBPR is an emerging BPR process that incorporates fermentation of return sludge in an anaerobic zone that is on the sidestream, meaning that the influent wastewater does not flow through it. This sidestream anaerobic zone receives only a portion of the RAS, with the remainder of the RAS mixed with the primary effluent in the mainstream tanks (which could consist of a TN removal process such as the modified Ludzack-Ettinger process). S2EBPR is less dependent on influent carbon sources for successful BPR, improving BPR performance for facilities with lower influent rbCOD and VFA concentrations. This process, or similar configurations, have been used in Europe for more than 10 years and have begun to be implemented in the United States in the past few years. A schematic of an S2EBPR process is presented in Figure 7.03-2.

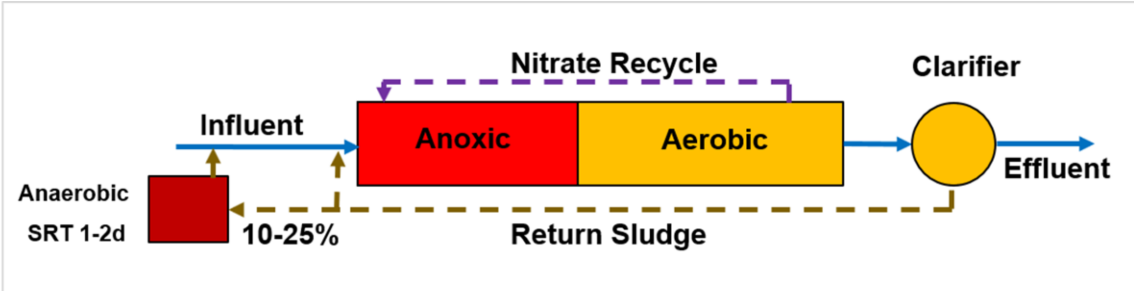


Figure 7.03-2 Example S2EBPR Process Schematic

In the side stream anaerobic reactor of the S2EBPR process, the RAS is exposed to deep anaerobic conditions in which PAOs of the genus *Tetrasphaera* work in conjunction with the “conventional” PAOs (e.g., *Accumulibacter*) by breaking down organic material into VFAs for use by other PAOs while also storing carbon within their cells for future phosphorus uptake. The effluent from the side stream anaerobic zone then passes into the mainstream anoxic/aerated zones where phosphorus is taken up by the PAOs and removed from the system through the waste activated sludge. S2EBPR has several benefits compared to conventional BPR process, including the following:

- Improved BPR performance at facilities with inadequate influent carbon for conventional BPR since the carbon storage occurs in a side stream reactor using fermented RAS.
- Improved TN removal because influent rbCOD is not used for BPR and can be used for denitrification.
- Improved wet-weather treatment performance by moving the anaerobic zone out of the main liquid treatment flow path where its retention time is unaffected by high influent flows.
- Reduction of glycogen accumulating organisms (GAOs) that typically compete with PAOs for readily biodegradable carbon sources in conventional anaerobic zones and can result in BPR process upsets.

In this alternative, the activated sludge system consists of an S2EBPR system with a mainstream anoxic and aerobic zone as shown in Figure 7.03-2. The mainstream anoxic and aerobic zones would be included as part of newly constructed tanks while the existing solids contact basins could be repurposed as anaerobic S2EBPR zones. This configuration provides protection from peak flow events and improved nutrient removal performance while also cost effectively using existing infrastructure.

The City currently co-thickens its WAS from the solids contact basins in its primary clarifiers. Once BPR is implemented, co-thickening of WAS results in the release of phosphorus from the WAS within the primary clarifiers, negatively impacting phosphorus removal. Therefore, this alternative includes the construction of a new biosolids thickening process that consists of a new building, mechanical thickening device (assumed to be GBTs for the purpose of this Plan), and thickened sludge pumps. An aerated WAS storage tank of approximately 350,000 gallons is also included to provide approximately 3 days of

WAS storage at the 2045 maximum month condition. This allows continuous wasting while only operating the mechanical thickening equipment 40 hours per week or less.

One of the key considerations of the conversion of the existing trickling filter and solid contact secondary treatment process to activate sludge is phasing of the improvements and the operation of parallel treatment processes (trickling filters and activated sludge) and the use of the existing clarifiers by both processes during the initial phases. To accomplish this, an addition to the solids contact basin splitter box is included in this alternative that allows the City to combine the ML with either the first or second stage trickling filter effluent and use either the intermediate or final clarifiers to settle the activated sludge ML. Phasing considerations will be discussed in greater detail in Section 11 of this Plan.

A preliminary layout of this alternative is presented in Figure 7.03-3.

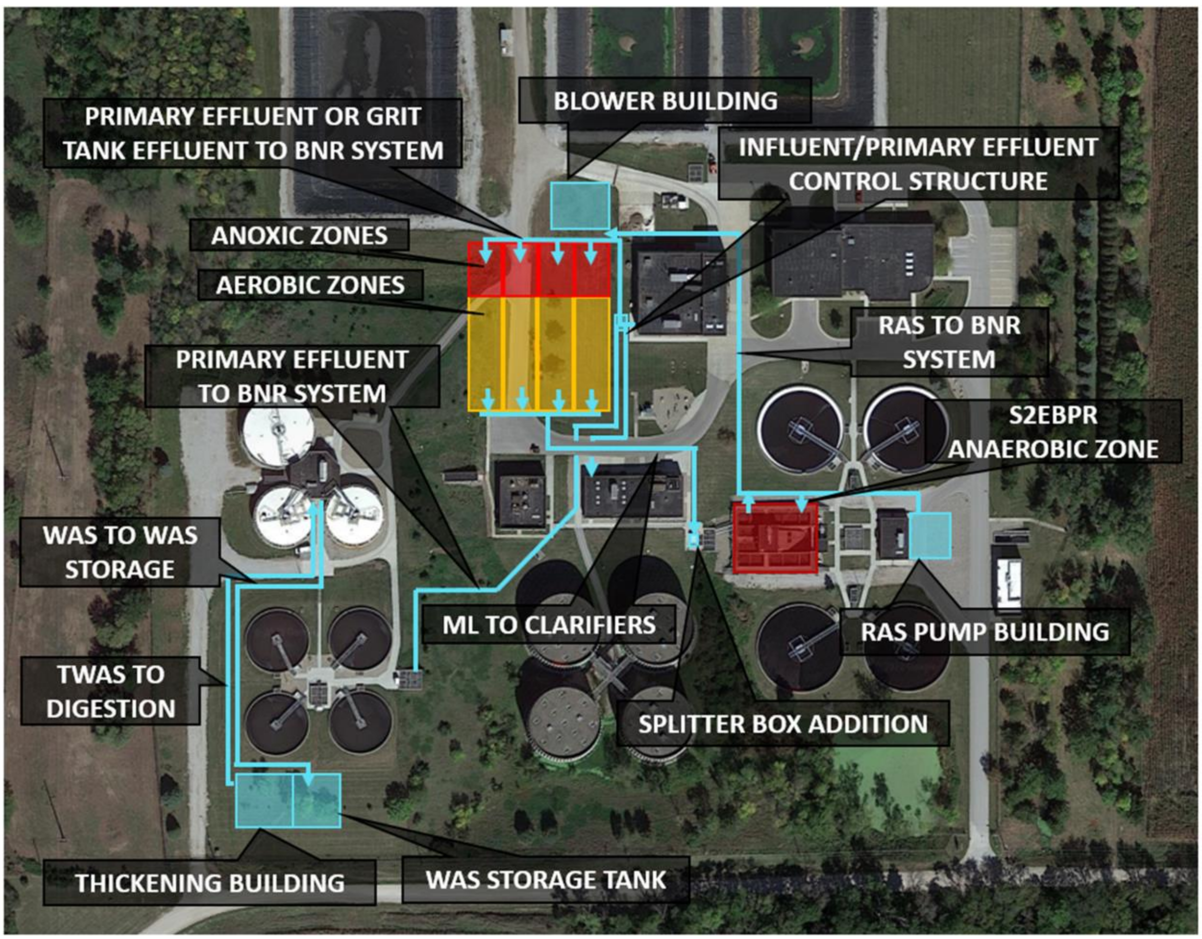


Figure 7.03-3 Alternative BNR1 Preliminary Site Layout

This alternative includes the following elements:

1. Demolition of Trickling Filter Complex and second stage trickling filter pumps.

2. Construction of four 1.25-MG activated sludge basins in an MLE configuration with a concrete baffle wall separating the swing anoxic zones and aerated zones.

3. Conversion of the existing solids contact basins to two 0.3-MG sidestream anaerobic zones for S2EBPR including structural modifications and installation of new mixers and process monitoring equipment.

4. Installation of aeration equipment for new activated sludge system, including blowers, piping, fine bubble diffusers, and associated controls.

5. Installation of mixers in anoxic zones and nitrate recycle pumps and piping between aerobic and anoxic zones.

6. Construction of a building to house new blowers and electrical equipment associated with a new activated sludge system. A portion of the existing Raw Wastewater Pump Station could potentially be used for housing the blowers if the grit removal equipment is moved out of the building. This is discussed in greater detail in Section 9.

7. Expansion of existing solids contact splitter box to receive ML from new BNR activated sludge system.

8. Installation of new centrifugal RAS pumps and modifications to existing RAS piping to eliminate telescoping valves.

9. Construction of the RAS Pump Station adjacent to existing Sludge Pump Building to house new RAS pumps.

10. Construction of an aerated WAS storage tank and associated diffusers and blowers.

11. Construction of a new Thickening Building located near the anaerobic digester complex to house WAS thickening equipment and WAS storage blowers.

12. Installation of two GBTs and associated pumps and controls to thicken WAS before digestion.

A BioWin model of this alternative was created to simulate treatment performance (see Figure 7.03-4). Model simulation results for this alternative at the 2045 design average and maximum month flow and loadings are presented in Table 7.03-1. All BioWin kinetic parameters were maintained at the default values for these simulations. The DO concentration in the aerated zones was set at 2.0 mg/L and the nitrified ML recycle was set at 300 percent of the influent flow for all simulations. A S2EBPR anaerobic zone receiving 25 percent of the RAS and thickened to approximately 1 percent solids within the anaerobic zone was also included. Secondary clarifier performance was assumed to result in an effluent TSS concentration of approximately 10 mg/L. The sludge lagoon was modeled as a clarifier with biological and chemical reactions occurring within the sludge blanket. While historical plant data often included lagoon supernatant with solids contents greater than 3 percent, the supernatant from the lagoon was maintained at approximately 0.5 percent solids for the purposes of this Plan to reduce nutrient and solids recycling to the activated sludge system. This assumes that control of the lagoon supernatant will be optimized for nutrient removal operation when nutrient limits are implemented in the future. The primary clarifiers were assumed to provide 60 percent TSS removal, with an associated BOD_5 removal of approximately 37 percent based on the influent characteristics presented earlier in this section.

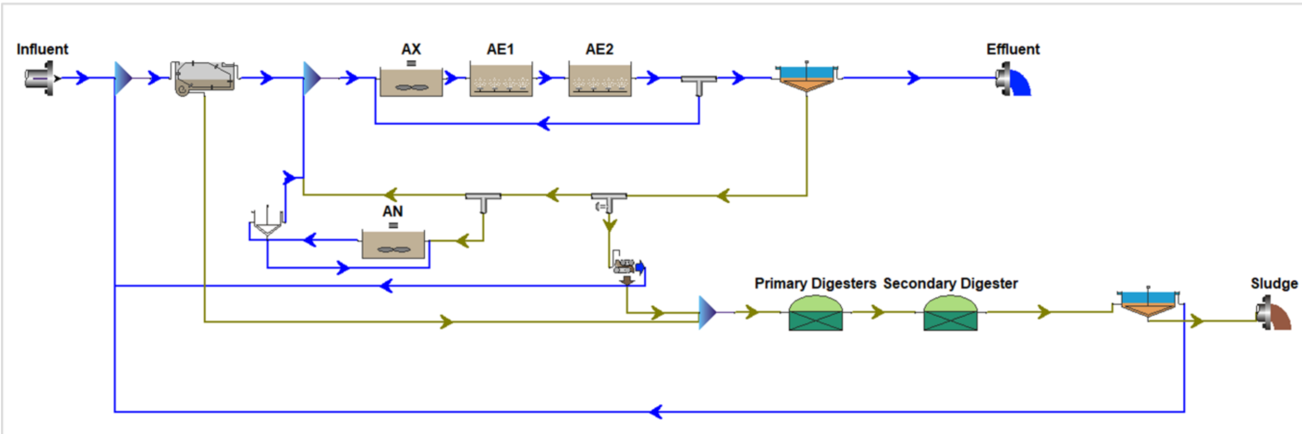


Figure 7.03-4 Alternative BNR1 Process Model Flowsheet

Parameter	Loading Condition		
	2045 Maximum Month	**2045 Annual Average**	**2045 Annual Average**
Influent Parameters			
Flow, MGD	15.8	10.5	10.5
BOD_5 Load, lb/day	20,580	16,100	16,100
TSS Load, lb/day	25,470	18,560	18,560
TKN Load, lb/day	3,780	2,820	2,820
TP Load, lb/day	480	360	360
Primary Clarifier Performance			
TSS Removal, %	60	60	60
BOD_5 Removal, %	37	37	37
Operating Conditions			
Temperature, degrees Celsius (°C)	10	10	10
MLSS, mg/L	3,600	2,800	2,900
RAS Flow, MGD	15.8	10.5	10.5
Solids Loading Rate, lb/sf/day	30	16	16
aSRT, days	12	12	12
Airflow, scfm	5,400	4,000	4,000
CPR chemical addition[1], gpd	0	0	50
Methanol addition[2], gpd	0	0	0
Simulated Effluent			
BOD_5, mg/L	3	3	3
TSS, mg/L	10	10	10
NH_3-N, mg/L	0.6	0.7	0.7
TN, mg/L	8	11	11
TP, mg/L	1.5	1.3	1.0

Note: aSRT=aerobic solids retention time

[1]Based on 32 percent ferric chloride solution
[2]Based on 100 percent methanol solution

Table 7.03-1 Steady-State Process Model Simulation Results: Alternative BNR1

As shown in Table 7.03-1, the BioWin simulation at the 2045 maximum month condition during cold weather predicts near complete nitrification (effluent ammonia less than 1.0 mg/L) and an effluent TN value below the target of 12.5 mg/L. However, the simulated effluent TP at this condition exceeds the 1.0-mg/L TP target. Two simulations are presented for the 2045 annual average condition: one with no chemical (phosphorus removal chemical or carbon) added and another with chemical addition as necessary to meet the nutrient reduction targets. At the 2045 annual average condition, the model simulation indicates that the effluent TN target of 12.5 mg/L can be achieved without chemical addition, but the TP target of 1.0 mg/L may require CPR chemical addition (in this case 50 gpd of ferric chloride was used in the simulations). Because it is not anticipated that the IDNR will require chemical addition to meet the nutrient reduction targets and are based on what is readily achievable via BPR, infrastructure for chemical addition or the associated chemical costs are not included in this alternative.

B. Alternative BNR2–Simultaneous Nitrification-Denitrification (SNDN) Activated Sludge

In this alternative, a new SNDN activated sludge system is constructed to replace the trickling filters. SNDN is an activated sludge process in which nitrification and denitrification occur simultaneously within the same reactor, meaning that there is not a dedicated anoxic zone that is mixed but unaerated. SNDN has been successfully implemented for decades, particularly in oxidation ditches and through the use of aerated anoxic zones in conventional BNR configurations. A recent emphasis on energy efficiency and efficient carbon use for denitrification has led to an emerging interest in operating entire activated sludge systems at low DO concentrations (typically between 0.3 mg/L to 0.7 mg/L), under which both nitrification and denitrification can occur. This both saves aeration energy but also eliminates the need for a dedicated (and typically mechanically mixed) anoxic zone as well as nitrified ML recycle pumps. While there are few plug flow facilities (as compared to oxidation ditches or sequencing batch reactors [SBRs]) that currently operate their entire aeration volume at DO concentrations below 0.7 mg/L, this is an area of extensive research because of the energy and nutrient removal benefits.

Like the conventional BNR alternative presented earlier, SNDN systems can be configured as an S2EBPR system to provide improved performance and protection from solids washout during peak flow events. A schematic of an SNDN S2EBPR process is presented in Figure 7.03-5.

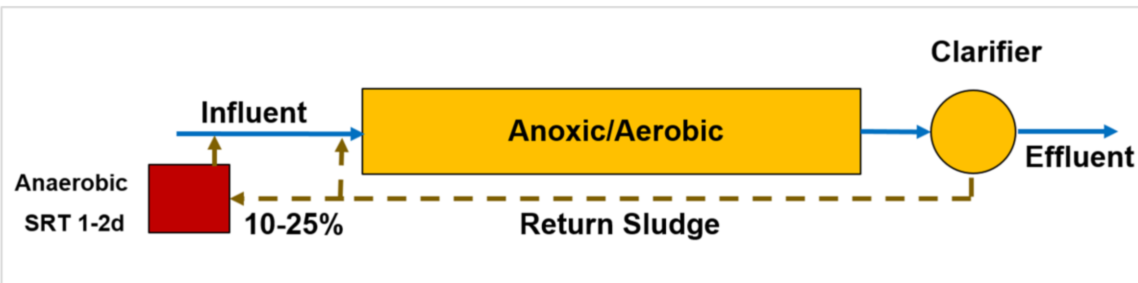


Figure 7.03-5 SNDN S2EBPR Process Schematic

In this alternative, the activated sludge system consists of an S2EBPR system with a mainstream SNDN aerated zone. The mainstream SNDN zones would be included as part of newly constructed tanks while the existing solids contact basins could be repurposed as anaerobic S2EBPR zones.

This alternative is similar to Alternative BNR1 with the exception of the operation of the mainstream activated sludge tanks. Like alternative BNR1, this alternative includes an aerated WAS storage tank, new biosolids thickening process (new building, mechanical thickening device, and pumps), solids contact basin splitter addition, a new RAS Pump Station, and a new Blower Building.

Much of the infrastructure required to implement alternatives BNR1 and BNR2 are the same, with the major differences being the components installed within the aeration tanks (mixers, recycle pumps, diffusers). Because of the lack of significant industry experience in low DO operations at facilities with stringent ammonia limits, particularly in cold climates, this alternative also includes the components necessary to allow operation in either SNDN or conventional BNR modes.

In addition, this alternative includes the installation of a hydrocyclone sludge densification system to mitigate poor sludge settling issues that have been reported at other WPCF operating under low DO conditions. This system includes a skid of hydrocyclones installed as the WAS storage tank connected to the WAS piping with the hydrocyclone underflow (denser sludge) returned by gravity to the activated sludge system and the hydrocyclone overflow (light sludge) discharged to the WAS storage tank.

Preliminary layout of this alternative is presented in Figure 7.03-6.

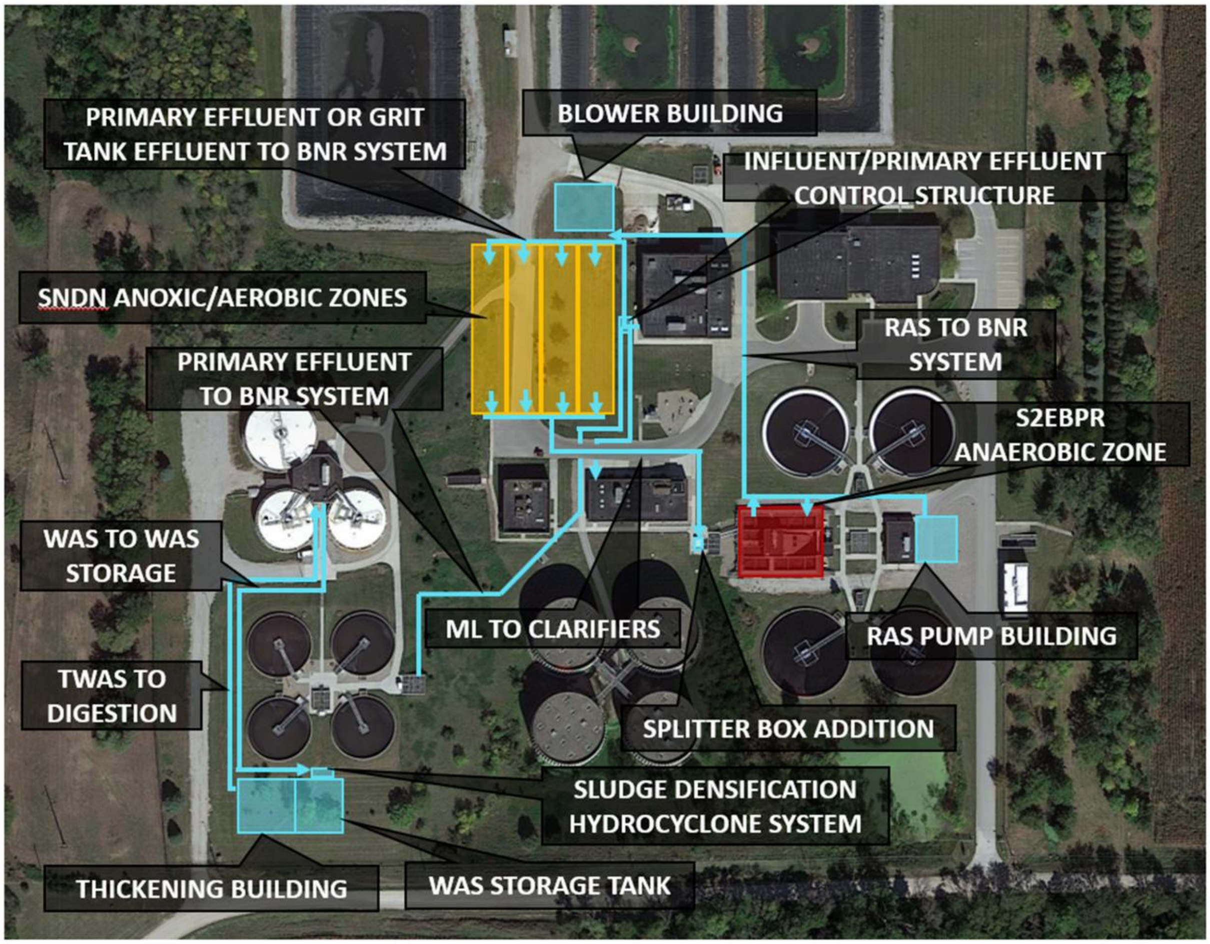


Figure 7.03-6 Alternative BNR2 Preliminary Site Layout

This alternative includes the following elements:

1. Demolition of Trickling Filter Complex and second stage trickling filter pumps.

2. Construction of four 1.25-MG activated sludge basins with baffle walls to create swing anoxic/aerated zones and allow operation in conventional BNR mode.

3. Conversion of the existing solids contact basins to two 0.3-MG sidestream anaerobic zones for S2EBPR, including structural modifications and installation of new mixers and process monitoring equipment.

4. Installation of aeration equipment for new activated sludge system, including blowers, piping, fine bubble diffusers, and associated controls.

5. Installation of mixers in swing anoxic zones and nitrate recycle pumps and piping between aerobic and swing anoxic zones to allow operation in conventional BNR mode.

6. Construction of a building to house new blowers and electrical equipment associated with a new activated sludge system. A portion of the existing Raw Wastewater Pump Station could potentially be used for housing the blowers if the grit removal equipment is moved out of the building. This is discussed in greater detail in Section 9.

7. Expansion of existing solids contact splitter box to receive ML from new a BNR activated sludge system.

8. Installation of new centrifugal RAS pumps and modifications to existing RAS piping to eliminate telescoping valves.

9. Construction of a RAS Pump Station adjacent to existing Sludge Pump Building to house new RAS pumps.

10. Construction of an aerated WAS storage tank and associated diffusers and blowers.

11. Construction of a new WAS Storage/Thickening Building located near the anaerobic digester complex to house WAS thickening equipment and WAS storage blowers.

12. Installation of two GBTs and associated pumps and controls to thicken WAS before digestion.

13. Installation of sludge densification hydrocyclone system and associated piping.

A BioWin model of this alternative was created to simulate treatment performance (see Figure 7.03-7). As discussed earlier, low DO activated sludge and SNDN are an area of current research and, therefore, there are not industry-wide standards for process modeling of these systems. EnviroSim (the developer of the BioWin process modeling software) recommends modeling low DO activated sludge systems using the default kinetic parameters included within the model (the same as used for the conventional DO BNR activated sludge systems) unless site-specific kinetic tests indicate that parameters should be changed. The potential parameters changes that are most often considered for low DO activated sludge systems involve the half-saturation concentrations that impact the nitrification and/or denitrification rate at low DO. Using the default kinetic values for these parameters may underestimate the amount of SNDN occurring in the system. Previous studies have been conducted on low DO activated sludge systems, such as the system in St. Petersburg, Florida (Jimenez et al, 2010[1]), that indicated that changes to the default parameters were necessary to simulate the SNDN performance that was observed at the WPCF. Because of the importance of these kinetic parameters to the predicted performance, simulations were conducted at both the BioWin default kinetic parameters and the values determined in the model calibration of the SNDN system at St. Petersburg, Florida (Jimenez et al, 2010) to indicate potential SNDN performance. These simulation results are presented in Tables 7.03-2 and 7.03-3, respectively. For these simulations, all of the aeration basins were operated between 0.2- and 0.8-mg/L DO. Like the Alternative BNR1 model, an S2EBPR anaerobic zone receiving 25 percent of the RAS and thickened to approximately 1 percent solids within the anaerobic zone was also included, secondary clarifier performance was assumed to result in an effluent TSS concentration of approximately 10 mg/L, and the sludge lagoon was modeled as a clarifier with biological and chemical reactions occurring within the sludge blanket.

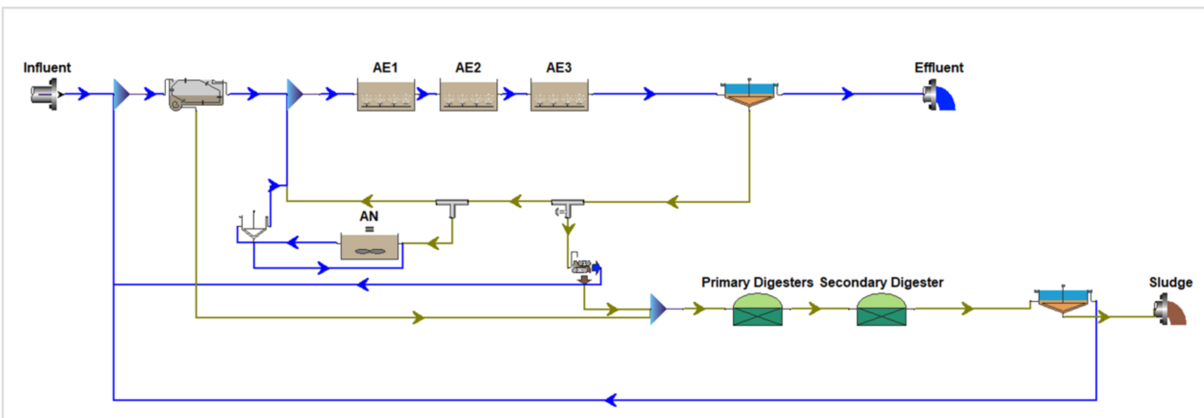


Figure 7.03-7 Alternative BNR2 Process Model Flowsheet

[1]Reference: Jimenez, J., Dursun, D., Dold, P., Bratby, J., Keller, J., & Parker, D. (2010) Simultaneous nitrification-denitrification to meet low effluent nitrogen limits: Modeling, performance, and reliability. Proceedings of the 83rd Annual Water Environment Federation Technical Exposition and Conference, New Orleans, Louisiana, Oct. 2-6.; Water Environment Federation: Alexandria, Virginia.

Parameter	Loading Condition		
	2045 Maximum Month	2045 Annual Average	2045 Annual Average
Influent Parameters			
Flow, MGD	15.8	10.5	10.5
BOD_5 Load, lb/day	20,580	16,100	16,100
TSS Load, lb/day	25,470	18,560	18,560
TKN Load, lb/day	3,780	2,820	2,820
TP Load, lb/day	480	360	360
Primary Clarifier Performance			
TSS Removal, %	60	60	60
BOD_5 Removal, %	37	37	37
Operating Conditions			
Temperature, degrees C	10	10	10
MLSS, mg/L	2,700	2,400	2,700
RAS Flow, MGD	15.8	10.5	10.5
Solids Loading Rate, lb/sf/day	23	13	15
aSRT, days	12	12	12
Airflow, scfm	4,400	3,300	4,000
CPR chemical addition[1], gpd	0	0	0
Methanol addition[2], gpd	0	0	600
Simulated Effluent			
BOD_5, mg/L	3	3	3
TSS, mg/L	10	10	10
NH_3-N, mg/L	0.8	1.1	1.6
TN, mg/L	16	17	12
TP, mg/L	1.3	1.1	0.5

Notes:[1]Based on 32 percent ferric chloride solution
[2]Based on 100 percent methanol solution

Table 7.03-2 Steady-State Process Model Simulation Results: Alternative BNR2 (BioWin Default Kinetic Parameters)

Parameter	Loading Condition 2045 Maximum Month	2045 Annual Average	2045 Annual Average
Influent Parameters			
Flow, MGD	15.8	10.5	10.5
BOD_5 Load, lb/day	20,580	16,100	16,100
TSS Load, lb/day	25,470	18,560	18,560
TKN Load, lb/day	3,780	2,820	2,820
TP Load, lb/day	480	360	360
Primary Clarifier Performance			
TSS Removal, %	60	60	60
BOD_5 Removal, %	37	37	37
Operating Conditions			
Temperature, degrees C	10	10	10
MLSS, mg/L	2,600	2,300	2,500
RAS Flow, MGD	15.8	10.5	10.5
Solids Loading Rate, lb/sf/d	22	13	14
aSRT, days	12	12	12
Airflow, scfm	4,400	3,300	3,300
CPR chemical addition[1], gpd	0	0	100
Methanol addition[2], gpd	0	0	0
Simulated Effluent			
BOD_5, mg/L	3	3	3
TSS, mg/L	10	10	10
NH_3-N, mg/L	0.7	1.0	1.0
TN, mg/L	12	12	12
TP, mg/L	1.5	1.3	1.0

Notes: [1]Based on 32 percent ferric chloride solution
[2]Based on 100 percent methanol solution

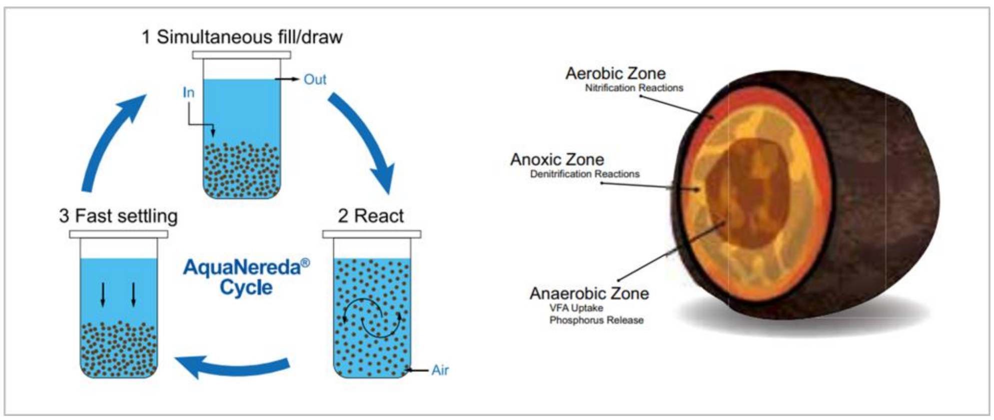
Table 7.03-3 Steady-State Process Model Simulation Results: Alternative BNR2 (Modified Kinetic Parameters)

As shown in Table 7.03-2, the BioWin simulation using the default kinetic parameters at the 2045 maximum month condition during cold weather predicts near complete nitrification (effluent ammonia less than 1.0 mg/L) but effluent TN and TP values greater than the targets. At the 2045 design average conditions, approximately 600 gallons of methanol per day were required to achieve the effluent TN target. The high methanol dose is a result of limited SNDN occurring in the simulations and a portion of the methanol being oxidized by aerobic heterotrophs in the aerated zone rather than being used strictly for denitrification. When the same flow and loading conditions were simulated using the modified kinetic parameters, the TN target of 12.5 mg/L was achieved for the 2045 maximum month and annual average design conditions without any methanol addition (see Table 7.03-3). Because it is not anticipated that the IDNR will require chemical addition to meet the nutrient reduction targets, infrastructure for chemical addition or the associated chemical costs are not included in this alternative. The simulated airflow for these models was approximately 18 percent less than the Alternative BNR1 alternatives operated at a 2.0-mg/L setpoint.

C. Alternative BNR3a–Aerobic Granular Sludge (AGS) With Primary Clarification

In this alternative, the trickling filters and solids contact basins are demolished and a new AGS system is constructed to treat all of the influent flow. AGS is an emerging process that selects for sludge that forms granules over flocculent sludge. These granules are denser than flocculent sludge and have improved settling characteristics, allowing reactors to operate with high MLSS concentrations (typically 8,000 mg/L or greater) and have a relatively short settling phase. This allows a smaller reactor volume compared to conventional SBRs.

The AGS reactors operate as upflow SBRs with three phases (see Figure 7.03-8). During the fill/draw phase, influent enters the reactor from the bottom while treated water is discharged over fixed weirs at the top. No aeration is provided during this first phase, which creates anoxic and anaerobic conditions for BNR. During the react phase, the influent flow is terminated and the reactor is aerated through fine bubble diffusers on the bottom of the tank. During this phase, BOD_5 reduction, phosphorus uptake, and simultaneous nitrification and denitrification occurs. During the settling phase, the air flow is shut off and the granules settle in preparation for another fill/draw phase. Excess sludge is wasted from mid-depth of the reactor during the settling phase to waste flocculent sludge while maintaining granules in the system. As an SBR, the AGS process does not require secondary clarifiers or RAS pumping.



Source: Aqua-Aerobics Systems, Inc.©

Figure 7.03-8 AquaNereda® Aerobic Granular Sludge Process

Currently, the only established commercial technology for AGS in the United States is the AquaNereda® system by Aqua-Aerobic Systems, Inc.© A proposal was received for an AquaNereda® system for the proposed design flows and loads for the WPCF. This proposal indicates that six reactors, each with a volume of approximately 1.13 MG, would be required to treat the proposed flows and loads.

Because the AGS system does not require dedicated clarifiers, the existing secondary clarifiers are converted to AGS reactors for this alternative. Based on the required reactor volume (1.13 MG each), the existing clarifiers walls would be raised approximately 3 feet to provide a process water depth of approximately 19.25 feet with 2 feet of freeboard. Other structural modifications to the existing clarifiers are also included in this alternative, such as the removal of weir troughs, levelling of the concrete floor, and construction of pipe galleries for feed and waste pipes. Two new reactors of the same geometry and volume of the modified clarifiers are also included to provide six total reactors. Conversion of the existing clarifiers is anticipated to save approximately $5 million compared to constructing six new reactors. However, this conversion impacts project phasing because one or more of the existing clarifiers will be converted to a AGS reactors while the existing solids contact/trickling filter plant is in service, effectively reducing the clarification capacity of the existing system for a period between the initial phase(s) and six reactor full buildout.

Each reactor includes a fine bubble diffuser assembly and fixed weir troughs. Five blowers to aerate the AGS tanks would be installed in a new Blower Building or a modified Raw Wastewater Pump Station (if new grit removal equipment is installed in a different location).

To prevent ML from spilling over the effluent weir as the water level rises during aeration, the water level in the reactors is drawn down approximately 6 inches before aeration. This water is stored in a water level correction tank and returned to the head of the plant. While this water could be drained directly to the head of the plant, the drawdown occurs over a relatively short period (approximately 8 to 10 minutes) making equalization beneficial. A portion of the existing solids contact basins could be repurposed as a water level correction tank.

Because the light flocculent sludge is preferentially wasted in the AGS system, the waste sludge has a low solids content (typically less than 0.1 percent TS). Therefore, sludge buffer tanks are typically provided to both store WAS from the intermittent wasting as well as to thicken the WAS to approximately 1 percent TS (similar to the WAS solids content of the other alternatives). A portion of the existing solids contact basins could be repurposed as sludge buffer tanks as part of this alternative, with existing WAS pumps used to pump sludge out of the tanks. Like the other BNR alternatives, this alternative includes an aerated WAS storage tank (that receives the WAS from the sludge buffer tanks) and a new biosolids thickening process that consists of a new building, mechanical thickening device (assumed to be GBTs for the purpose of this Plan), and thickened sludge pumps.

The AGS system in this alternative includes six total reactors. Because the AGS reactors in this alternative operate as SBRs, each reactor is batch-fed and at least three reactors are required to always have one reactor in the feed phase, allowing influent flow to be continuously fed to the AGS system (otherwise influent equalization or storage are required). The number of reactors in this alternative was selected with an understanding that the selected nutrient reduction alternative would likely be implemented in phases. Therefore, the first phase could include two reactors (allowing influent to be fed to the system most of the time along with redundancy) or three reactors (allowing a portion of the influent to be continuously fed).

A preliminary layout of this alternative is presented in Figure 7.03-9.

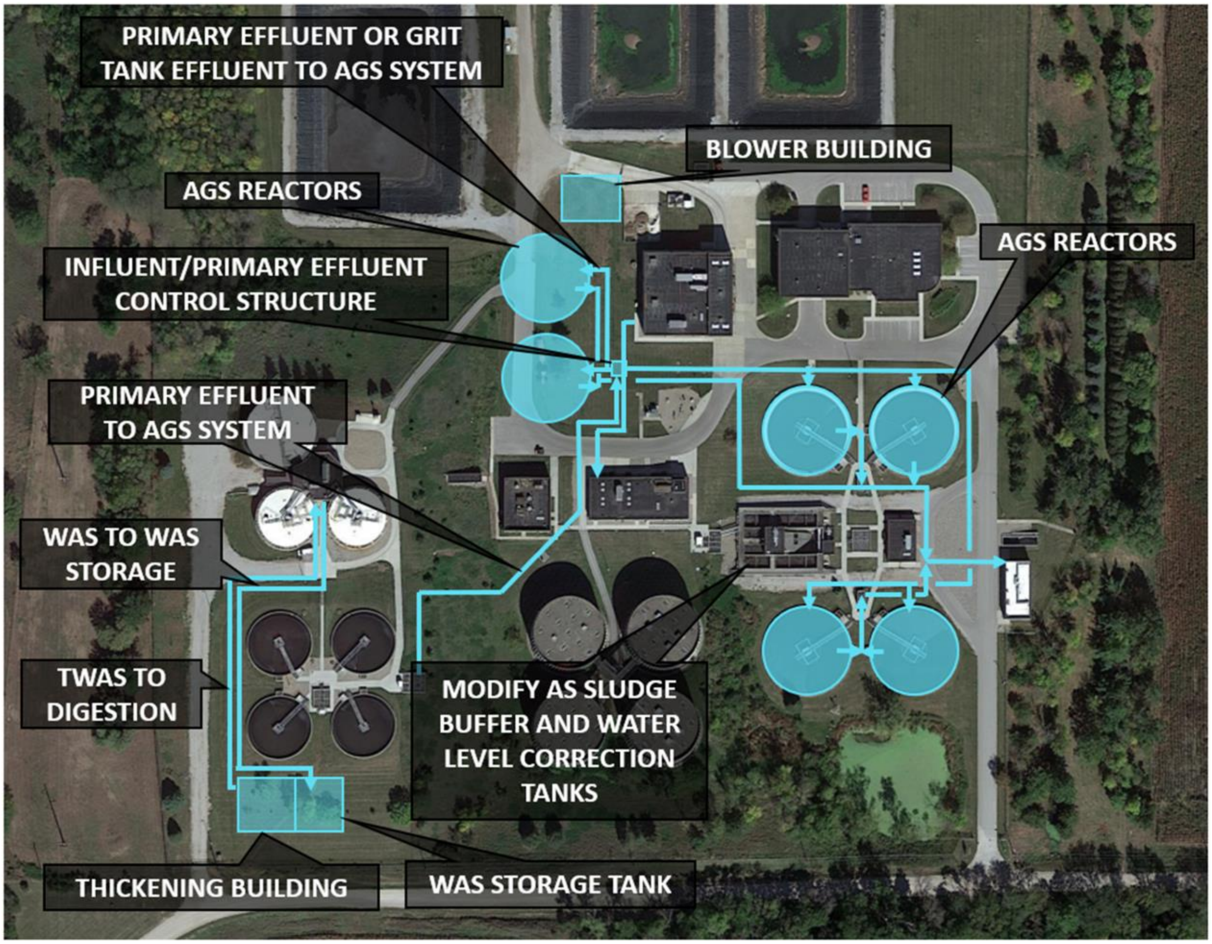


Figure 7.03-9 Alternative BNR3a Preliminary Site Layout

This alternative includes the following elements:

1. Demolition of the Trickling Filter Complex and second stage trickling filter pumps.

2. Construction of two 1.13-MG AGS reactors with adjacent piping gallery.

3. Structural modifications to existing secondary clarifiers for conversion to AGS reactors, including raising tank walls, levelling floor, and constructing pipe galleries.

4. Installation of aeration equipment for a new AGS system, including blowers, piping, fine bubble diffusers, and associated controls.

5. Installation of a weir trough assembly in the AGS reactors.

6. Construction of a building to house new blowers and electrical equipment associated with the AGS system. A portion of the existing Raw Wastewater Pump Station could potentially be used for housing the blowers if the grit removal equipment is moved out of the building. This is discussed in greater detail in Section 9.

7. Modifications to solids contact basins to provide an 85,000-gallon water level correction tank and four 22,400-gallon sludge buffer tanks with associated pumps and controls.

8. Construction of an aerated WAS storage tank and associated diffusers and blowers

9. Construction of a new WAS Storage/Thickening Building located adjacent to the anerobic digester complex to house WAS thickening equipment and WAS storage blowers.

10. Installation of two GBTs and associated pumps and controls to thicken WAS before digestion.

A BioWin model of this alternative was created to simulate treatment performance (see Figure 7.03-10). Model parameters for the AGS module were modified from BioWin default values to those recommended by Aqua-Aerobic Systems, Inc.© for modeling of the AquaNereda® system. Model simulation results for this alternative at the 2045 design average and maximum month flow and loadings are presented in Table 7.03-4. As shown, the BioWin simulations predict complete nitrification and nutrient removal less than the target values for both the 2045 maximum month and annual average conditions without chemical addition.

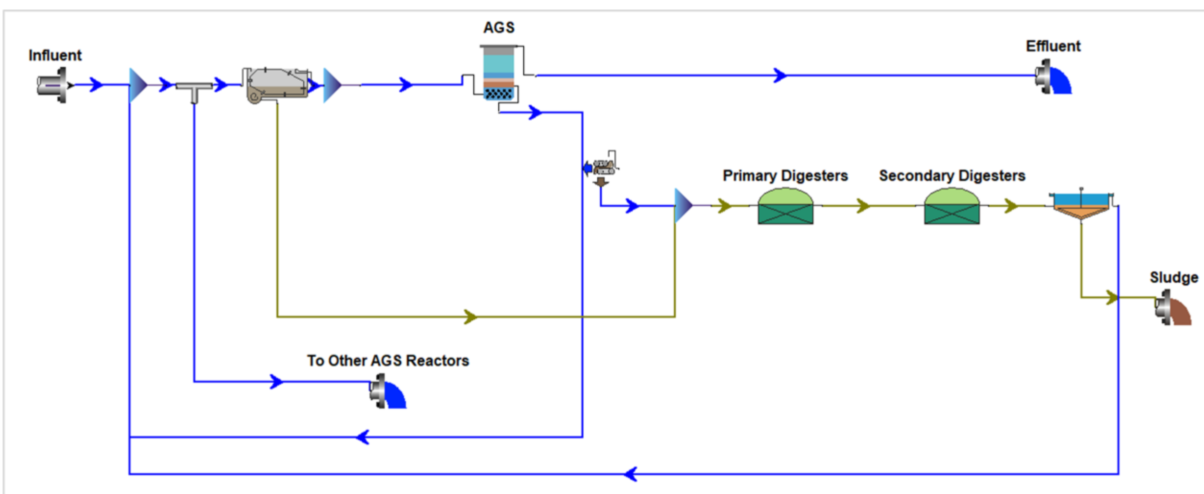


Figure 7.03-10 Alternative BNR3a Process Model Flowsheet

Parameter	Loading Condition	
	2045 Maximum Month	**2045 Annual Average**
Influent Parameters		
Flow, MGD	15.8	10.5
BOD_5 Load, lb/day	20,580	16,100
TSS Load, lb/day	25,470	18,560
TKN Load, lb/day	3,780	2,820
TP Load, lb/day	480	360
Primary Clarifier Performance		
TSS Removal, %	60	60
BOD_5 Removal, %	37	37
Operating Conditions		
Temperature, degrees °C	10	10
MLSS, mg/L	8,500	8,000
CPR chemical addition[1], gpd	0	0
Methanol addition[2], gpd	0	0
Simulated Effluent		
BOD_5, mg/L	3	3
TSS, mg/L	11	11
NH_3-N, mg/L	0.6	0.1
TN, mg/L	9	9
TP, mg/L	0.5	0.3

Notes:[1]Based on 32 percent ferric chloride solution
[2]Based on 100 percent methanol solution

Table 7.03-4 Steady-State Process Model Simulation Results: Alternative BNR3a

D. Alternative BNR3b–Aerobic Granular Sludge (AGS) Without Primary Clarification

This alternative is similar to Alternative BNR3a, but in this alternative the existing primary clarifiers would no longer be used and the AGS reactors would receive grit tank effluent. Unlike the activated sludge tanks in Alternative BNR1 and BNR2 that are sized mainly based on organic loading, the AGS reactors in Alternative BNR3a are sized based on influent flow because of the low organic loadings to the AGS system when receiving primary effluent. Therefore, the AGS reactor size necessary to accommodate the additional organic load resulting from the elimination of the primary clarifiers is identical to the size indicated in Alternative BNR3a with primary clarifiers. Eliminating the primary clarifiers also eliminates the need for the first stage trickling filter pumps that are currently used to pump grit tank effluent to the primary clarifiers.

The main differences between this alternative and Alternative BNR3a are an increase in blower sizing to accommodate higher organic loads as well as larger sludge buffer tanks because of increased sludge production.

Aqua-Aerobic Systems, Inc.© indicates that there are currently no AquaNereda® systems that are operating without primary clarifiers but with anaerobic digestion. While there are conventional activated sludge facilities that include anaerobic digestion without primary clarification, this is not commonly practiced partially because of potential operational issues (such as digester foaming) that can be experienced when operating anaerobic digesters without feeding primary sludge and the loss of beneficial use of the additional biogas generation.

A preliminary layout of this alternative is presented in Figure 7.03-11.

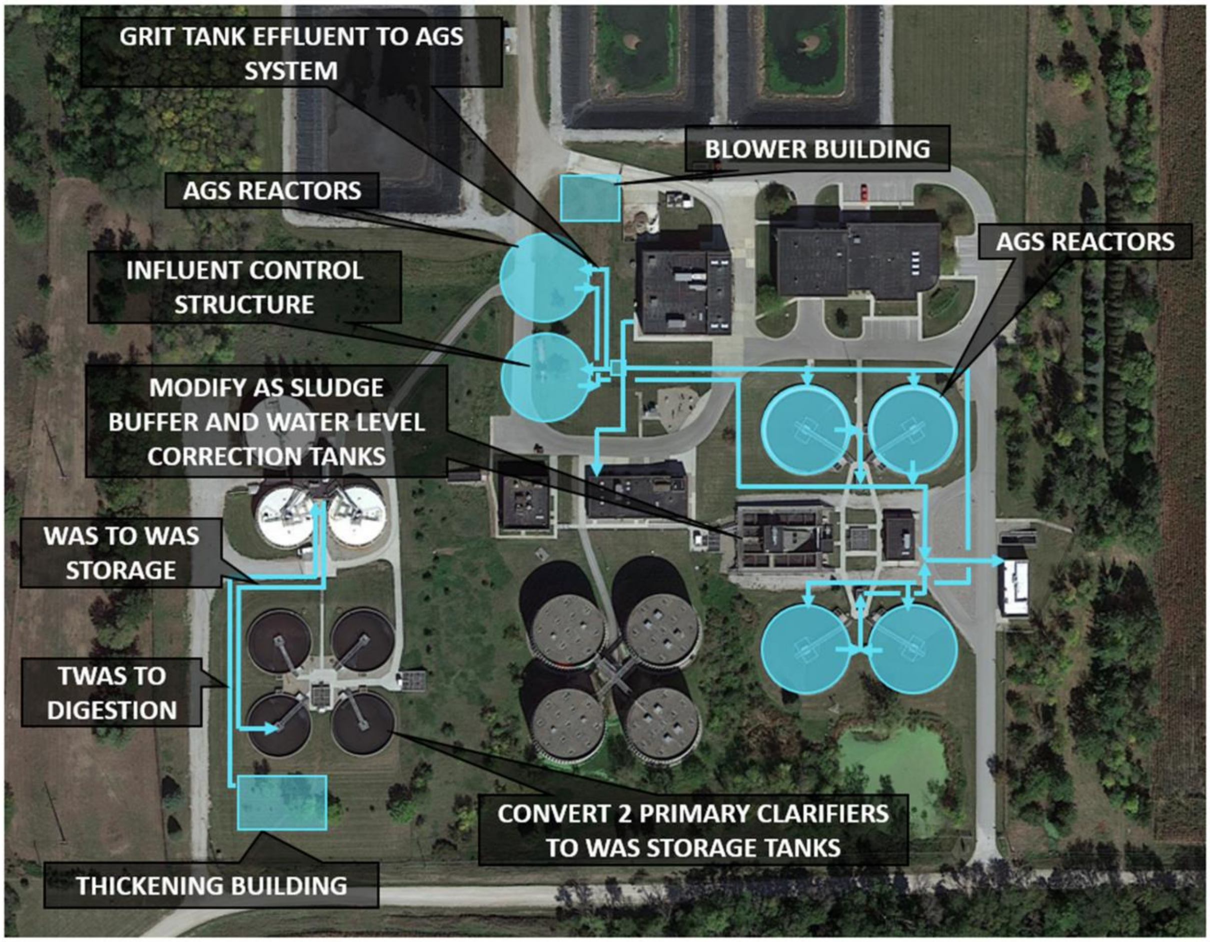


Figure 7.03-11 Alternative BNR3b Preliminary Site Layout

This alternative includes the following elements:

1. Demolition of the Trickling Filter Complex and second stage trickling filter pumps.

2. Construction of two 1.13-MG AGS reactors with adjacent piping gallery.

3. Structural modifications to four existing secondary clarifiers for conversion to AGS reactors, including raising tank walls, levelling floor, and constructing pipe galleries.

4. Installation of aeration equipment for a new AGS system, including blowers, piping, fine bubble diffusers, and associated controls.

5. Installation of weir trough assembly in the AGS reactors.

6. Construction of a building to house new blowers and electrical equipment associated with AGS system. A portion of the existing Raw Wastewater Pump Station could potentially be used for housing the blowers if the grit removal equipment is moved out of the building. This is discussed in greater detail in Section 9.

7. Modifications to solids contact basins to provide an 85,000-gallon water level correction tank and four 22,400-gallon sludge buffer tanks with associated pumps and controls.

8. Construction of an aerated WAS storage tank and associated diffusers and blowers

9. Construction of a new WAS Storage/Thickening Building located adjacent to the anerobic digester complex to house WAS thickening equipment and WAS storage blowers.

10. Installation of three GBTs and associated pumps and controls to thicken WAS before digestion.

A BioWin model of this alternative was created to simulate treatment performance (see Figure 7.03-12). Model parameters for the AGS module were modified from BioWin default values to those recommended by Aqua-Aerobic Systems, Inc.© for modeling of the AquaNereda® system. Model simulation results for this alternative at the 2045 design average and maximum month flow and loadings are presented in Table 7.03-5. As shown, the BioWin simulations predict complete nitrification and nutrient removal less than the target values for both the 2045 maximum month and annual average conditions without chemical addition.

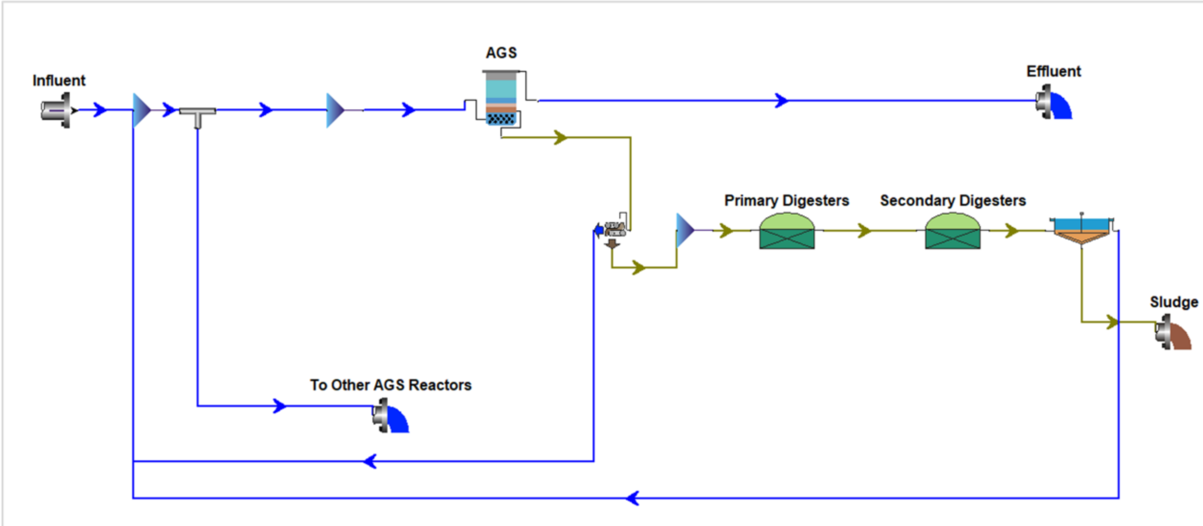


Figure 7.03-12 Alternative BNR3b Process Model Flowsheet

Parameter	Loading Condition	
	2045 Maximum Month	2045 Annual Average
Influent Parameters		
Flow, MGD	15.8	10.5
BOD_5 Load, lb/day	20,580	16,100
TSS Load, lb/day	25,470	18,560
TKN Load, lb/day	3,780	2,820
TP Load, lb/day	480	360
Operating Conditions		
Temperature, degrees C	10	10
MLSS, mg/L	8,500	8,000
CPR chemical addition[1], gpd	0	0
Methanol addition[2], gpd	0	0
Simulated Effluent		
BOD_5, mg/L	5	4
TSS, mg/L	14	11
NH_3-N, mg/L	0.1	0.1
TN, mg/L	7	7
TP, mg/L	0.4	0.3

Table 7.03-5 Steady-State Process Model Simulation Results: Alternative BNR3b

B. Monetary Comparison

Table 7.03-5 summarizes the 20-year present worth analysis for each of the nutrient reduction alternatives. Additional detail on the present worth analysis is provided in Appendix C. While all of the opinions of probable construction costs (OPCC) are based on fourth quarter 2022 dollars (no portions of the alternative are discounted as a future capital cost), the costs are escalated to account for an implementation plan that is assumed to include three phases. This accounts for increased capital costs for contractor mobilization, project management/supervision, engineering, and other costs that are incurred when projects are split into several smaller projects. This approach allows a comparison of the present worth of the alternatives on a common cost basis, with more detailed evaluation of phasing discussed in Section 11 of this Plan. Likewise, operations and maintenance (O&M) costs included in the present worth analysis are based on the full implementation of each alternative rather than partial implementation (with partial existing parallel trickling filter O&M costs) over several phases. At the study phase of alternative evaluation, the expected accuracy range of this OPCC is -20 to +40 percent based on the AACE International Recommended Practice 17R Cost Estimate Classification System. Alternatives BNR1 and BNR2 have essentially the same 20-year present worth cost and these two alternatives have a present worth cost approximately 20 percent less than the next closest alternative, Alternative BNR3a.

	Alternative BNR1 Conventional BNR Activated Sludge	**Alternative BNR2** SNDN Activated Sludge	**Alternative BNR3a** AGS with Primary Clarification	**Alternative BNR3b** AGS without Primary Clarification
Capital Costs				
Equipment/Structure Subtotal	$15,650,000	$16,070,000	$31,610,000	$32,620,000
Mechanical	$6,420,000	$6,520,000	$7,500,000	$7,810,000
Electrical	$4,700,000	$4,830,000	$3,820,000	$3,820,000
Sitework	$2,350,000	$2,420,000	$1,910,000	$1,910,000
Undefined Scope	$3,130,000	$3,130,000	$3,130,000	$3,130,000
Contractor General Conditions	$4,840,000	$4,840,000	$4,840,000	$4,840,000
Phasing Escalator	$3,710,000	$3,710,000	$3,710,000	$3,710,000
Supply Chain Escalator	$5,570,000	$5,570,000	$5,570,000	$5,570,000
Contingencies	$6,960,000	$6,960,000	$6,960,000	$6,960,000
Technical Services	$9,280,000	$9,280,000	$9,280,000	$9,280,000
Total Opinion of Capital Costs	**$62,610,000**	**$63,330,000**	**$78,330,000**	**$79,650,000**
Annual O&M Costs				
Power	$206,000	$164,000	$165,000	$149,000
Maintenance and Supplies	$90,000	$100,000	$90,000	$100,000
Total	**$296,000**	**$264,000**	**$255,000**	**$249,000**
Summary of Present Worth Costs				
Capital Cost	$62,610,000	$63,330,000	$78,330,000	$79,650,000
Replacement	$620,000	$620,000	$30,000	$30,000
O&M Cost	$4,460,000	$3,970,000	$3,840,000	$3,750,000
Salvage Value	($3,390,000)	($3,346,000)	($1,520,000)	($1,520,000)
Total Present Worth	**$64,300,000**	**$64,460,000**	**$80,680,000**	**$81,910,000**

Notes: All costs in fourth Quarter 2022 dollars.

Table 7.03-6 Nutrient Reduction Alternative Present Worth Evaluation Summary

C. Nonmonetary Factor Evaluation

Nonmonetary factors for each alternative were evaluated and are summarized in Table 7.03-6. In collaboration with City staff, 14 nonmonetary factors were identified and an importance weight factor was assigned to each. Each of the alternatives were then scored from 1 to 5 for each nonmonetary factor category, with a higher score indicating that the alternative better satisfies that nonmonetary factor. These scores were then weighted based on the weighting factors developed by the City for each category. As shown, Alternative BNR3a–AGS with Primary Clarification had the most favorable nonmonetary score of the alternatives evaluated.

Nonmonetary Factor	Factor Weight	Alternative BNR1		Alternative BNR2		Alternative BNR3a		Alternative BNR3b	
		Conventional BNR		SNDN		AGS		AGS	
		Raw Score	Weighted Score	Raw Score	Weighted Score	Raw Score	Weighted Score	Raw Score	Weighted Score
Performance	10%	4	4.0	4	4.0	5	5.0	5	5.0
Resiliency to Changing Conditions and Process Upsets	9%	5	4.3	5	4.3	5	4.3	5	4.3
Safety	8%	5	4.1	5	4.1	5	4.1	5	4.1
Operational Complexity	8%	4	3.2	3	2.4	5	4.0	5	4.0
Maintenance Requirements	8%	4	3.2	4	3.2	5	4.0	5	4.0
Peak Flow Handling	8%	5	3.9	5	3.9	4	3.1	4	3.1
Adaptability for Future Regulations	7%	5	3.7	5	3.7	4	3.0	4	3.0
Implementation/Constructability	7%	3	2.2	3	2.2	5	3.6	5	3.6
Solids Handling Impacts	7%	5	3.3	5	3.3	4	2.6	2	1.3
Expandability	7%	3	2.0	3	2.0	5	3.3	5	3.3
Environmental Impacts	7%	3	2.0	4	2.6	5	3.3	5	3.3
Flexibility	6%	4	2.5	5	3.1	3	1.9	3	1.9
Social Impacts	4%	5	2.2	5	2.2	5	2.2	5	2.2
Public Acceptance	4%	5	2.0	5	2.0	5	2.0	5	2.0
Total Score	**100%**		**42.7**		**43.2**		**46.5**		**45.2**

Table 7.03-7 Nutrient Reduction Alternative Nonmonetary Factor Evaluation Summary

A brief description of the impact of each alternative on each of the categories and rationale for the scores presented in Table 7.03-6 are presented in the following.

1. Treatment Performance

Based on the simulation results presented in this section, all the alternatives achieved complete nitrification, while Alternatives BNR3a and BNR3b achieved the greatest amount of nutrient removal without chemical addition. Therefore, all alternatives received high scores in this category, with Alternatives BNR3a and BNR3b receiving slightly higher scores than the others.

2. Resiliency to Changing Conditions and Process Upsets

BNR processes are inherently susceptible to process upsets resulting from changing influent or environmental conditions. Alternatives BNR1 and BNR2 includes a sidestream anaerobic zone that provides resiliency because the biomass in this reactor is not impacted by the influent flow. Alternatives BNR1 and BNR2 also provide more dilution to slug influent loads compared to Alternatives BNR3a and BNR3b, which could result in all of a slug load entering one or two SBRs. However, alternatives BNR3a and BNR3b include granular sludge that inherently provides process resiliency based on the granule structure that protects a portion of the biomass from potentially toxic substances. Therefore, all the alternatives received high scores for this category.

3. Safety

There is no anticipated difference between the alternatives with respect to safety. While the model results indicate that chemical addition may be needed under some circumstances for all alternatives, it is not anticipated that IDNR will require chemical addition at this time. Therefore, no difference in chemical handling and associated safety concerns is anticipated for the alternatives at this time.

4. Operational Complexity

All the alternatives are provided with process control and monitoring systems to provide automation and process optimization. Of the three alternatives, the SNDN activated sludge system (Alternative BNR2) is anticipated to be the most complex and require the most operator attention because of the susceptibility to incomplete nitrification, sludge bulking, and other process performance issues that can occur under low DO conditions. Alternative BNR1 includes more operational variables (such as RAS rate, nitrified ML recycle rate, flowrate to S2EBPR zone, etc.) than Alternative BNR3 and, therefore, received a slightly lower score for this category.

5. Maintenance Requirements

Alternatives BNR1 and BNR2 have more equipment than Alternatives BNR3a and BNR3b (RAS pumps, clarifiers, mixers, recycle pumps) and, therefore, it is anticipated that this additional equipment will result in higher maintenance requirements for those alternatives. The anticipated O&M cost impact of the alternatives is included in the present worth evaluation in this section. Alternative BNR3a and BNR3b received higher scores in this nonmonetary factor category to account for reduced maintenance items and the associated staff attention required for equipment maintenance.

6. Peak Flow Handling

All the alternatives presented are capable of treating the design peak flows indicated in this Plan and, therefore, all of the alternatives received high scores in this category. The flow through systems (Alternatives BNR1 and BNR2) with dedicated clarifiers received higher scores because these are anticipated to handle unanticipated peak flows more effectively than a batch process (Alternative BNR3) and the sidestream anaerobic zone provides protection against solids washout. Furthermore, BPR performance of Alternatives BNR1 and BNR2 is anticipated to be more stable at peak flows because the hydraulic retention time (HRT) of the sidestream reactor is not affected by high influent flows.

7. Adaptability for Future Regulations

All the alternatives completely nitrify and provide BNR and they all could be expanded or modified if these limits became more stringent in the future. While the AGS system includes flexibility in the cycle timing, the other alternatives that include dedicated reactors and clarifiers provide more adaptability to allow reconfiguration of the treatment process for implementation of new processes, technologies, or controls that may be more efficient or provide better performance in the future. Therefore, Alternatives BNR1 and BNR2 received slightly higher scores in this category than the other alternatives.

8. Implementation and Constructability

As presented earlier, all the alternatives are laid out to allow phased implementation with the existing secondary treatment process in service during construction and the initial implementation phases. Alternatives BNR1 and BNR2 rely on using the existing secondary clarifiers that will also need to be used for the existing secondary treatment system during initial phases. Because of this, Alternative BNR3 received a higher score in this category than Alternatives BNR1 and BNR2.

9. Solids Handling Impacts

All the alternatives will result in more solids production than the current WPCF operation. Alternatives BNR3a and BNR3b result in a very thin waste sludge that must first be thickened in a sludge buffer before further thickening in a thickening process. Furthermore, Alternative BNR3b results in significantly more WAS with the elimination of primary clarifiers and the potential for digester operational issues associated with anerobic digesters fed only WAS. Therefore, Alternative BNR1 and BNR2 received higher scores than BNR3a or BNR3b in this category.

10. Expandability

All the alternatives can be expanded beyond the design 2045 condition with the construction of additional tanks. Because the AGS system does not require clarifiers, RAS pumps, RAS piping, and other infrastructure that may be required to increase capacity of the other alternatives, Alternative BNR3 is anticipated to be easier to expand in the future and received a higher score than the others in this category.

11. Environmental Impacts

All the alternatives will have a positive environmental impact by improving treatment performance and reducing nutrient loads to the receiving stream. The alternatives were ranked in this category based on their energy efficiency and anticipated nutrient reduction performance, with Alternatives BNR3a and BNR3b receiving the highest scores.

12. Flexibility

Operational controls within all the alternatives provide some flexibility to make operational changes for various influent and environmental conditions. As described earlier, Alternative BNR2 includes the flexibility to operate as either a conventional or low DO activated sludge system while Alternative BNR1 would operate only as a conventional BNR system. Therefore, Alternative BNR2 received a higher score for this category than the other alternatives.

13. Social Impacts

There is no anticipated difference between the alternatives with respect to social impacts.

14. Public Acceptance

There is no anticipated difference between the alternatives with respect to public acceptance. All the alternatives fit on the existing treatment site and there is no significant anticipated change to noise or odors from any of the alternatives versus the current treatment facility.

SECTION 8
EVALUATION OF RAW WASTEWATER PUMP STATION

8.01 INTRODUCTION

An assessment of the capacity of screening and grit removal processes at the Raw Wastewater Pump Station is presented in this section. Based on this assessment, capacity deficiencies and potential improvements are identified.

8.02 CONDITION ASSESSMENT OF RAW WASTEWATER PUMP STATION

In this section, the existing Raw Wastewater Pump Station processes are evaluated based on their performance and ability to treat and handle the projected flows as presented in Section 4. This section will include a condition assessment of process, structural, heating, ventilation, and air conditioning (HVAC), plumbing, and electrical.

Process Condition Assessment

A. <u>Influent Gate and Parshall Flume Flow Measurement</u>

The main plant 66-inch reinforced concrete pipe (RCP) influent interceptor is tied into Control Box A with a 120- by 72-inch influent sluice gate with an electric actuator to control wastewater into the Raw Wastewater Pumping Station through a 6- by 10-foot inlet duct. Staff complete typical maintenance on the gate operator (i.e., greasing and exercising), but the gate is original to the plant and staff have requested that this hydraulic sluice gate and actuator be replaced. The gear box was replaced in 2022.

Before raw wastewater splitting into the three screenings channels, the flow is measured by a 3-foot-wide nested Parshall flume into a 5-foot Parshall flume located below the grating in Figure 8.02-1. The flume invert is near the bottom of the screening channel; therefore, water backs up into the flume thereby reducing capacity compared to if a free discharge existed directly downstream of the flume. The flume was originally constructed with an upstream level sensor but was since retrofitted in 2017 with a downstream level sensor to correct for backwater when flume is more than 70 percent submerged. City staff have indicated that the flume is submerged when flows exceed 7,500 gpm (10.8 MGD) and is not a reliable means of flow measurement at the higher flow rates.

Figure 8.02-1 Parshall Flume and Level Sensors

If the flume is kept in service, the 3-foot nested flume will need to be removed and the flume restored to a 5-foot flume to pass the future PHWW flow rate of 40.3 MGD. However, removing the flume entirely from service increases available hydraulic capacity and physical space available to install screens in the existing channel(s). Influent flow could be more reliably measured off the raw wastewater and equalization force main. Section 9 contains an evaluation of screening alternatives and provides additional discussion of the existing flume's hydraulic limitations.

B. Screening Equipment

Inside the Raw Wastewater Pumping Station, two existing Infilco Degremont 1/2-inch clear opening climber screens, installed in the outermost channels, are put into service when influent flows typically exceed 7,500 gpm. Each screen has a nominal flow capacity of 13.3 MGD and is original to the plant when constructed in the 1980s. Screenings are captured on the screen, removed by a rake arm, and are dumped into a hopper of a screenings grinding system. Ground screenings are discharged back into the channel downstream of the screen. Figure 8.02-2 shows the existing setup and significant wear on the equipment. City staff have indicated that the original mechanical screening equipment is functional; however, spare parts have been difficult to obtain.

Figure 8.02-2 Original Infilco Degremont Screen and Grinder System

Coarse manual bar racks are shown on the original plant drawings upstream of the existing screens. These manual bar racks have been removed from all three channels. Also original to plant, three constant velocity weirs were installed downstream of each of the screens to reduce the velocity through the screen by controlling a relatively consistent water level downstream of the screens before wastewater entering the wet well. Operators control raw pumping to maintain a 6.0-foot water level in the raw pump wet well. The wet well level could be as high as 20.75 feet before backing up into the channel. The weir plates downstream of the screens may either need to be removed from service or replaced as recommended by the selected screen manufacturer(s) as discussed in Section 9.

A 3/8-inch clear spaced Vulcan Industries Multi-Rake (VMR) bar screen was installed in the middle channel as shown in Figure 8.02-3 and is typically operated as the lead screen. This screen was designed for a flow capacity of 13.3 MGD; however, water begins backing up into the flume at flows greater than approximately 9.5 MGD. Operators modulate the control gate in Control Box A to limit flows into the Raw Wastewater Pumping Station to less than 9.5 MGD and use the main outfall sewer to the plant as temporary storage. Water level in Control Box A is monitored with a level sensor, and additional screens are brought online before the upstream water level rises to overtop upstream manholes.

Figure 8.02-3 Vulcan Industries VMR Screen Lower Level

The screen extends from the channel invert to the ground floor elevation, which is greater than 30 feet (Figure 8.02-4). A Vulcan washing and compacting unit (wash press) is installed for material processing with a capacity of 33 cf per hour batch or 99 cf per hour continuously. The wash press discharges into a bagging system and directly to a dumpster as shown in Figure 8.02-5 below. Approximately two dumpsters of screenings are accumulated in 1 week. Screenings are landfilled.

Figure 8.02-4 Vulcan Industries VMR Screen Upper Level

City staff complete occasional maintenance work to grease bearings but no other modifications have been made to the screening system since installed. As part of the 2017 project, level transducers were installed upstream and downstream of the screen so the screen operations can be controlled based on the differential water level. The screen can also operate continuously in "Storm Mode" if the differential level reaches a maximum setpoint and does not lower after an adjustable time delay. City staff have stated that they have not had issues with the newer mechanical screen and the wash press from a maintenance, treatment, and ease of operation perspective. The screen and wash press are in good condition.

Figure 8.02-5 Vulcan Industries Wash Press

The existing screening system with the Parshall flume does not meet the IDNR redundancy requirements as follows from Section 15.2.4.6, “where a single mechanically cleaned screen is used, an auxiliary manually cleaned screen shall be provided. Where two or more mechanically cleaned screens are used, the design shall provide for taking any unit out of service without sacrificing the capability to handle the PHWW flow.” The future PHWW flow is 40.3 MGD as indicated in Section 4. The screens are to be designed to pass the PHWW flow with the largest unit out of service. The current firm screening capacity is approximately 26.6 MGD.

C. Raw Wastewater Pumping Equipment and Wet Well

After the raw wastewater is screened, wastewater enters the plant pump station wet well. Pumping consists of six Fairbanks Morse Vertical Turbine Solids Handling (VTSH) pumps, which were installed in 2013. Three pumps with one standby are typically used to pump wastewater to the secondary treatment process and two pumps are used to pump to the flow equalization basin. Each pump has a rated capacity of 5,500 gpm at 60 feet of total dynamic head (TDH). Pump 1 is currently out of service for rehabilitation. Pump 6 is also out of service until it can be rehabilitated. Specific discussion on the existing capacity of the pumps is included in Section 8.03.

Each pump has an Emerson Motor Company (US Motors) 1,200-revolutions per minute (rpm), 3-phase, 460-volts alternating current (VAC), 125-hp motor. Pump impellers are 14.25 inches. All of the pumps operate on VFDs to maintain a 6-foot (11.50-foot "plan elevation") water level in the wet well. Figure 8.02-6 shows the pumping equipment arranged above the wet well in the lower level of the Raw Wastewater Pumping Station.

Figure 8.02-6 VTSH Raw and Equalization Pumps

Each VTSH pump has a seal water system, pressure gauge, and isolation valves. Pumps require flushing of the column pipe with seal water before and during pumping operations. City staff have indicated that they recently replaced the seal water system on all of the pumps and are actively working on replacing the wear rings for each pump. The existing pressure gauges are no longer functioning.

The wet well level is measured using a manually controlled bubbler system as shown in Figure 8.02-7. The pump VFDs are controlled to maintain a water level in the wet well. Air tubing is routed from the common manifold shown in Figure 8.02-7 to each VTSH pump column pipe. Staff manually open a valve on the manifold and close the remaining valves so water level is only being read at one pump. Air is supplied by two air compressors located in the Electrical Room on the ground level of the

Raw Wastewater Pumping Station. City staff have stated that the air lines can plug with grit and become unusable when the lines are not in use.

Figure 8.02-7 Bubbler System for Level Measurement

The raw wastewater wet well has not been cleaned out for more than 10 years. Since grit removal processes are downstream of the raw wastewater pumping, it is recommended that the wet well be cleaned out the next time it is taken out of service.

D. Grit Removal Equipment and Classifying

The raw wastewater pumps lift raw wastewater to a splitter box on the ground level of the Raw Wastewater Pumping Station. Flow is split between four Eutek grit removal TeaCup® units. The header box has deteriorated from grit abrasion over time, and staff have welded additional steel to reinforce the areas that have thinned. A plug valve on the influent line to each TeaCup® unit allows the units to be removed from service. The grit system can be completely bypassed through bypass piping and valves. City staff have indicated that the grit removal system is the "bottleneck" of the treatment process since the peak hydraulic limit to the system is 20.4 MGD. At flows greater than 20.4 MGD, wastewater spills out of the grit splitter tank. These units are recommended to be replaced. The existing splitter tank and TeaCup® grit removal units are shown in Figure 8.02-8.

Figure 8.02-8 Header Box and TeaCup® Grit Removal Units

Staff operate two Eutek Grit Snail units to classify grit, each of which receive grit from two TeaCup® units. The Grit Snail settles grit and lifts it out with a stepped belt to a conveyor, which was installed when the plant was constructed. The conveyor transfers grit to the adjacent truck bay. In discussions with City staff, it is apparent that the conveyor has become a significant nuisance due to maintenance and cleaning required to keep the conveyor functioning.

Staff use trucks to move grit to the grit dewatering pad on the north side of the Raw Wastewater Pumping Station. Grit is treated with lime and land applied about two to three times per year. Staff intends to continue land applying grit. The motors on both Grit Snails have become obsolete and the City recently replaced them due to issues finding replacement parts. Weekly maintenance of the units include cleaning out the Grit Snails and greasing.

Industry standards for grit removal performance have improved since the equipment was originally installed. Current grit removal technologies can achieve 95 percent removal of particles 106 micrograms per meter (µm) and larger at the design flowrate and 95 percent removal of particles 75 µm and larger at the average day flow rate. Replacing the grit removal and grit handling system is recommended and will be necessary since the equipment is beyond its useful life, cannot pass the required future design flow, and improved grit removal will prolong the life of downstream equipment and prevent accumulation in secondary treatment basins and the anaerobic digesters.

E. Piping, Fittings, Flow Meters, and Hydraulic Gates

Much of the piping, fittings, and valves in the dry side of the raw pump station shown in Figure 8.02-9 have become corroded with exposure to the humid and damp environments. When staff have replaced the pipe and fittings, the flange bolts break and become unusable. City staff have been replacing these bolts with stainless steel bolts for better corrosion resistance whenever they have disassembled the piping. The check valves on raw wastewater Pumps 1 through 4 have recently been replaced. The City has also replaced the elbow in the force main to the grit removal system, which experienced significant wear and began leaking. All plug valves are original to the plant and are difficult to operate. The combination air valves on each raw pump are original but are still operational. Staff periodically exercise the gate valves on the raw wastewater discharge header and the electric actuators on the existing header gate valves have recently been replaced.

Figure 8.02-9 Raw Wastewater Pump Station Pump Room

In the pump room, it is recommended to remove and replace the following piping, fittings, valves, and appurtenances:

- Process plug valves on each pump discharge
- Gate valves in the discharge header with plug valves
- Check valves on the Equalization (EQ) Pumps 5 and 6
- Combination air valves Pumps 1 through 6
- All pipe supports
- Wet well level measurement

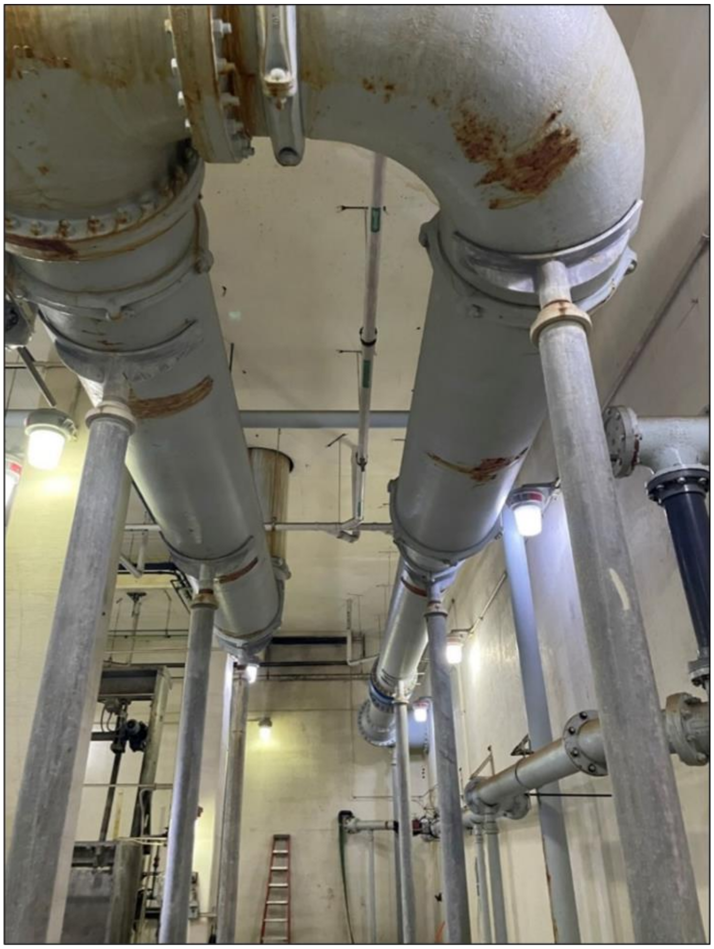


Figure 8.02-10 Grit Influent and Effluent Piping

Due to the recommended replacement of grit removal and grit handling equipment, most of the piping, pipe supports, valves, fittings, and appurtenances in the grit influent and effluent lines will need to be replaced to accommodate the selected grit removal technology (see Figure 8.02-10). Much of the piping and fittings have deteriorated overtime, specifically the 90-degree elbows, due to grit abrasion. The City has replaced select fittings that began leaking due to abrasion inside the fitting. The flow meter on the line to the treatment process can be reused along with electric actuators since they more recently replaced. The 20-inch equalization basin influent force main appears to be in acceptable condition and will not require replacement. The flowrate to the equalization basin is not currently directly metered and is calculated by subtracting the flow to the secondary treatment process from the influent Parshall flume flow.

In the lower-level screenings area, there are eight hydraulic gates (two gates per channel) with manual operators to isolate each of the three channels and to take each screen out of service. A hydraulic gate is also located at each of the two channel entrances to the raw wet well. All eight gates are original to the plant, and it is unknown whether the gates downstream of the screens are operable. See Figure 8.02-11 below. The gates upstream of the screens are operable and staff exercise these gates that are required take screens in and out of service. To accommodate the new screenings system and considering the gates are well beyond their useful life, it is recommended that all hydraulic gates in the lower level screenings room be replaced.

Figure 8.02-11 Raw Wastewater Pump Station Lower-Level Screenings Room

Structural Condition Assessment

A. Overall Exterior Building Envelope

The exterior abovegrade portion of the building consists of precast concrete wall and roof panels. These appear to be in good condition. There are some connector plates in the north wall at the removable section of the wall that are showing signs of rust. The belowgrade portion of the building is cast-in-place concrete floor slabs, walls, and elevated ceilings and floors (with concrete column and beam support systems). These all appear to be in good condition.

Figure 8.02-12 Exterior of Building

The EPDM-adhered membrane roofing system was reported to be replaced in 2007. This makes the roof currently approximately 15 years old. A normal life expectancy for this type of roof system is 15 to 20 years. Overall, the roof system appears to be in condition for its age. There was a couple noted deficiencies with some minor flashing issues at some of the roof penetrations, ponding water on sheet metal flashing at HVAC unit/opening closure, and two of the roof scuppers where flashing has failed around the wall penetrations (see Figure 8.02-13) and could be allowing water into the building.

Figure 8.02-13 Roof Scupper Failed Flashing

It was noted by the City and visible at wall sections and roof areas that settlement has occurred between the taller loading area portion of the building and the remainder of the rest of the building over the years. The wall joints in precast panels, block walls, and roof panels show signs where upper portion of the joints and cracks have opened anywhere from a 1/2- to 1-inch larger gap than normal (see Figure 8.02-14). It was noted that these settlements started to occur shortly after the building was built over 30 years ago. There had been movement monitoring devices placed across these joints and it was reported by the City that it has not seen much, if any, movement in the last 10 to 15 years. Based on a review of the original building drawings, the loading area portion of the building has a shallow foundation system versus the remainder of the building, which has a deep foundation system. It is assumed the building movements occurred because of the initial settlement/consolidation of the backfill from the deeper portion of the building that the loading area building foundations were bearing on. This would be consistent with the settlements starting shortly after original construction and eventually subsiding over time. There does not appear to be any long-term adverse effects on the building other than the opening up of some cracks and joints in walls and roof panels at the interface of the two buildings that need to be maintained.

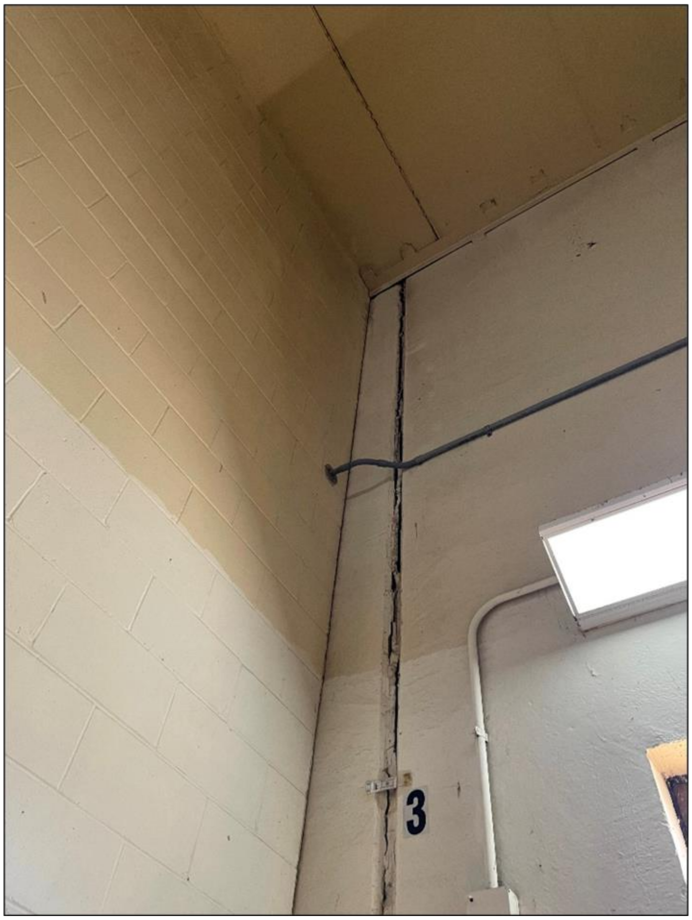


Figure 8.02-14 Joint in Wall and Roof Opened from Settlement

The exterior garage doors at the loadout garage bay show signs of rust and deterioration and the tracks for these doors are bent and in disrepair. Guard posts at the exterior of these garage doors need repainting.

B. Interior Building Conditions

The interior walls consist mostly of concrete block walls that appear to be in good condition. There are areas where the paint on the interior face of the precast concrete walls have peeling and signs of deteriorating paint, mostly in the Grit Removal and Loading Rooms. Where there are coatings on the floors, they are mostly worn off or deteriorated to varying degrees. The floors themselves appear to be in good condition.

The piping located mostly in the Screening, Pump, and Grit Removal Rooms are showing varying degrees of rust and deterioration of the coatings as indicated in Figure 8.02-15. Where pipes are to remain, they are most likely in need of repainting.

Figure 8.02-15 Pipe Coatings

The intermediate platform over the loading garage area appears to have slightly pulled away from the east exterior wall of the building as can be seen in Figure 8.02-16. This is assumed to have been caused by the settlement issues in this portion of the building noted previously. Since this platform appears to be supported with columns independently of the wall system, there does not appear to be structural concern here.

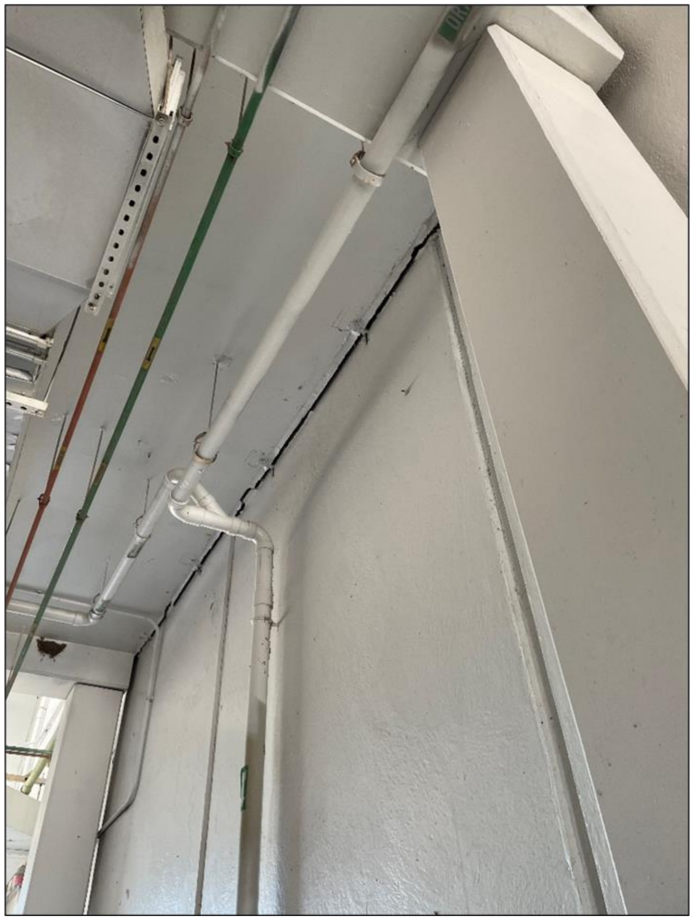


Figure 8.02-16 Intermediate Loading Platform Separation

The man doors (both interior and exterior) that are hollow metal doors and frames, mostly in the stairwells and Hatch/Controls Rooms, appear to need new hardware and repainting of doors and frames.

Plumbing and HVAC Condition Assessment

A. <u>Plumbing</u>

The Raw Wastewater Pump Station is served by an nonpotable water (NPW)/plant water and effluent return water piping network.

The Plant water piping is provided from wells on-site, which serve the entire site. Plant water piping in the lower level of the screening area has been abandoned because of heavy corrosion. This piping system in the lower level has been replaced by one effluent return water line that enters from the upper level on the east side of the room to one hose bib.

The effluent return water piping has a valved connection to the Plant Water along the north wall of the ground level Headworks Building.

For all piping systems piping insulation is either nonexistent or severely damaged. Piping supports for all piping (plant water, effluent water, and sanitary drains/vents) are heavily corroded.

Plumbing fixtures through the building show significant corrosion including hose bibbs (both interior and exterior), and sinks.

The compressed air system is served by an air compressor located within the Electrical Room. The compressed air piping system is copper and heavily corroded in the lower and upper levels of the building with valves in the lower level that do not function.

B. HVAC

The Raw Wastewater Pump Station is served by multiple HVAC systems.

Existing makeup air unit (MAU)-E1 is located on the roof and was replaced in 2015. The makeup air unit serves the garage area and is paired with relief vent (RV)-E1, RV-E2 and RV-E3. The existing makeup air unit appeared to be in good working order and would not require replacement based on condition alone. The existing roof ventilators were installed 1986 and are past their useful life.

Existing MAU-E2 is located on the roof and was replaced in 2014. The makeup air unit serves the Screening and Grit Removal Rooms and is paired with RV-E4 and RV-E5. The existing makeup air unit appeared to be in good working order and would not require replacement based on condition alone. The existing roof ventilators were installed 1986 and are past their useful life.

Existing heat recovery unit (HRU)-E1 is located on the roof and was replaced in 2009. The HRU serves the Pump and Hatch Rooms. The existing HRU appeared to be in good working order and would not require replacement based on condition alone.

The Control/Electrical Room is served by exhaust fan (EF)-E1 via thermostat. The exhaust fan is paired with an existing filter for makeup air. The exhaust fan and filter appears to be original to 1986 and is past useful life.

The gas and electric unit heaters throughout the building appear to be original to 1986 and are past their useful life.

Existing ductwork, duct insulation and supports throughout the building is original to 1986 are severely corroded.

Existing natural gas piping throughout the facility appeared corroded with paint missing or pealing but were unable to detect if any pipes were a concern for leaking.

Electrical Condition Assessment

A. Electrical Power Distribution Equipment

A 12.47-kilovolt (kV) electric utility service is the primary power source for the facility. It serves a substation within the facility that steps the voltage down to 277/480 volts. Under normal conditions, the substation delivers power to the facility's main switchgear in the Trickling Filter Pump Station. City staff indicated the substation and associated service equipment were replaced in 2014. The main switchgear, which is shown in Figure 8.02-17, was manufactured in 1988 and, along with its associated wiring, is nearing the end of its expected useful life of 35 to 40 years. City staff indicated that regular testing is performed on the main switchgear; however, replacement should be considered to minimize the potential of long-term facility outages caused by equipment failure. Replacement should also be considered because there is only one spare breaker with no room for switchgear expansion, so powering new facilities on upcoming projects will be difficult. During utility service outages, power to the main switchgear is provided from a diesel standby generator, which is also located in a dedicated room in the Trickling Filter Pump Station. City staff indicated the standby generator is exercised every 2 weeks and that the City plans to replace the generator within 10 years.

Figure 8.02-17 Main Switchgear

The Raw Wastewater Pump Station contains a dedicated Electrical Room for power distribution and control equipment. During a site visit, a thermostat in the room read 83°F, which is several degrees warmer than ideal for an electrical room. Adequate cooling capacity should be included as part of any major upgrade project at this building. The Electrical Room is not directly accessible from the Screening and Grit Room, but it is open to the influent wet well via hatches and a door. Thus, without infilling the interior door, the Electrical Room should be rated as a Class I, Division 1, Groups C and D hazardous location. There is also a 30-inch influent wastewater pipe, shown in Figure 8.02-19, routed through the

Electrical Room that should be relocated to remove the potential of a failed flange leaving the room flooded.

A 2,000-ampere circuit breaker in the main switchgear provides 277/480-volt electrical power to motor control center (MCC) MCC-1 in the Electrical Room. MCC-1, which is shown in Figure 8.02-18, is a Square D Model 6 MCC that was originally installed in 2013 and appears to be in good condition with no visible corrosion or damage. It is rated for 1,600 amps and has a 2,000-amp main circuit breaker with a long-time trip setting of 1,600 amps. The MCC contains motor starters and circuit breakers to distribute 480-volt power to various equipment throughout the building as well as a feed to the North Storage Complex.

Figure 8.02-18 MCC-1

The MCC feeds a step-down transformer for two 120/208-volt panelboards (LP-1 and LP-1A). These panelboards power the building's lighting, receptacles, and small equipment loads. LP-1 appears original and LP-1A was installed in 1993. Both panelboards appear to be in good condition, with no visible corrosion or damage. However, the panelboards and associated wiring are approaching the end of their expected useful life and replacement should be considered.

The Electrical Room also contains a small automatic transfer switch that is dedicated to the influent gate. In the event that both utility power and the standby generator fail, there is a 12-kW natural gas generator to power the influent gate. The generator was manufactured in 2007 and appears to be in good condition despite some rusting on the weather protective enclosure, which is visible in Figure 8.02-12.

The influent pump VFDs were replaced in 2011 and are Allen-Bradley PowerFlex 753 VFDs, which are a current product offering. They are located in older, dedicated VFD cabinets in the Electrical Room, which are shown in Figure 8.02-19. The VFDs and cabinets appear to be in good condition with no visible corrosion or damage.

Figure 8.02-19 Influent Pump VFDs and 30-inch Influent Wastewater Pipe

B. Control Equipment

There are three programmable logic controller (PLC)-based control panels located in the Electrical Room. One PLC resides in remote terminal unit (RTU)-1 and is an Allen-Bradley SLC-5/05 PLC. This model is currently designated as lifecycle status “Active Mature” by the manufacturer. This means that the PLC is fully supported, but a newer product is available that may provide more value and features, and replacement parts will generally become more expensive as it moves to the “End of Life” status. The second PLC resides in the Vulcan Screen Control Panel and is an Allen-Bradley MicroLogix 1400 PLC. This model is currently designated as lifecycle status “Active Mature” by the manufacturer, but it is slated for a faster than normal discontinuation because of recent supply chain interruptions, and many suppliers have ceased taking new orders. The third PLC resides in the Influent Pump VFD Control Panel and is an Allen-Bradley SLC-5/05 PLC. This model is currently designated as lifecycle status “Active Mature” by the manufacturer.

Given these lifecycle designations, it is apparent that the SLC PLCs in this structure are nearing the end of their expected useful life, the MicroLogix PLC will soon be discontinued, and that replacement should be considered. It should be noted that while the PLCs are still fully supported, the age of the equipment and the increasing cost of replacement parts contribute to the recommendation for replacement. All programming functionality from the three PLCs could easily be implemented into a single new PLC, which would simplify future SCADA programming modifications, reduce potential points of failure in the SCADA system, and lower overall construction costs and maintenance costs.

Aside from the physical PLC hardware, the PLC programming software should be considered as well. As new PLC families are released, the associated programming software is updated with new features and capabilities. The SLC and MicroLogix PLCs must be programmed using the older Allen-Bradley RSLogix500 software while newer CompactLogix PLCs are programmed using the current Allen-Bradley Studio 5000 Logix Designer software. Replacing the older PLCs would provide multiple benefits when it comes to programming. First, while all qualified system integrators should be fluent in both programming software packages, the effort by those working with the PLCs would be streamlined through the use of a single software package. Second, the use of a single software package would reduce training and licensing costs.

As the older PLCs are replaced, the existing PLC programs cannot be directly transferred to the new PLC software. Two options are available to migrate to a new PLC: converting the existing PLC programs or writing completely new PLC programs. While converting existing PLC programs is generally successful, Strand Associates, Inc.® (Strand) typically specifies new PLC programs if the budget will allow. Creating new programs using programming standards and methodologies that are consistent across all the PLCs at the WPCF instead of converting programs with varying standards or old, abandoned programming will make the system more intuitive for operators and reduce time spent troubleshooting.

C. Lighting Systems

Three different types of light fixtures are used throughout the building. Exterior building-mounted light fixtures were recently upgraded to light-emitting diode (LED) fixtures. Light fixtures in the stairwells, electrical, and hatch rooms use fluorescent lamps. Light fixtures in the dry well, truck bay, screening, and influent channel rooms use high-intensity discharge lamps within Class I, Division 2-rated fixtures. It is recommended that all non-LED fixtures be replaced with energy-efficient LED fixtures. Additionally, much of the building should be rated as a Class I, Division 1 hazardous location, which means the current light fixtures are not properly rated for the space.

D. Electrical Raceway System

There are a number of rigid metal conduits in the process areas and exterior of this building that are significantly rusted. These conduits should be replaced as part of associated equipment upgrades. All of the liquid-tight flexible metal conduits in the grit and screening areas are at best rated for only a Class I, Division 2, Groups C and D location. New flexible conduits in these areas should be specified properly as flexible conduit couplings rated for Class I, Division 1, Groups C and D locations.

E. Combustible and Toxic Gas Detection and Ventilation Monitoring Systems

The building does not currently have fixed combustible or toxic gas detection systems. Recent projects in the Digester Complex and Gas Handling Building have included these systems in areas where accumulation of gases could be expected. As identified in the National Fire Protection Association (NFPA) 820 review included in this technical memorandum, several spaces within this building should be provided with fixed gas detection. Additionally, any spaces that are unclassified by means of sufficient ventilation, such as the dry well, should be provided with ventilation monitoring systems. These systems have also been provided on recent projects in other buildings at the facility.

F. SCADA System

The facility's SCADA system contains a server and desktop computers in the Administration Building, along with thin clients located in each of the main process buildings. The service tags indicate the server is more than 5 years old and other computers are approaching 10 years old. It is generally recommended to have a scheduled policy of replacing computers and servers every 4 to 5 years to minimize the chance that an equipment failure would occur and cripple the SCADA system. Batteries for uninterruptible power supplies should also be replaced at a similar interval.

The City currently uses Wonderware's InTouch 2014 R2 SP1 human-machine interface (HMI) software and Historian 2014 RS SP1 historian software. These software packages are several versions older than the current offerings, and the City would benefit from the updated features and security protections by keeping software current. Additionally, the City's use of the historian software is limited by the number of tags provided by its current license to the point where existing tags have had to be removed by more important tags during recent process upgrades. Each tag represents one process variable, such as a flow or level. The City should consider upgrading its license to increase the number of available historian tags.

NFPA 820 Assessment

A. Fire Protection Standards

Fire protection design standards for wastewater treatment facilities include the NFPA 820 Standard for Fire Protection in Wastewater Treatment and Collection Facilities and Recommended Standards for Wastewater Facilities 2014 Edition (Ten States Standards). These documents include design standards to address potential fire and explosion hazards in wastewater treatment facilities and collection systems. Areas which are considered rated spaces generally require increased ventilation provisions and electrical requirements for controls, lighting, motors, power systems, and other electrical items within the rated area.

B. Room Ratings Review

NFPA 820 classifications for the spaces in the Raw Wastewater Pumping Station are summarized in Appendix D. Because of the existing 12 air changes per hour (ACH) ventilation in the Screening, Grit, and Loading Rooms, room classifications are Class I, Division 2 under NFPA 820. Room classification for these same spaces under Ten States Standards is Class I, Division 1. Ten States Standards is an adopted code, so all spaces in the existing Raw Wastewater Pumping Station are required to be rated Class I, Division 1.

The existing Electrical Room (Room E106) has two interior doorways to the Pump Hatch Room (Room E105). While the Electrical Room has separate ventilation, the room is not physically separated from the adjacent Class I, Division 1 rated Pump Hatch Room. NFPA 820 requires physical separation of a rated space from an unclassified space by a gastight partition and a separate exterior entry to the unclassified space. Alternatively, a positive pressure airlock can be provided between the two spaces; however, control of the airlock can be difficult. The interior Electrical Room doors would be required to be physically separated and the grit influent line would also need to be relocated out of the Electrical Room to be considered unclassified.

The existing motors on the multirake screen and screenings wash press are rated for Class I, Division 1 environment.

C. NFPA 820 Improvements

Additional upgrades based on NFPA 820 include but are not limited to:

- Install Class 1, Division 1 rated electrical outlets and light fixtures.
- Remove any combustible materials.
- Physical separation of the Electrical Room from the other rooms in the building.
- Add combustible gas detectors, ventilation monitoring, and audio and visual alarms.
- Replace motors on existing raw pumps, multirake screen, wash press and any other equipment with Class 1, Division 1 rated motors.

It should be noted that bringing an entire area up to current design standards is not usually a requirement unless significant improvements are being made in that area. Any planned improvements presented in Section 9 would be designed around Class I, Division 1 requirements, except for the electrical room, which will be unclassified.

D. OPC for Upgrades to Fire Protection Standards

An OPC for upgrades in the wet well and pump room areas of the Raw Wastewater Pumping Station equipment, lighting, and mechanical equipment to address NFPA 820 standards is presented in Table 8.02-1. Upgrades to the existing raw pumping area and equipment was not included in the proposed scope of screening and grit improvements, so costs for these upgrades are presented separate from the opinion of costs for the screening and grit removal improvements summarized in Section 9.

Equipment Subtotal	$305,000
Mechanical	$120,000
Electrical	$90,000
Undefined Scope	$110,000
Contractor's General Conditions	$100,000
Supply Chain Escalator	$110,000
Contingencies	$130,000
Technical Services	$167,000
Total OPC	**$1,132,000**

Notes: All costs in fourth quarter 2022 dollars.

Table 8.02-1 Capital Costs for Upgrading the Wet Well and Pump Room Areas of the Raw Pumping Station to NFPA 820 Class I, Division 1 Classification

8.03 INFLUENT PUMPING HYDRAULIC EVALUATION

The City collected pump test data from the historical SCADA system to verify the capacity of existing Pumps 1 through 5. Pump 6 has been out of service for some time while it awaits being rebuilt. Data collected and summarized in Table 8.03-1 as SCADA flowrate and frequency is for one pump in operating to maintain a 6-foot water level in the wet well.

Pump	SCADA Flowrate (gpm)	SCADA Frequency (Hz)	Modeled Frequency (Hz)	% Capacity Increase
Pump No. 1	4,969	57.5	57.5	0.0%
Pump No. 2	5,358	55.3	59.0	6.8%
Pump No. 3	4,914	56.2	58.0	3.2%
Pump No. 4	4,017	55.6	54.5	-2.1%
Pump No. 5	3,939	54.2	54.2	0.0%
Pump No. 6	Not operable	Not operable	Not Operable	Not Operable

Note: Hz=hertz

Table 8.03-1 Influent Pumping Hydraulic Evaluation

The rated capacity of the pumps is 5,500 gpm at 60 feet of TDH and full speed (60 Hz) per the certified pump curves provided by the City. A hydraulic model was used to evaluate the capacity of the existing pumps compared to the rated capacity. The specific pumping condition of an individual pump at the tested flow rate was used in the model to calculate a system curve. The frequency of operation for the pump was varied until the operating point occurred at the tested flow rate. The modeled frequency is reported in Table 8.03-1. If the modeled frequency exceeds the tested frequency, then this is an indication that the pump is pumping more water than expected at the reported SCADA frequency. Results show that Pumps 2 and 3 are producing more water than expected at the reported SCADA frequency. This is consistent with results that operators have seen that the pumps are more efficient after being rebuilt. Pumps 1 and 5 are pumping as expected according to the certified pump curve. Pump 4 is pumping less than expected. In summary, the existing pumps that are in operation have capacities at or greater than expected based on the certified pump curves.

Information from this hydraulic evaluation is further described in the screening and grit alternatives evaluation in Section 9.

8.04 SUMMARY OF DEFICIENCIES

As presented in this section, the following deficiencies of the existing headworks processes were identified and will be considered in the evaluation of alternatives later in this Plan:

- The existing screens and grit removal system do not have sufficient hydraulic capacity for the future design PHWW flow (screening) or the proposed MWW flow to the secondary treatment process (grit removal).
- The existing Parshall flume elevation limits the hydraulic capacity of the screens.
- Screenings from the two existing screens that were installed in 1980 are ground and then discharged back into the wastewater downstream of the screens.
- Availability of parts for existing screens and grit removal equipment installed in the 1980s are not readily available.
- Most of the existing hydraulic gates are seldom operated and operability of these gates is likely an issue.
- The Control Box A hydraulic gate requires replacement.
- Existing valves are difficult to operate due to wear and the piping system has experienced deterioration due to external corrosion and internal wear.
- Miscellaneous painting is recommended; the extent of which will be determined following the headworks alternative selection.
- The existing roof vents in the Raw Water Pumping Station serving the Screening, Grit, and Loading rooms are past their useful life and will need to be replaced with exhaust fans to remove air from the space. The existing ductwork and insulation is degrading past usefulness in the existing system.
- The existing electrical room is served by an exhaust fan and Purafil filter that are past their useful life and will need to be replaced.
- The heat recovery unit serving the Pump and Hatch rooms is sized for 6 ACH and recirculates air during unoccupancy. This is not allowed based on the updated room rating per NFPA 820 and will need to be ventilated similar to the other process areas of the building.
- The existing compressed air piping and valves are degrading and not functioning.
- The abandoned plant water piping should be disconnected completely from the effluent water line and removed from the building.
- The electrical room has doors that open to a hazardous location as well as a raw wastewater pipe in close proximity to motor control equipment.
- Some power distribution equipment, such as the panelboards and transformer, appear to be nearing the end of their expected useful life.
- The PLCs are nearing end-of-life status.

- Light fixtures in many spaces use less-efficient HID lamps and many light fixtures are not rated for the hazardous location rating of the space.
- There are severely rusted conduits and conduits that are not rated for the hazardous location rating of the space.
- The building does not have combustible and toxic gas detection.
- The WPCF's main switchgear is nearing the end of its expected useful life and only has one spare circuit breaker, which will likely not accommodate requirements of the proposed upgrades. The capital cost for replacing the switchgear is approximately $2 million. This will be evaluated further in siting and phasing technical memorandums.
- The existing SCADA software is several versions out of date, which opens the WPCF to security vulnerabilities.
- The existing SCADA computers and server are past their recommended replacement interval. Hardware failure could lead to extended SCADA outages.

SECTION 9
HEADWORKS ALTERNATIVES EVALUATION

9.01 INTRODUCTION

In this section, several bar screens and perforated plate/band screens are evaluated for their effectiveness. Three grit removal technologies are evaluated for improved grit removal performance at the WPCF to protect equipment downstream of the Raw Wastewater Pump Station.

9.02 HEADWORKS AND EQUALIZATION FLOW STRATEGY

All raw wastewater enters the existing Raw Wastewater Pumping Station through a Parshall flume located in the basement of the headworks area, upstream of the screens. For each of the alternatives evaluated for the headworks processes, the raw influent will continue to first enter the Raw Wastewater Pumping Station and the existing screen channels. Any screening that occurs before raw pumping will be sized for the design PHWW flow rate of 40.3 MGD. Any screening and grit removal systems downstream of raw pumping will be sized for 24.5 MGD, which is the design capacity of the secondary treatment process. Influent flows greater than 24.5 MGD will be pumped to the existing equalization basin by the equalization pumps in the Raw Wastewater Pumping Station. Specifics related to each alternative are discussed herein.

9.03 EVALUATION OF SCREENING ALTERNATIVES

The following screenings alternatives will be discussed in greater detail in the succeeding sections. Each of the alternatives noted herein will require demolition of the existing 3-foot-wide flume (and the 5-ft flume in which it is embedded) to make additional channel space available for improvements and alleviate the hydraulic limitation caused by the existing flume. With the flume removed from service, approximately 3.5 feet of channel depth is gained, which will allow screens and the existing channels to handle higher flow rates. In lieu of the flume, it is proposed that influent flow will be more reliably measured by magnetic flow meters. One flow meter will measure flow downstream of the grit removal process to the secondary treatment process. A second flow meter will be installed downstream of the equalization pumps to measure flow to the equalization basin. The total influent flow to the plant will be calculated by adding the flow rates of the two meters. Equalization return flow metering will continue to be measured by the existing flume (FM-6).

The following are the three screenings alternatives:

1. Alternative S1: 6-millimeter (mm) Perforated Plate Screens–Install two 1/4-inch clear opening (6 mm) perforated plate screens in the existing headworks channels. The screens will extend to the upper (ground) level of the Raw Wastewater Pumping Station and discharge into wash presses. The existing multirake bar screen would remain in place and serve as a spare to the perforated plate screens. A manual bar rack would be installed upstream of the screens in the location of the existing influent flow metering flume.

1A. Alternative S1A: Raw Wastewater Pumping Station Addition–The existing east and west screens would be replaced by manual coarse bar racks. Replace The existing 3/8-inch clear opening multirake screen would remain in service. Construct an addition to the existing Raw Wastewater Pump Station. Install two single level 1/4-inch (6 mm) perforated plate screens.

2. Alternative S2: 3/8-inch Multirake Screens–Install one new 3/8-inch multirake screen with wash press in the existing east channel. Install coarse bar rack in the existing west channel.

3. Alternative S3: 1/4-inch Lace Linked Screens–Install two 1/4-inch laced linked traveling water screens with wash presses in the outer channels. The existing 3/8-inch multirake would remain in service and serve as a redundant spare.

Each of the alternatives will meet the IDNR standards which require "where a single mechanically cleaned screen is used, an auxiliary manually cleaned screen shall be provided. Where two or more mechanically cleaned screens are used, the design shall provide for taking any unit out of service without sacrificing the capability to handle the PHWW flow." The manual bar rack included in some of the alternatives is capable of passing the peak flow of 40.3 MGD.

Under the perforated plate screen Alternatives S1 and S1a, the perforated plate screen manufacturers require coarse bar rack type screens upstream to protect the perforated plates.

<u>Alternative S1: 6-mm Perforated Plate Screens</u>–The AGS Alternative for the secondary treatment discussed in Section 7 requires use of a 6-mm (1/4-inch) perforated plate screen to improve removal of fine stringy material from the wastewater and protect downstream equipment. Perforated plate screen manufacturers recommend using a bar rack upstream of the perforated screen to protect the plate from damage by larger materials (logs, bricks, rocks, etc.).

Alternative S1 includes installing a coarse manual bar rack with 2-inch clear bar spacing in the location of the existing influent flume. The screenings that accumulate on the manual bar rack would need periodically raked to a concrete platform with a drain over the channel. Large debris would need removed from the screenings. Rags and other screenings that would not damage the perforated plate screens could be pushed back into the channel downstream of the manual bar rack. A floor hatch and pick point with hoist would be provided in the ground level floor to allow large screenings to be hoisted from the basement and to the ground level for disposal.

The existing VMR Screen would remain in service to provide redundancy to the perforated plate screens as required by IDNR standards. This screen would only be used temporarily to handle any peak flows while one of the perforated screens was out of service. Two new perforated plate screens would be installed in the place of the existing screens in the outside channels and would be sized for a flow of 20.2 MGD each to meet the design PHWW flow of 40.3 MGD. Each screen would also have a dedicated wash press for solids washing and handling. To make this alternative hydraulically feasible at the peak flow condition, the water level downstream of the screens will need to increase to a range of 3 to 5 feet to achieve both reasonable clean screen velocity of about 4 feet per second (fps) and headloss of less than 2 feet. All hydraulic gates would be replaced.

A preliminary layout of this alternative is presented in Figure 9.03-1.

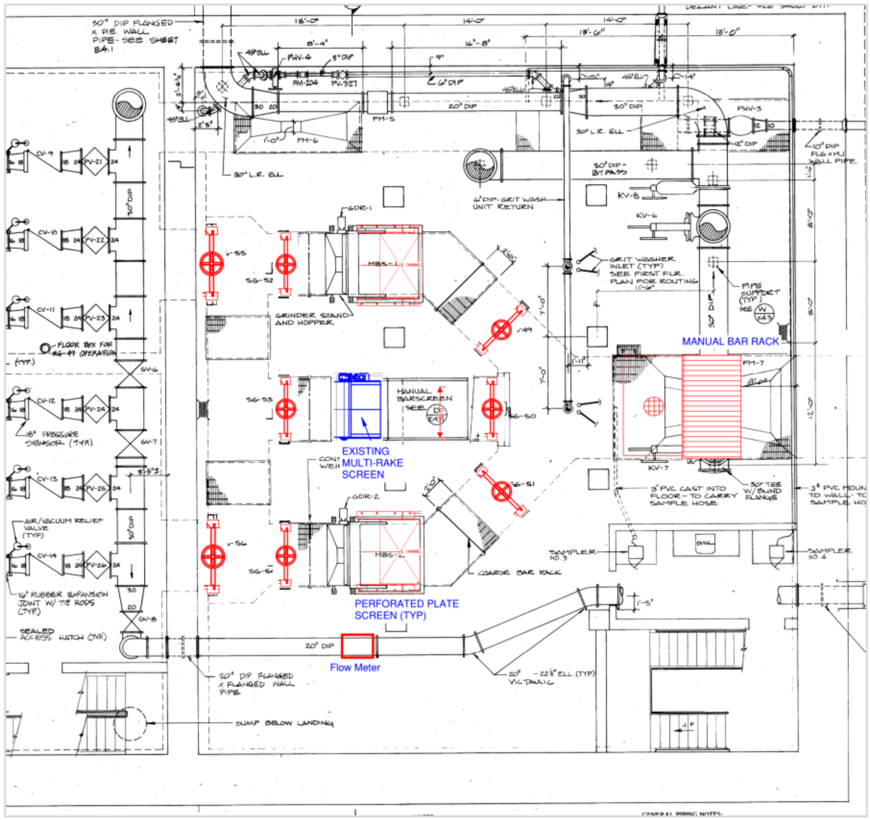
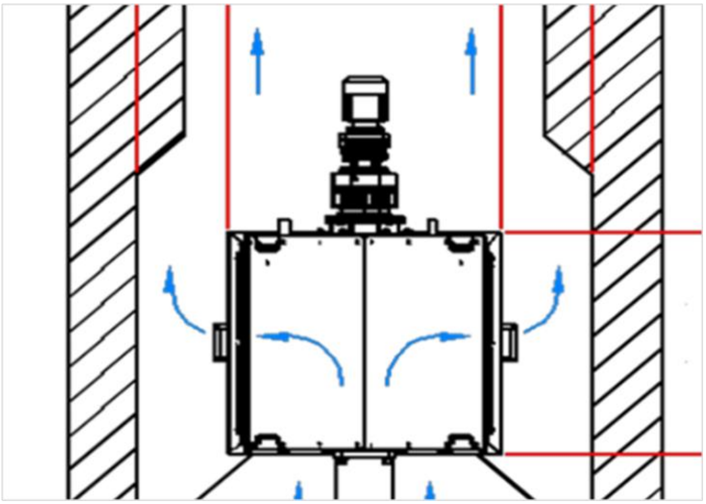


Figure 9.03-1 Alternative S1 Preliminary Layout

There are a few different perforated plate screen types available that would work in this application. The first is an inclined continuous belt screen, similar to Parkson's AquaGuard or Hydro-Dyne's Bull Shark screen. Each of these screens has plates with 6 mm holes that screen influent wastewater. Headloss through the inclined continuous belt screen can be as high as 22 inches at 20 MGD with a 30 percent blinding factor. Blinding is a percent of the total area blocked by screenings materials. A typical acceptable blinding factor can be 30 percent to 40 percent of the screen surface. Headloss across the perforated plate screens is dependent on the type of screen.

A center flow screen is another type of perforated plate option. Flow enters through the middle of the screen, splits perpendicular to the channel flow direction; and passes through the perforated plate surface on the sides of the screen. The screened wastewater then recombines downstream of the screen as shown in Figure 9.03-2. The perforated band captures the material on both sides and rotates to lift the material out of the channel. A wash spray bar requiring 72 gpm at 60 pounds per square inch (psi) removes the screenings from screen surface and directs them to a wash press before the band lowering and re-entering the wastewater. This type of perforated plate screen is typically oriented vertically. Figure 9.03-3 shows the entire unit with the continuous band, support system, and head compartment for the wash spray bars.



Source: Hydro-Dyne Engineering Great White Center Flow Screen

Figure 9.03-2 Hydro-Dyne Great White Center Flow Screen (Plan View)

Source: Hydro-Dyne Engineering Great White Center Flow Screen

Figure 9.03-3 Hydro-Dyne Great White Center Flow Screen

Headlosses through the center flow screen are significantly less as compared to the inclined belt screen because it has about double the surface area compared to a traditional band screen and the flow does have to pass through the bands twice. Headloss through a center flow screen at 20 MGD is approximately 8 inches with a 50 percent blinding factor.

Controls can be set to operate the screen after a time setpoint and differential or upstream water level setpoint. All maintenance is completed above the channel, and the screen has no submerged sprockets, bushings, or bearings in the channel.

<u>Alternative S1A: Raw Wastewater Pumping Station Addition</u>– Under this alternative, two perforated plate screens would be installed in a separate Raw Wastewater Pumping Station addition. The existing multirake screen will remain in service. The main purpose of the multirake screen will be to remove larger debris and to protect the downstream pumps and perforated plate screens from damage. With the flume removed, the existing multirake screen would have capacity for the full 40.3 MGD PHWW flow. Manual bar racks would be installed in the existing west and east channels additional screening capacity is available with one screen out of service. All existing hydraulic gates would be replaced. A preliminary layout of modifications to the existing screening is presented in Figure 9.03-4.

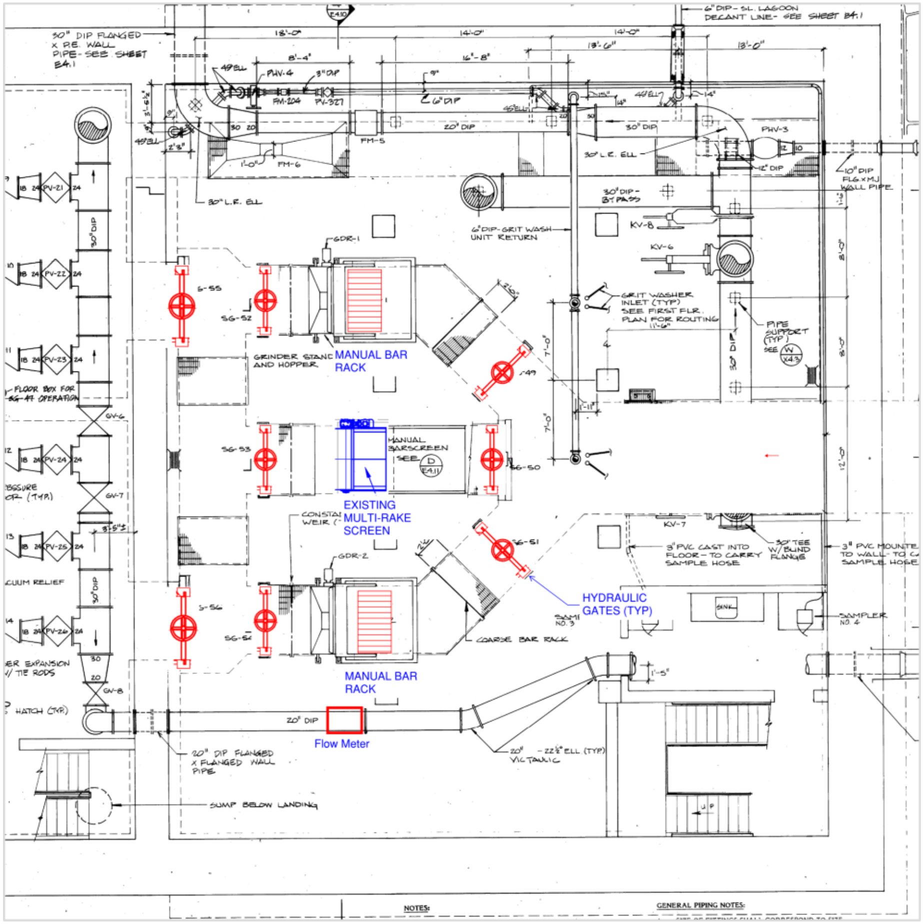


Figure 9.03-4 Alternative S1A Preliminary Screening Layout

The perforated plate screening, grit removal, and grit classifying would be installed in a headworks building addition, which would have an approximate 40- by 40-foot footprint. These processes would have a treatment capacity of 24.5 MGD, which would be the design secondary treatment process. A preliminary layout of this alternative is presented in Figure 9.03-5.

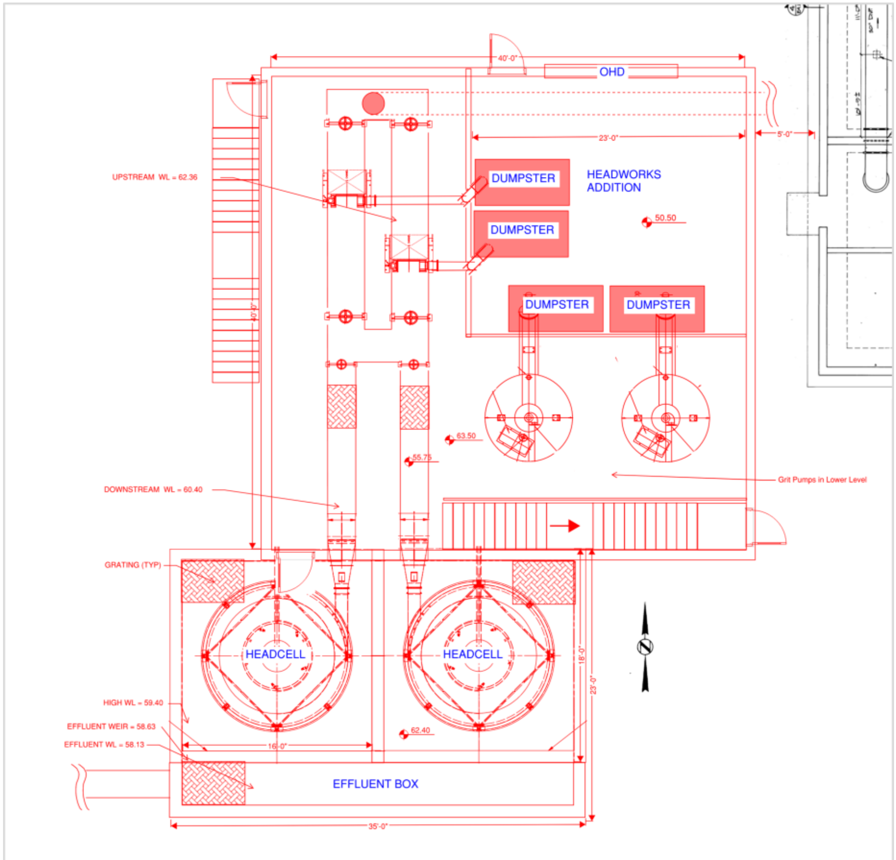


Figure 9.03-5 Alternative S1A Headworks Addition Layout

Two perforated plate screens, each rated for 24.5 MGD, would screen all secondary treatment influent water. This screening arrangement provides 100 percent redundancy for perforated plate screening when one screen is out of service for maintenance or repair. Hydraulic gates would be installed in the channels to allow isolation of the screens. Grit improvements will be discussed in more detail under Grit Alternative G1A below.

<u>Alternative S2: 3/8-inch Multirake Screens</u>–Multirake screens such as the VMR Screen, shown in Figure 9.03-6, are available with bar rack spacing between 1/4- to 3-inch or greater. Raw wastewater passes through the bar screen openings and solids are trapped on the screen face. The screen is raked on the upstream side of the screen to remove screenings from the bar rack. Screenings are transported upward and removed with a wiper blade to the discharge chute and into the washing compacting and dewatering equipment.

Source: Vulcan Industries Multi Rake Screen

Figure 9.03-6 VMR Screen

The multirake screen has a lower rake engagement system with either guide rail bearings or sprockets below the water level. No discharge water or brushes are required to clean the screen. Controls can be set to operate the screen based on an adjustable time setpoint, water level differential, or upstream water level. The screen can span the height to the ground level floor with a setting angle of 70 degrees to match the existing openings through the ground floor level.

Alternative S2 requires the fewest modifications to the existing structure to provide 40.3 MGD of screening. Like the modifications to the existing multirake screens described in Alternative S1A, the existing multirake screen will remain in service and a new 3/8-inch multirake screen and dedicated screenings wash press would be installed in the east channel. The PHWW flow of 40.3 MGD could pass through a single 3/8-inch multirake screen at a velocity greater than 5 fps through the bars, which is greater than the recommended clean screen velocity of 2 to 4 fps. For this evaluation, the additional redundancy of having a second mechanically cleaned screen was the basis of evaluation, each with a capacity of 20.2 MGD. A manual bar rack would be installed in the existing west channel to provide 100 percent redundancy with one screen out of service for a total firm capacity of 40.3 MGD. All existing hydraulic gates would be replaced.

The AGS secondary treatment process requires perforated plate screening, so this alternative is not recommended for the AGS process alternative described in Technical Memorandum 2. A preliminary layout of modifications to the existing screening is presented in Figure 9.03-4.

At the peak flow condition, the downstream operational water level will need to increase to achieve both reasonable clean screen velocity and screen headloss. The downstream screen level at peak flow condition is anticipated to be 4 feet, 0 inches to 4 feet, 6 inches above the bottom of channel floor. Operational changes may be made to increase the wet well operating level at peak flow condition or baffle plates downstream of the screens could be required by the screen manufacturers to maintain a level at peak condition. This option also requires demolition of the existing channel grout.

Alternative S3–1/4-inch Laced Linked Screens: Lace-linked screens such as Hydro-Dyne's Bull Shark or Parkson's AquaGuard are equipped with a continuous belt of laced links each equipped with hooks to grab screenings material and hoist out of the wastewater for disposal. Perforated plates can also be specified for either screen (see Alternative S1). The links can be constructed of either stainless steel or plastic depending on screen manufacturer. This screen type is equipped with a brush at the toe of the screen to prevent screenings from short circuiting the screen (i.e., flowing under the screen) since there is a gap between the floor and screen toe to allow the hooks on the laced links to make the full rotation. Depending on the screen manufacturer, each screen would be equipped with either a rotating brush and/or spray bar to remove screenings from the laced links into the wash press. There are no submerged sprockets, bushings, or bearings. Each manufacturer has a specific angle of installation requirements, but screens are typically installed at 60 to 90 degrees angles. An example of Hydro-Dyne's Traveling Water Screen is presented in Figure 9.03-7.

This type of screen provides better removal efficiency compared to other traditional bar screens because the screen cleaning can be controlled to develop a mat of materials on the screen surface to help improve removal of stringy materials that would otherwise flow through the screen. To account hydraulically for mat development on the screen surface, a 30 to 40 percent blinding factor would be assumed to account for higher headloss across the screen. At a 40 percent blinding factor, the channel would not be expected to overflow with two screens in service at a peak flow of 40.3 MGD. Under more normal flow conditions, the operational blinding factor would be significantly higher to achieve improved removal efficiency.

Source: Hydro-Dyne Traveling Water Screen

Figure 9.03-7 Hydro-Dyne Traveling Water Screen

Improvements required to provide improved bar screening were evaluated in Alternative S3, which includes installing two new 1/4-inch clear opening laced link traveling water screens in the existing outermost channels and leaving the existing 3/8-inch multirake in place to provide the 100 percent required redundancy. Each new screen would have a dedicated screenings wash press for screening washing and handling. Unlike the 3/8-inch multirake alternative, there is too much headloss through the 1/4-inch screen to pass the PHWW flow of 40.3 MGD through one screen without flooding the channel. Each new 1/4-inch screen should be designed with a capacity of 20.2 MGD to meet IDNR standards. The existing 3/8-inch multirake screen in the center channel is capable of passing 40.3 MGD and provides the IDNR required redundancy. The AGS secondary treatment process requires perforated plate screening, so this alternative is not recommended for the AGS process alternative described in Technical Memorandum No. 2. The proposed layout for these improvements is presented in Figure 9.03-8.

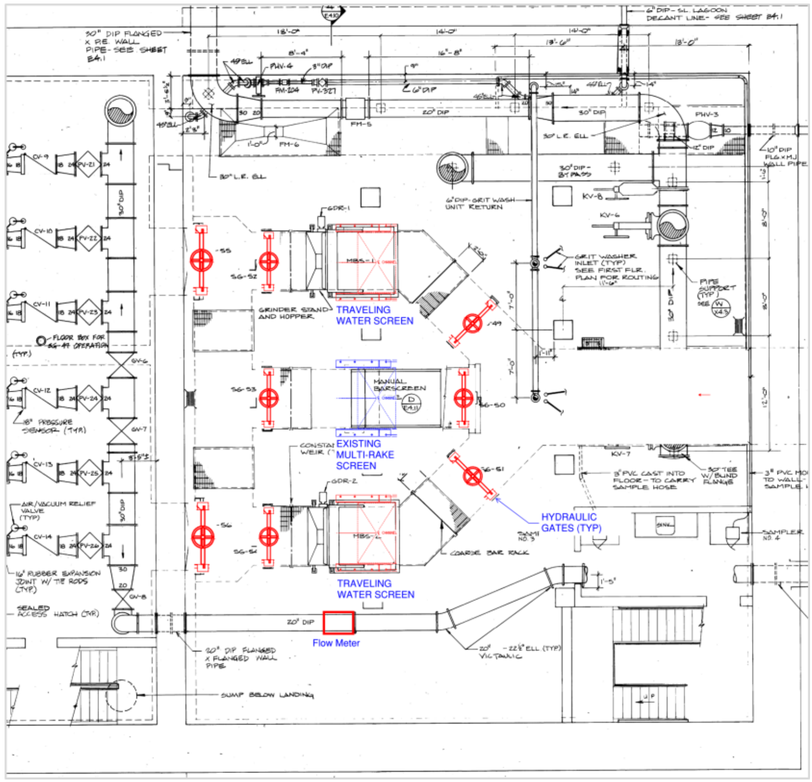
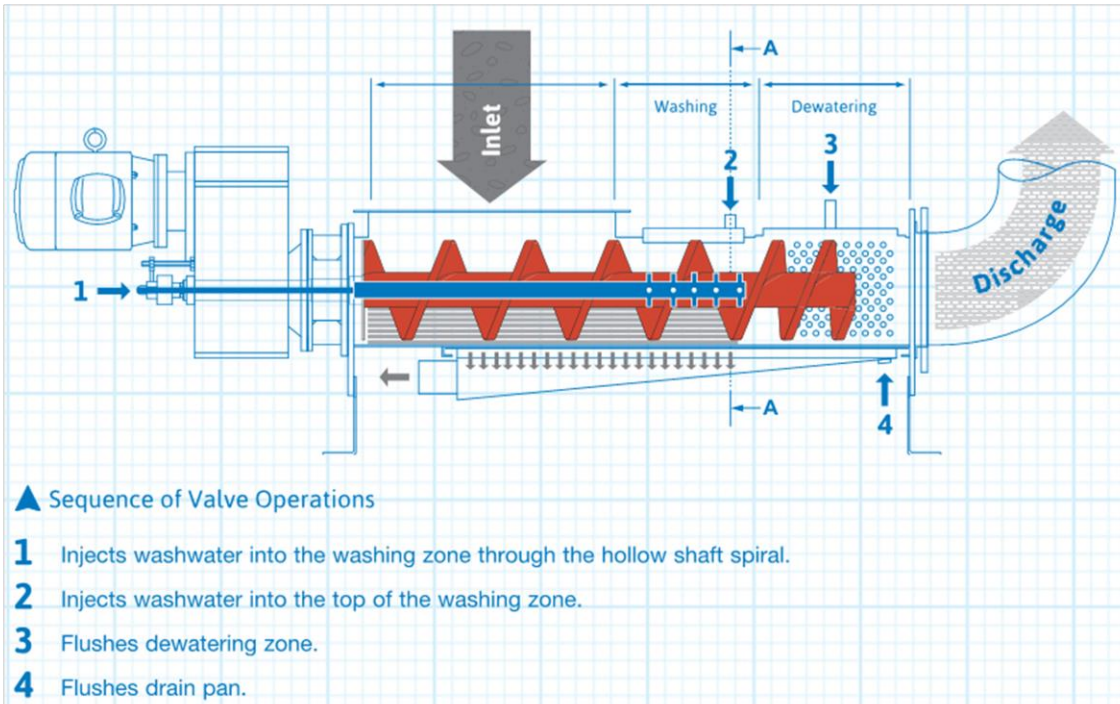


Figure 9.03-8 Alternative S3 Headworks Addition Layout

Washing Compacting and Dewatering (Wash Press)

In all screening alternatives, material captured the screen would be cleaned and dewatered by a screenings wash press. An example of a wash press is presented in Figure 9.03-9. Wash presses are commonly installed for washing, cleaning, and compressing screenings. Since the material is washed to remove organics and has minimal moisture content, lime is typically not needed to stabilize, thus the material can be sent directly to the landfill. Most wash presses can also be equipped with an automatic bagging system. Screenings are discharged into the top of the wash press denoted “inlet” in the figure. The wash press can either operate in batch or continuous mode. In batch mode (according to Vulcan’s typical operation), the screw operates in a forward direction and reverses after a time setpoint while wash water at an average rate of 13 gpm and pressure of 40 to 60 psi is introduced through sprayers to wash the screened material. As material is pushed into the dewatering zone, the screw spiral tightens along with backpressure from the discharge elbow to help dewater the screenings material into a drain pan and send the organic laden water back into the raw wastewater channel for treatment.



Source: Vulcan Industries Washing Press

Figure 9.03-9 Vulcan Wash Press Operation

Continuous mode or "storm mode" is when the press continually operates in the forward motion with continual washing. The wash press has discharge height limitations and cannot discharge more than approximately 15 feet above its mounting location without plugging. It is recommended that new screens extend to the ground level of the Headworks Building and wash presses are installed for washing and dewatering screenings.

Screenings and Screenings Handling Discussion

Alternatives S1 and S1A include perforated plate screening as required by the AGS secondary treatment process discussed in Technical Memorandum No. 2. The AGS manufacturer requires perforated plate screens upstream of its system to remove more of the stringy material that could otherwise interfere with growth of the granules and reduce efficiency of the treatment process. Perforated plate screening is provided in the existing Headworks Building in Alternative S1 and requires an upstream manual bar rack to protect the perforated plate screens. There is potential for the material on the nearly 30-foot-tall, perforated plate screens in Alternative S1 to dry out and become difficult to remove, which would require additional maintenance to clean the screen surface. Another disadvantage is the added cost of maintaining a taller screen and the increased number of perforated plate replacements that would be required over the life of the screen.

The advantage of Alternative S1A is the screen will discharge directly above the channel, so the screenings will not be as likely to dry out on the screen surface. Alternative S1A will require the construction of a Headworks Building addition to house the new perforated plate screens, wash presses, and grit equipment as discussed later in this section; however, this will allow the space in the existing Headworks Building ground level to be repurposed for another use. While there are some cost savings with a shorter screen, most of the expense of this alternative will be the building addition.

If AGS is not the selected secondary treatment process, Alternatives S2 and S3 can be considered. The multirake screen can provide removal of stringy material, but it is not as effective as a traveling water screen. The traveling water screen can be operated based on upstream level to help develop a mat on the screen surface to provide better removal of stringy material compared to the existing bar screens.

9.04 EVALUATION OF GRIT REMOVAL ALTERNATIVES

Grit removal modifications would be sized for a peak flow of 24.5 MGD, which is the design secondary treatment process capacity. Alternatives for installing grit removal systems inside the existing Raw Wastewater Pumping Station in stainless steel tanks and outside in concrete tanks were evaluated. Each alternative would include a valved bypass to allow the grit removal equipment to be taken offline for maintenance, cleaning, and repair. This evaluation also includes redundancy grit removal by providing two grit removal units, each sized for 12.3 MGD, which is 50 percent of the design flow.

The following are the four grit removal alternatives which were evaluated:

1. Alternative G1: Hydro-International's HeadCell–Install two Hydro-International HeadCell units inside stainless steel tanks within the footprint of the existing Raw Wastewater Pump Station.

1A. Alternative G1A: New Screen and Grit Building Addition–Two Hydro-International HeadCells installed in concrete tanks located outside of a new Headworks Building addition described in Alternative 1a.

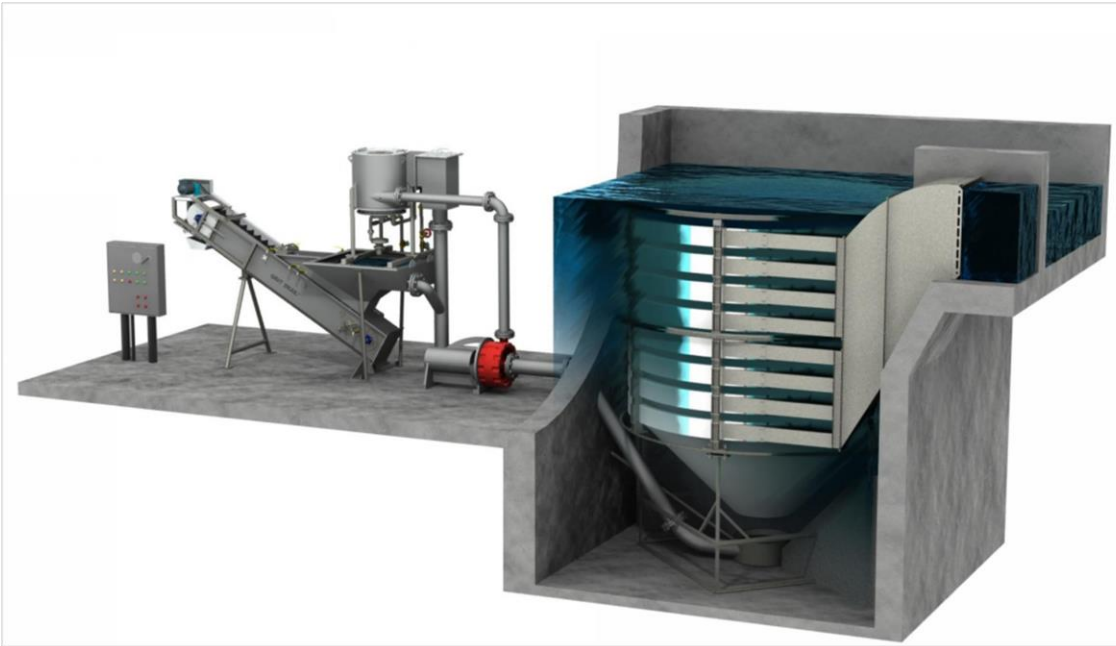
1B. Alternative G1B: New Grit Building–Two Hydro-International HeadCells installed in concrete tanks located outside of a new Headworks Building addition, which does not include screening.

2. Alternative G2: Smith and Loveless INVORSOR–Install two Smith and Loveless INVORSOR units inside stainless steel tanks within the footprint of the existing Raw Wastewater Pump Station.

3. Alternative G3: Huber's Lamella Grit Trap GritWolf®–Install two Huber GritWolf® units inside stainless steel tanks within the footprint of the existing Raw Wastewater Pump Station.

<u>Alternative G1: Hydro-International's HeadCell</u>–Hydro-International's HeadCell is a hydraulic grit concentrator with a vortex flow pattern and a stacked tray design to capture and settle particles. Flow enters the HeadCell's stacked trays tangentially through the inlet duct, and the effluent flows over an

overflow weir. The grit that is trapped on the series of low-density polyethylene trays settles to the bottom section to be pumped out via a grit pump. Figure 9.04-1 presents a HeadCell unit arrangement.



Source: Hydro-International HeadCell ®

Figure 9.04-1 Alternative G1: Hydro-International HeadCell

A HeadCell unit with seven 12-foot-diameter trays would provide 95 percent grit removal efficiency of grit larger than or equal to 106 microns in size at a design peak flow of 12.3 MGD per unit. A total of two units would be installed to meet peak flow demand of 24.5 MGD. Each unit would be sized a total surface area of 791 square feet per unit and would be designed for a loading rate of 10.8 gpm/sf. The headloss at peak design flow would be approximately 12 inches with both units in service. One grit pump would be dedicated to each unit and pump to a dedicated grit washer or classifier.

The HeadCell does not require any external power and does not have any mechanical equipment (other than a grit pump), nor does it have any internal moving parts. The grit pump would operate continuously to remove grit from the underflow section. With continuous operation of the grit pump, flush water would not be required to continuously fluidize the grit at the underflow connection to the HeadCell. The pump would normally discharge in the channel upstream of the HeadCell units to continually capture the recycled grit. An automated valve would periodically actuate to allow the pumped grit to discharge to a grit washer or grit classifier. Fluidizing water could be installed so the grit pumps could operate intermittently. The fluidizing water would consist of an intermittent flush water flowrate of 80 gpm at 50 psi to suspend grit.

The tank diameter is proposed to be 16 feet in diameter with an inlet channel sized at five times the inlet diameter of the transition discharge chute into the trays or approximately 12 feet long according to the manufacturer's recommendations for laminar flow into the tray system. A proposed layout of this alternative is presented in Figure 9.04-2.

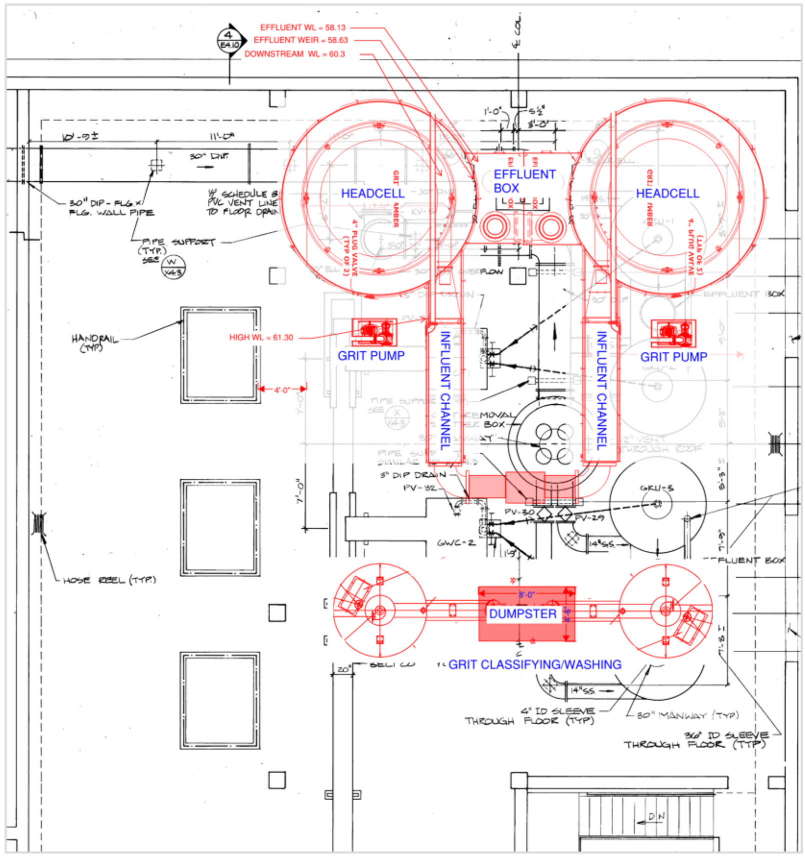


Figure 9.04-2 Alternative G1 HeadCell

Grit could be discharged to grit classifiers or grit washers. It is recommended that two grit classifiers or washers be installed for redundancy, though a single unit may be possible. The proposed layout includes grit washers, which have a larger footprint than grit classifiers so grit classifiers would also fit in the space allocated in this layout. Additional discussion of grit handling equipment is discussed below.

Alternative G1A: New Screen and Grit Building Addition–Alternative G1A includes construction of a new headworks building as described in screenings Alternative S1A and presented in Figure 9.03-5. Any of the grit removal options, HeadCell, INVORSOR, or a traditional vortex grit removal system could be designed with the Headworks Building expansion. Under this alternative, the grit removal equipment would be installed in concrete tanks and located outside to minimize the enclosed building footprint. Grit removal would be downstream of screening and sized for two units each rated for 12.3 MGD.

The building exterior would be constructed of precast wall panels with precast hollow core roof to match the adjacent buildings on-site. The top of channel elevation would need to be set to 62.50 feet, which is approximately 12 feet above the existing Raw Wastewater Pumping Station finished floor (50.50 feet) to flow by gravity to the downstream first Stage Trickling Filter Pumping Station. Access to the top of the channel would be provided from the grade level (50.50 feet) with a staircase. A second means of egress would be provided with an exterior staircase. A platform would be constructed adjacent to the channel, which is where the grit washers or classifiers would be installed. Overflow from these units would drain back to the channel. The grit pumps would be located below the elevated platform at grade so they are in a submerged suction condition. One grit pump would be dedicated to each grit removal tank. Grit classifiers and screenings wash press, which was discussed in screenings Alternative S1A, would discharge to dumpsters. An overhead door would be provided on the lower level to provide access for removing grit and screenings from the facility. The roof line may be matched or slightly higher than the existing Headworks Building to accommodate head room for the elevated channels and for the screen head compartment for maintenance.

Alternative G1B: New Grit Building–Alternative G1B includes construction of a new Headworks Building similar to the addition described in Alternative S1A and presented in Figure 9.04-3. The building would be constructed northwest of the Raw Wastewater Pumping Station.

Under this alternative, the grit removal equipment would be installed in concrete tanks located outside to minimize the enclosed building footprint. Grit removal, like Alternative G1A, would be downstream of screening and sized for two units each rated for 12.3 MGD.

The building exterior would be constructed of precast wall panels with precast hollow core roof to match the adjacent buildings on-site. The top of channel elevation would need to be set to 62.50 feet, which is approximately 12 feet above the existing Raw Wastewater Pumping Station finished floor (50.50 feet) to flow by gravity to the downstream first Stage Trickling Filter Pumping Station. Access to the top of the channel would be provided from the grade level (approximately 50.50 feet) with a staircase. A second means of egress would be provided with an exterior staircase.

A platform would be constructed adjacent to the channel, which is where the grit washers or classifiers would be installed. Overflow from these units would drain back to the channel. The grit pumps would be located below the elevated platform at grade so they are in a submerged suction condition. One grit pump would be dedicated to each grit removal tank. Grit classifiers would discharge to dumpsters on the ground level. An overhead door would be installed on the lower level to provide access for removing grit and screenings from the facility.

The aeration blowers are planned to be installed in a newly constructed room inside the Raw Wastewater Pumping Station, along the north wall of the headworks room. The blower intakes will be on the north wall of the Raw Pumping Station, so a new grit pad would be constructed near the northwest corner of the Grit Building to move the grit storage away from the intakes of the blowers.

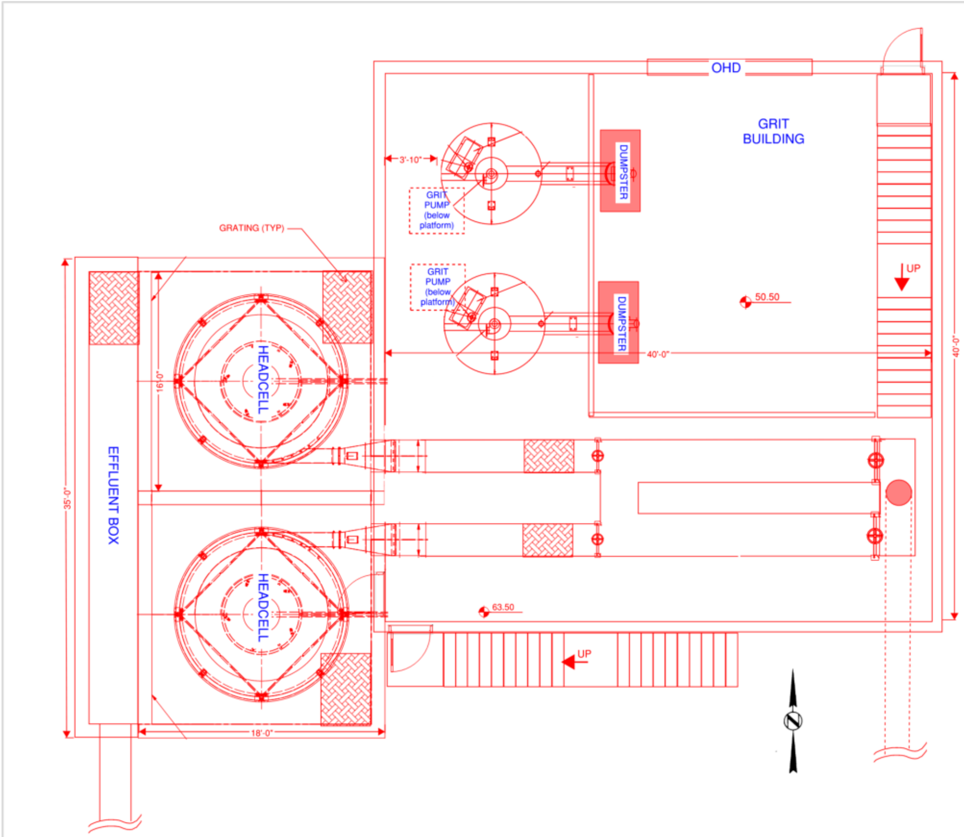
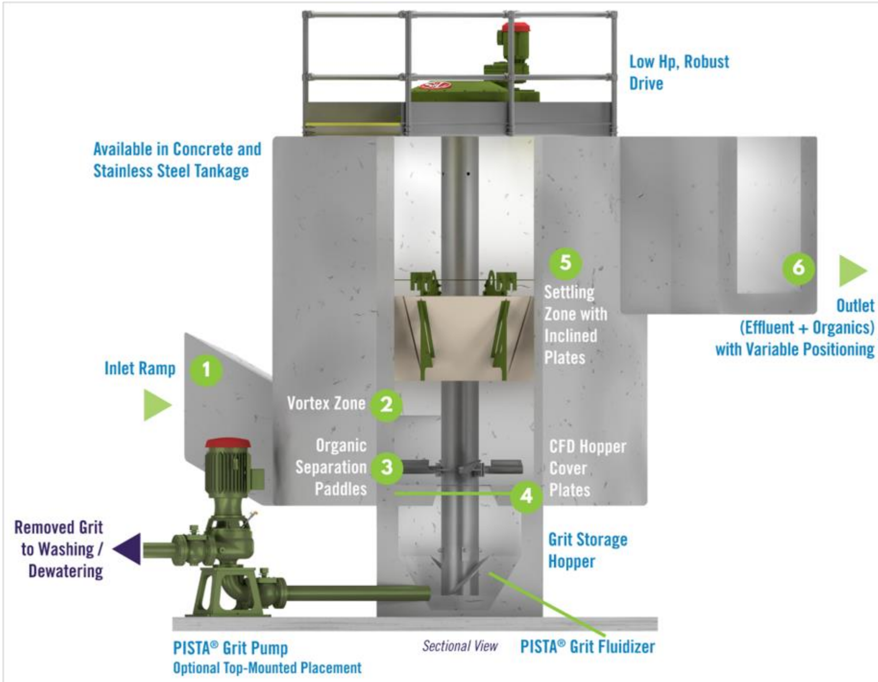


Figure 9.04-3 Alternative G1B Grit Building Layout

Alternative G2: Smith and Loveless INVORSOR–Smith and Loveless' INVORSOR is the fifth generation of vortex grit removal equipment by this manufacturer, which uses the tangential forces of influent flow and inclined cones to settle grit. A diagram of the INVORSOR is presented in Figure 9.04-4. Wastewater flows tangentially through the sloped inlet channel to the bottom of the unit. The paddles in the bottom of the unit facilitate in separating out the organics from the individual grit particles. The wastewater flows into the settle zone with inclined cone settling plates where the fine grit particles are allowed to settle. To prevent grit from resuspending from the hopper, cover plates are installed just under the paddles. Settled grit in the grit storage hopper is pumped out to either a grit classifier or grit washer.



Source: Smith and Loveless INVORSOR

Figure 9.04-4 Smith and Loveless INVORSOR

The INVORSOR provides 95 percent grit removal efficiency of grit larger than or equal to 75 micron in size at a design peak flow of 12.3 MGD per unit and at the average day flow. A total of two units in stainless steel tanks would be provided to meet peak flow demand of 24.5 MGD. The headloss at peak design flow is approximately 17 inches. One grit pump would be dedicated to each INVORSOR unit and pump to a dedicated grit washer or classifier (a single unit is also a possibility). Grit would be discharged to a dumpster until final storage on the grit pad and land application. A layout of the proposed improvements is presented in Figure 9.04-5.

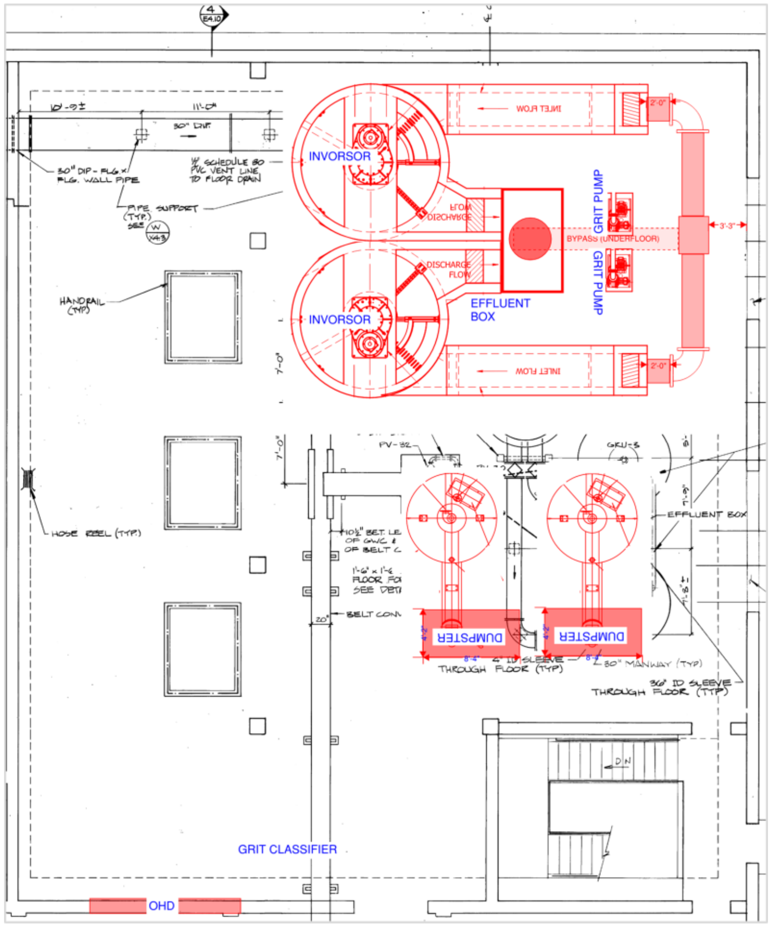
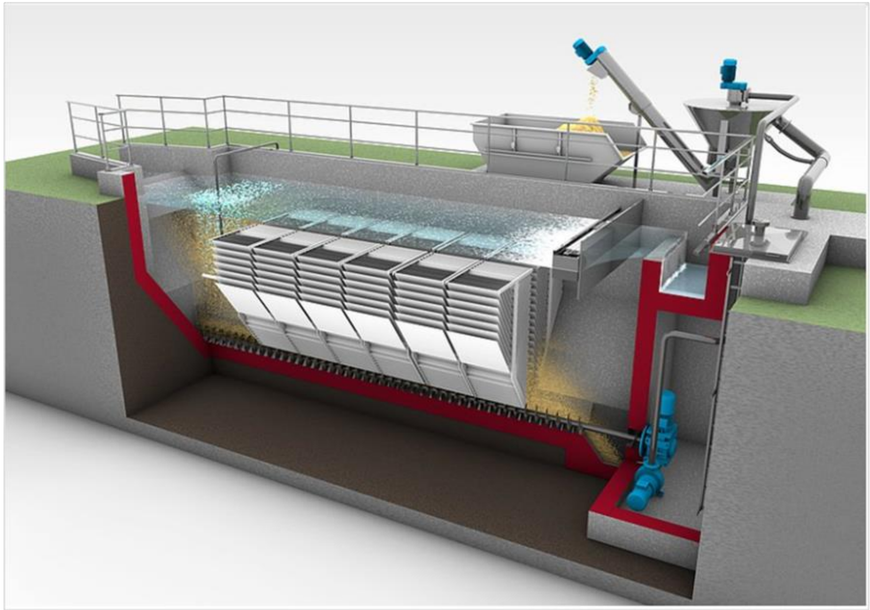


Figure 9.04-5 Alternative G2 INVORSOR Layout

In addition to the fifth generation unit (INVORSOR), any of Smith and Loveless's earlier generation vortex grit removal systems could also be installed in the same footprint in stainless steel tanks. Some earlier versions, like the first generation Pista grit removal system, require specific orientations of the inlet and outlet to the grit chamber. This allows for less flexibility in layout. The advantage of these earlier generation units is that there are other manufacturers, so there is more competition in the market to drive the bid price. The disadvantage of the earlier generations is that they are not effective in removing smaller grit compared to the HeadCell or existing TeaCup® grit removal systems. The original Pista grit removal system can remove 95 percent of grit down to 300 micron.

Alternative G3–Huber's Lamella Grit Trap GritWolf®–Huber's Lamella Grit Trap GritWolf® is an integrated lamella grit separator. As wastewater flows through one side of the unit, it is aerated with fine bubble diffusers before passing through the series of stainless steel lamella plates. As the grit settles out in the lamella plates and falls to the bottom of the unit, it is transported with a horizontal grit transfer auger to a grit sump. A grit pump removes the grit from the sump and lifts the grit to a grit washer and classifier. Any fats, oils, and greases are collected via scum skimmer to a trough and scum is pumped out via a grease pump. Figure 9.04-6 presents the components of the GritWolf®.



Source: Huber GritWolf®

Figure 9.04-6 Alternative G3: Huber Grit Trap GritWolf®

Huber's GritWolf® unit has a large footprint compared to the other grit removal alternatives. Two 40-foot-long by 10-foot-wide units would be required to provide 95 percent grit removal efficiency of all grit material 106 micron and larger at a design peak flow of 12.3 MGD per unit. The GritWolf® units will not fit into the existing screening and grit removal room of the Raw Wastewater Pump Station, so they would be required to be installed outside. The GritWolf® compared to other grit removal alternatives has the ability to remove scum from wastewater, which could be beneficial to the NFPA 820 rating by making the downstream areas unclassified; however, this has not been officially ruled on by NFPA or other code authorities.

Each GritWolf® unit has multiple pieces of mechanical equipment including a grit auger and motor, blower, grease skimmer, grease pump, and grit pump which will have weekly and monthly maintenance requirements. The GritWolf® is new technology and Huber does not currently have any installations in the United States. Due to the increased maintenance, submerged moving parts, size, complexity, and limited installations, the GritWolf® is not a recommended technology for grit removal and was not evaluated further.

Grit Removal Alternatives Discussion

The existing TeaCup® grit removal system is at the end of its useful life and is not providing adequate grit removal. The TeaCup® system is also the bottleneck to the treatment process in that it is unable to pass the design MWW flow of 24.5 MGD.

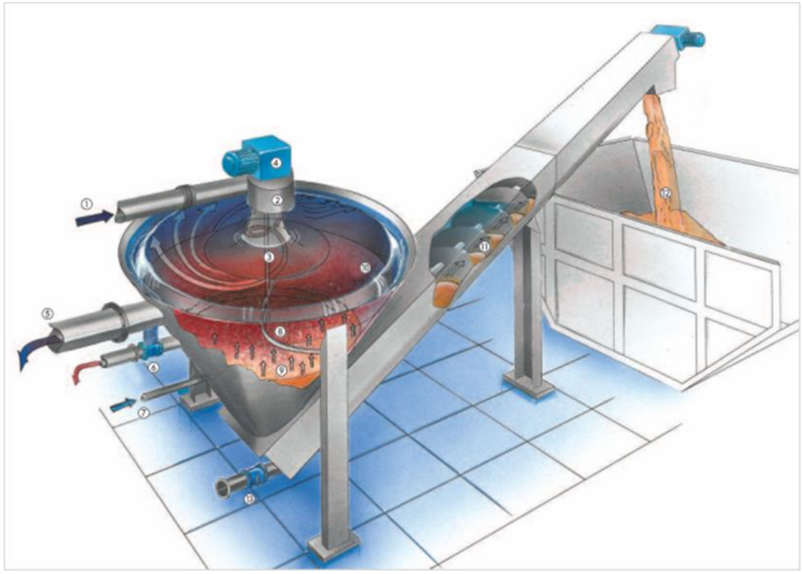
Hydro-International's HeadCell evaluated in Alternatives G1 and G1A provide low operation and maintenance costs with no moving parts or components to maintain other than an electrically actuated valves(s) to direct grit to the grit classifier/washer along with a solenoid valve and flow meter for the fluidizing water, if installed. Alternatively, the O&M costs would mainly be associated with the grit pump, which would be expected to operate continuously. This is clearly an advantage from an operational and maintenance perspective. The HeadCell system is a proven technology for grit removal with numerous installations. The system is also able to meet the removal 95 percent removal of 106 micron and larger particle size performance.

Construction of the new building addition in Alternative G1A could provide for better construction sequencing to implement perforated plate screening and the new grit removal technology since the existing grit system could remain in operation while the new building and grit removal equipment are constructed. Grit removal Alternatives G1 and G2 would require the existing grit removal system to be out of service for extended periods of time to construct the new grit removal systems and install piping (several months). Additionally, constructing a new Headworks Building would allow the footprint of the existing grit removal system to be repurposed for new equipment (i.e. blowers, pumps, etc.). Based on the evaluation of existing Raw Wastewater Pump Station capacity testing, the design capacity of 24.5 MGD could be pumped by three raw pumps, and the fourth pump would remain a redundant spare, to a new Headworks Building. All four raw wastewater pumps would be required to be in operation with no redundant spare if wastewater is pumped to new grit removal tanks installed inside of the existing Headworks Building because the water level in the inside tanks would need to be more than 10 feet higher than the water level in an exterior tank due to installing on existing floor elevations.

Smith and Loveless's INVORSOR is a newer grit removal technology than the HeadCell. This technology is capable of removing 95 percent of 75 micron and larger at the peak and average day flows, which is better removal of finer material compared to the HeadCell. The two-unit option Model 12.0 (each sized for 12.3 MGD) is able to fit the existing grit room footprint. Aside from the grit pump, the only moving part on the INVORSOR unit is a drive unit for the grit fluidizer in the bottom sump.

Grit Handling Equipment

Grit Washer and Dewaterer–Grit washers (i.e., Huber's Coanda Tulip or Vulcan's grit washer) wash and classify grit to remove volatile organics and moisture to minimize odor and insect attraction. The pumped grit mixture enters the unit through the top connection and drops through a rotating rake arm. The rake arm creates velocity gradients to allow grit to settle to the lower portion of the tank while allowing the lighter, low-density organics to rise. Settled grit is washed in a fluidized bed, stirred by the rake arm, to separate and remove residual organics attached to the grit particles. As the fluidized bed reaches a specified height as measured by a pressure sensor, the washed grit is removed from the bottom through an inclined auger and dumped into a dumpster. Organics are discharged from the system through an "organics" valve back into the wastewater for treatment. An example diagram of a grit washer is presented in Figure 9.04-7.



Source: Huber Grit Washer

Figure 9.04-7 Huber Grit Washer

A grit washer processes an intermittent flow that is sized to achieve a maximum volatile organics content and moisture content of 5 and 10 percent, respectively. The unit can be sized larger to accommodate higher flows pending application. Along with some instrumentation and electrically actuated valves, the grit washer mechanical equipment includes the grit stirrer and grit auger.

Grit Classifier–Grit classifiers separate some organic material from grit materials, returns organics laden liquid back to the treatment process, and discharges grit for disposal. Pumped grit slurry enters the top of the unit into a sedimentation tank to minimize turbulence and improve the settling of the material. The liquid overflows a sidewall baffle and discharges out the side of the unit. Flows are directed downstream of the grit removal process. The grit material settles in the sedimentation tank and is slowly discharged by an auger system to dewater the sediments for disposal. Pumped flowrates could vary between approximately 150 to 550 gpm depending on the unit size and the required application. An example of a grit classifier is presented in Figure 9.04-8.

Source: Vulcan Grit Classifier

Figure 9.04-8 Vulcan Grit Classifier

Grit Handling Discussion

Grit has historically been land applied and the City plans to continue this disposal method. Grit classifiers would be the most reasonable and cost-effective approach to handling grit for land application. Grit from grit classifiers do not meet USEPA's paint filter test and therefore landfills may not accept the material, which is the reason many municipalities pursue grit washers. Classified grit contains organics which can attract flies and create an odorous environment. Compared to grit washers, controls on grit classifiers are also much simpler and the footprint of these units are more compact.

It is recommended to install grit classifiers for the new grit removal system. As a result, the grit removal alternatives discussed above are all priced with grit classifiers.

9.05 MONETARY COMPARISON OF SCREENING AND GRIT REMOVAL ALTERNATIVES

Monetary comparison of screening and grit removal alternatives are evaluated in this section. All of the opinions of probable construction cost are based on fourth quarter 2022 dollars. At the study phase of alternative evaluation, the expected accuracy range of this opinion of cost is -20 to +40 percent based on the AACE International Recommended Practice 17R Cost Estimate Classification System.

A. Monetary Comparison of Screening Alternatives

Table 9.05-1 summarizes the 20-year present worth analysis for each of the screening alternatives. Additional detail on the present worth analysis is provided in Appendix C. Costs for Alternative S1A do not include the grit removal or classifying equipment, concrete tanks for that equipment, or demolition of the existing grit removal equipment. Alternative S1A OPC should not be compared directly to the other screening alternatives.

	Alternative S1 *6-mm Perforated Plate Screens*	Alternative S1A *Raw Wastewater Pumping Station Addition*	Alternative S2 *3/8-inch Multirake Screens*	Alternative S3 *1/4-inch Lace Linked Screens*
Capital Costs				
Equipment/Structure Subtotal	$2,840,000	$2,590,000	$1,580,000	$2,260,000
Mechanical	$560,000	$510,000	$310,000	$450,000
Electrical	$840,000	$770,000	$470,000	$670,000
Sitework	$0	$260,000	$0	$0
Undefined Scope	$560,000	$510,000	$310,000	$450,000
Contractor's General Conditions	$720,000	$700,000	$410,000	$580,000
Supply Chain Escalator	$830,000	$810,000	$470,000	$670,000
Contingencies	$960,000	$930,000	$540,000	$770,000
Technical Services	$1,270,000	$1,230,000	$710,000	$1,020,000
Total Opinion of Capital Costs	**$8,580,000**	**$8,310,000**	**$4,800,000**	**$6,870,000**
Annual O&M Costs				
Power	$0	$0	$0	$0
Maintenance and Supplies	$30,000	$20,000	$10,000	$20,000
Total	$2,000	$2,000	$2,000	$2,000
	$32,000	**$22,000**	**$12,000**	**$12,000**
Summary of Present Worth Costs				
Replacement Cost	$0	$0	$0	$0
O&M Cost	$480,000	$330,000	$180,000	$180,000
Salvage Value	$0	($210,000)	$0	$0
TOTAL PRESENT WORTH	**$9,060,000**	**$8,430,000**	**$4,980,000**	**$7,050,000**

Notes: All costs in fourth quarter 2022 dollars.

Table 9.05-1 Screenings Alternative Present Worth Evaluation Summary

B. <u>Monetary Comparison of Grit Alternatives</u>

Table 9.05-2 summarizes 20-year present worth analysis for each of the grit removal alternatives. Additional detail on the present worth analysis is provided in Appendix C. Alternative G1A presented in this table does not include the building, screening equipment, and other costs included in Alternative G1A of Table 9.05-1. Alternative G1A OPC should not be compared directly to the other grit alternatives.

	Alternative G1 *HeadCell*	**Alternative G1A** *Raw Wastewater Pumping Station Addition*	**Alternative G1B** *New Grit Building*	**Alternative G2** *INVORSOR*
Capital Costs				
Equipment/Structure Subtotal	$3,580,000	$1,770,000	$2,470,000	$3,440,000
Mechanical	$530,000	$270,000	$400,000	$510,000
Electrical	$710,000	$700,000	$900,000	$680,000
Sitework	$0	$180,000	$250,000	$0
Undefined Scope	$710,000	$350,000	$490,000	$680,000
Contractor's General Conditions	$830,000	$500,000	$680,000	$800,000
Supply Chain Escalator	$960,000	$570,000	$780,000	$920,000
Contingencies	$1,100,000	$660,000	$900,000	$1,060,000
Technical Services	$1,470,000	$870,000	$1,200,000	$1,410,000
Total Opinion of Capital Costs	**$9,890,000**	**$5,870,000**	**$8,070,000**	**$9,500,000**
Annual O&M Costs				
Relative Labor	$0	$0	$0	$0
Maintenance	**$20,000**	**$20,000**	$20,000	**$19,000**
Power	$7,000	$7,000	$7,000	$9,000
Subtotal Opinion of Annual O&M	**$27,000**	**$27,000**	**$27,000**	**$28,000**
Replacement Cost	$40,000	$40,000	$40,000	$40,000
O&M Cost	$410,000	$410,000	$410,000	$420,000
Salvage Value	($10,000)	($70,000)	($210,000)	($20,000)
TOTAL PRESENT WORTH	**$10,330,000**	**$6,250,000**	**$8,310,000**	**$9,940,000**

Notes: All costs in fourth quarter 2022 dollars.

Table 9.05-2 Grit Alternative Present Worth Evaluation Summary

B. Monetary Comparison of Headworks Improvements Alternatives

Table 9.05-3 summarizes 20-year present worth analysis for each of the headworks improvements alternatives, which include screening and grit removal and handling. The screening and grit alternative which are summed to obtain the totals presented are identified for each column. Screening Alternatives S1, S2, and S3 could instead be paired with grit removal Alternative G2 for the INVORSOR system, which would reduce the total capital cost and total present worth by approximately $400,000.

	Alternative S1 *6 mm Perforated Plate Screens+* **Alternative G1** Headcell	**Alternative S1A** *Raw Wastewater Pumping Station Addition*	**Alternative S2** *3/8-inch Multirake Screens+* **Alternative G1** Headcell	**Alternative S3** *1/4-inch Lace Linked Screens+* **Alternative G1** Headcell	**Alternative S2** 3/8-inch Multirake Screens+ **Alternative G1B** New Grit Building
Capital Costs					
Screening Alternative	$8,580,000	$8,310,000	$4,800,000	$6,870,000	$4,800,000
Grit Removal Alternative	$9,890,000	$5,870,000	$9,890,000	$9,890,000	$8,070,000
Total Opinion of Capital Costs	**$18,470,000**	**$14,180,000**	**$14,690,000**	**$16,760,000**	**$12,870,000**
Annual O&M Costs					
Screening Alternative	$32,000	$22,000	$12,000	$12,000	$12,000
Grit Removal Alternative	$27,000	$27,000	$27,000	$27,000	$27,000
Total	**$59,000**	**$49,000**	**$39,000**	**$39,000**	**$39,000**
Summary of Present Worth Costs (Total)					
Replacement Cost	$40,000	$40,000	$40,000	$40,000	$40,000
O&M Cost	$890,000	$740,000	$590,000	$590,000	$590,000
Salvage Value	($10,000)	($280,000)	($10,000)	($10,000)	($210,000)
TOTAL PRESENT WORTH	**$19,390,000**	**$14,680,000**	**$15,310,000**	**$17,380,000**	**$13,290,000**

Notes: All costs in fourth quarter 2022 dollars.

Table 9.05-3 Headworks Alternative Present Worth Evaluation Summary

SECTION 10
ALTERNATIVE SELECTION AND SITING

10.01 INTRODUCTION

Previous sections of this Plan presented background information, described and evaluated the projected flows and loadings, and reviewed alternatives necessary to meet the projected needs at the WPCF. In this section, the selected nutrient reduction and headworks alternatives are summarized and an evaluation of siting options for the new infrastructure is presented.

10.02 NUTRIENT REDUCTION ALTERNATIVE SELECTION

Based on the monetary and nonmonetary evaluation for the nutrient reduction alternatives presented in Section 7, the City has selected to proceed with Alternative BNR2–SNDN Activated Sludge.

As discussed in Section 8, the nutrient reduction selection impacts the screening technology selection, as finer screening (particularly perforated plate screens) is recommended for the AGS alternatives (BNR3a or BNR3b) but are not required for Alternatives BNR1 or BNR2. Therefore, the City has chosen to install bar screens. The selection of headworks alternatives is also impacted by the location of the proposed nutrient reduction infrastructure. Alternative BNR2, presented in Section 7, includes construction of the activated sludge system to the west of the Raw Wastewater Pump Station. However, this would not allow implementation of a headworks alternative that includes a new screening or grit facility in the same location as the proposed activated sludge tanks (such as screening Alternative S1A).

While Alternative BNR2 assumed a new activated sludge system would be installed west of the Raw Wastewater Pump Station for the purposes of a nutrient reduction technology selection, there are other options to site the activated sludge system at the WPCF that would allow a new screening or grit facility to be constructed in this location. This is discussed in greater detail in Subsection 10.03.

10.03 WPCF IMPROVEMENT SITING EVALUATION

The preliminary location of the proposed activated sludge system for Alternative BNR2 presented in Section 7 (west of the Raw Wastewater Pump Station) was chosen based on the available space on-site without the demolition or relocation of significant existing structures or buildings. However, this location has some drawbacks, including limited space for expansion, relocation of existing utilities, and significant sitework associated with constructing tanks into the existing hill. Concurrently with the nutrient reduction and headworks planning included in this Plan, the City is planning renovations to the Administration Building at the WPCF. The existing Administration Building is in need of updating and is also located in a relatively flat space adjacent to the final clarifiers. This provides an opportunity to consider relocation of the Administration Building to another location on-site and construction of the proposed activated sludge system in the location of the existing Administration Building. In this section, two siting alternatives for the nutrient reduction and headworks improvements are evaluated based on monetary and nonmonetary considerations.

1. Site Alternative 1–New Activated Sludge System West of Raw Wastewater Pump Station

In this alternative, the activated sludge system (Alternative BNR2) is constructed to the west of the Raw Wastewater Pump Station. The headworks improvements are implemented within the existing Raw Wastewater Pump Station (Screening Alternative S2 and Grit Removal Alternative G1) and the Administration Building is renovated in its current location. Replacement of the existing switchgear and a new Electrical Building to house the new switchgear are also included, as described in greater detail in Subsection 10.04.

A preliminary layout of this alternative is presented in Figure 10.03-1.

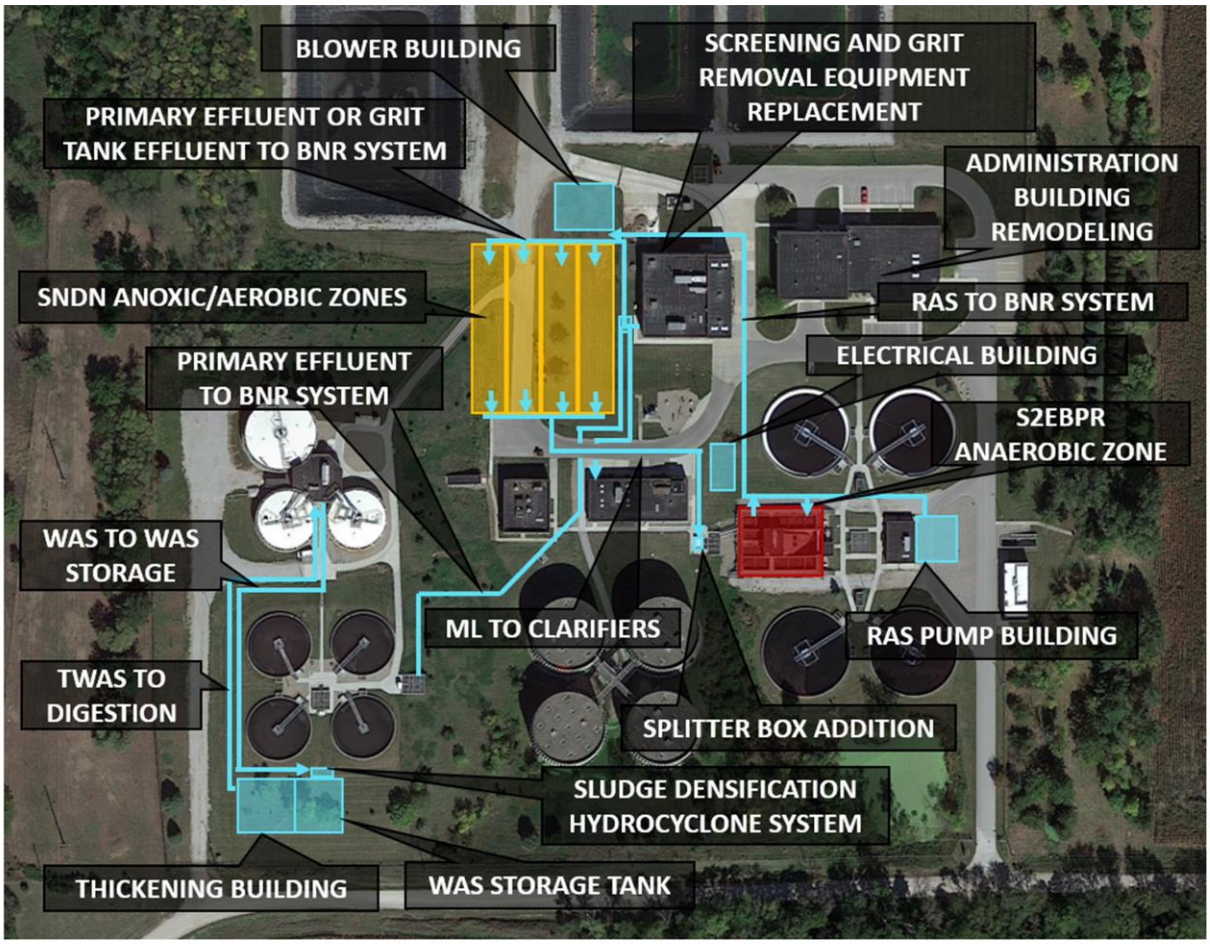


Figure 10.03-1 Siting Alternative 1 Preliminary Layout

2. Site Alternative 2–New Activated Sludge System At Location of Existing Administration Building

In this alternative, the existing Administration Building is demolished and the activated sludge system (Alternative BNR2) is constructed in its current location. The existing screens are replaced within the Raw Wastewater Pump Station (Alternative S2) and a new Grit Removal Facility is constructed to the west of the Raw Wastewater Pump Station (Alternative G1A). Because the grit removal equipment is no longer installed within the Raw Wastewater Pump Station, the space that the existing grit removal equipment occupies is available for the activated sludge blowers. This existing space is modified by separating the proposed blower room from the rest of the building along with a dedicated HVAC system for the blower room. Therefore, the blower building (included in Alternative BNR2) is not required for this alternative. By moving the grit equipment out of the existing Raw Wastewater Pump Station, the elevation of the new grit equipment can be optimally set, resulting in increasing the capacity of the existing raw wastewater pumps.

A new Administration Building and Maintenance Garage of the same size as the existing Administration Building are constructed on the northeast portion of the site adjacent to the equalization basins. Site and roadway modifications are included for access and parking at the new Administration Building and Maintenance Garage location. Replacement of the existing switchgear and a new Electrical Building to house the new switchgear are also included, as described in greater detail in Section 10.04.

A preliminary layout of this alternative is presented in Figure 10.03-2.

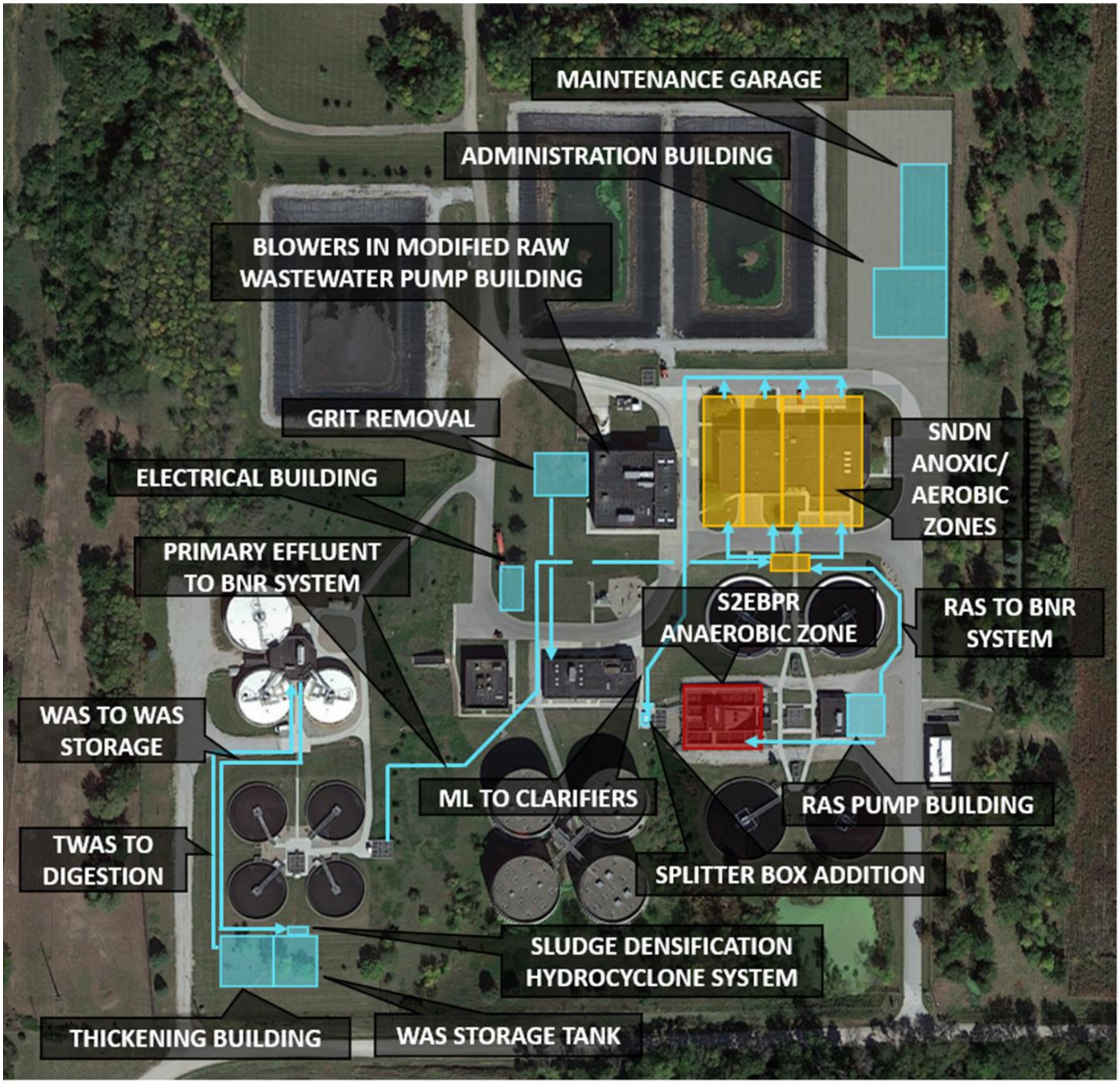


Figure 10.03-2 Siting Alternative 2 Preliminary Layout

A. Monetary Comparison

Table 10.03-1 summarizes the OPCC of each of the siting alternatives presented in this technical memorandum. While the OPCC are based on fourth quarter 2022 dollars (no portions of the alternative are discounted as a future capital cost), the costs are escalated to account for an implementation plan that is assumed to include three phases. This accounts for increased capital costs for contractor mobilization, project management and supervision, engineering, and other costs that are incurred when projects are split into several smaller projects. This approach allows a comparison of the present worth of the alternatives on a common cost basis, with more detailed evaluation of phasing discussed in Section 11 of this Plan.

	Siting Alternative 1– New Activated Sludge System West of Raw Wastewater Pump Station	**Siting Alternative 2–** New Activated Sludge System At Location of Existing Administration Building
Capital Costs[a]		
Alternative BNR2	$63,330,000	$61,480,000[b]
Alternative S2	$4,800,000	$4,800,000
Alternative G1B	-	$8,070,000
Alternative G1	$9,890,000	-
Switchgear and Electrical Building	$2,830,000	$2,830,000
Administration Building	$1,800,000[c]	$6,350,000[d]
Stormwater Management	$340,000[e]	$340,000[e]
Project Total Opinion of Capital Costs	**$82,990,000**	**$83,870,000**

[a]All costs in fourth quarter 2022 dollars.
[b]Alternative BNR2 reduced from costs presented in Section 7 to account for repurposing portion of Raw Wastewater Pump Station for new activated sludge blowers, reduced yard piping, and reduced sitework.
[c]Allowance of $1,000,000 for building remodeling plus Contractor's General Conditions (15 percent), Supply Chain Escalator (15 percent), Technical Services (15 percent), and Contingencies (20 percent).
[d]7,700 square feet of office space at $300 per square foot and 6,200 square feet of garage space at $200 per square foot plus Contractor's General Conditions (15 percent), Supply Chain Escalator (15 percent), Technical Services (15 percent), and Contingencies (20 percent).
[e]$180,000 for stormwater BMPs plus Contractor's General Conditions (15 percent), Supply Chain Escalator (15 percent), Technical Services (15 percent), and Contingencies (20 percent).

Table 10.03-1 Siting Alternative Evaluation Summary

C. Nonmonetary Factor Evaluation

Nonmonetary factors for each alternative were evaluated and are summarized in Table 10.03-2.

Alternative	Benefits	Limitations
Siting Alternative 1 New Activated Sludge System West of Raw Wastewater Pump Station	1. Reuses the existing infrastructure (Administration Building) 2. Maintains space at the northeast portion of site for other future uses (such as expanded flow equalization)	1. No space for activated sludge expansion adjacent to new tanks 2. Limits headworks alternative to those within the existing Raw Wastewater Pump Station 3. Less options for Administration Building renovation than the construction of new a building
Siting Alternative 2 New Activated Sludge System at Location of Existing Administration Building	1. Provides space adjacent to the new activated sludge system to more easily expand, as future growth requires 2. Construction of a new Administration Building and Maintenance Garage allows design optimized for City's current and future needs	1. Potentially longer construction period for new Administration Building to be constructed before demolishing the existing building

Table 10.03-2 Siting Alternative Nonmonetary Evaluation Summary

D. Siting Alternative Selection

Based on the monetary and nonmonetary evaluation for the siting alternatives presented in this section, the City has selected to proceed with Siting Alternative 2. A conceptual layout for Siting Alternative 2 is shown in Figure 10.03-3.

10.04 SITE CONSIDERATIONS

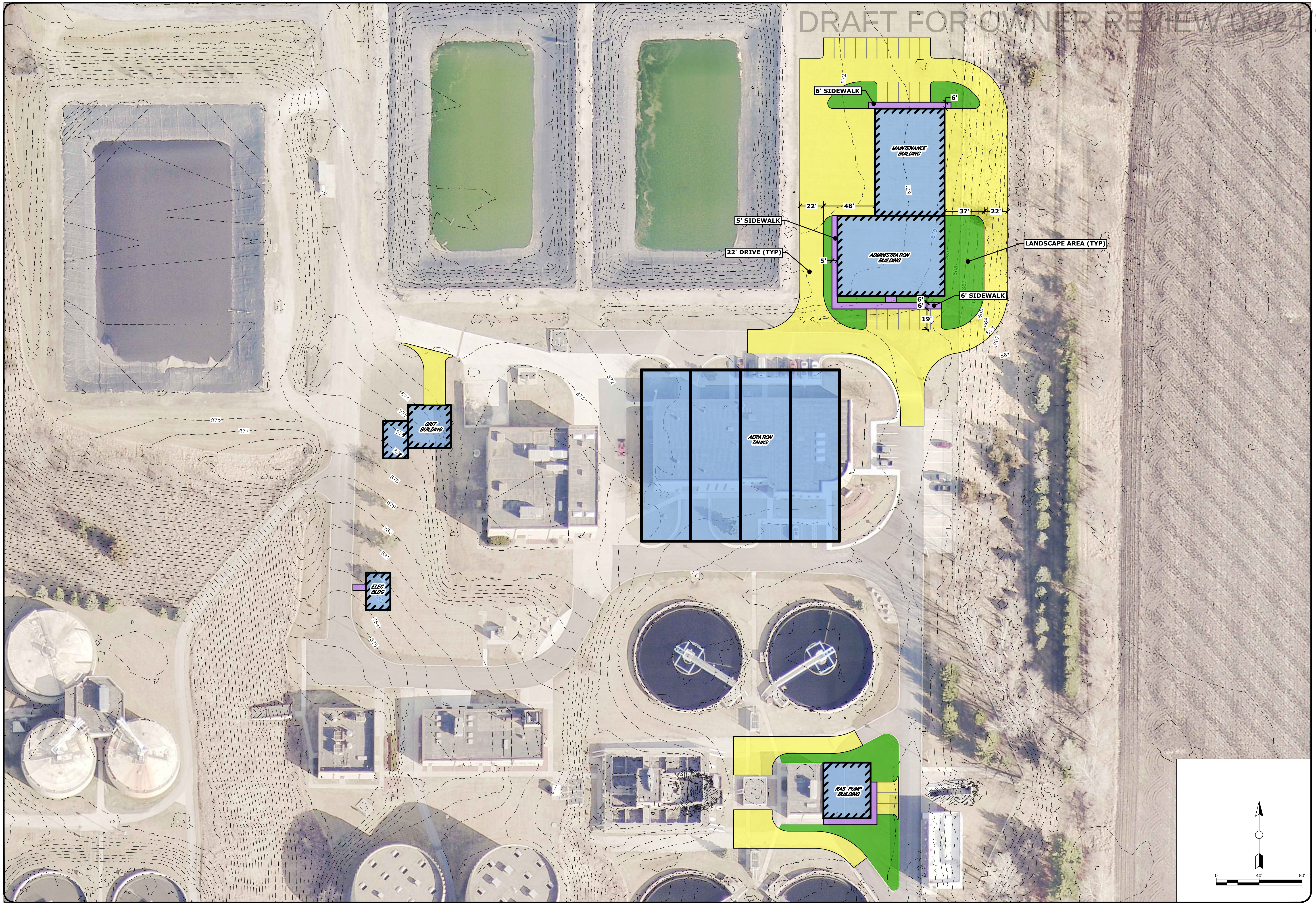
A. Roads and Access

The selected alternative does not significantly impact access to the existing structures at the site. The new Administration Building and Maintenance Garage will require an additional paved driveway to allow access to the building and to provide traffic movements around the new facilities.

The driveway system will be designed to provide access to the integral areas of the proposed facility improvements. Access will need to be maintained for proposed parking, delivery truck access, and access to unit processes for maintenance. Access to the proposed new facilities will be from the existing site entrance drive on the east side of the site and will generally match the existing drive width.

B. Stormwater

The existing site is 31 acres. The proposed development will include approximately 6 acres of disturbed area to allow for the construction of the proposed buildings, parking, sidewalks, and access drives. The following is a summary of the site land use changes as a result of the proposed improvements:



BY	DATE
DESIGNED: SPS	12/22
DRAWN: SRS	12/22
CHECKED:	
LAST UPDATE: 12/21/22	

REVISION

DATE

FOX Strand
414 South 17th Street, Suite 107
Ames, Iowa 50010
Phone: (515) 233-0000
FAX: (515) 233-0103

STRAND ASSOCIATES®

CONCEPT PLAN
AMES WASTEWATER TREATMENT PLANT

AMES, IOWA

PROJECT NO.
4429.009

FIGURE
10.03-3

DRAWING FILENAME		
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PLOT STYLE TABLE	LAYER MNGR NAME	LAYOUT NAME
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Phase 1

- Change in Impervious Area = +0.52 acres
- Water Quality Volume = 9,300 cubic feet

All Planned Phases

- Change in Impervious Area = +0.74 acres
- Water Quality Volume = 10,400 cubic feet

The Story County Land Development Regulations require the following:

1. The site shall be designed to manage the water quality volume of a rainfall depth of 1.25 inches and to manage corresponding recharge volume through infiltration practices.

2. To protect stream channels, the site shall be designed to provide 24 hours of extended detention of the channel protection volume determined for the 1-year, 24-hour storm.

3. Stormwater management shall be provided to limit the postdevelopment rate of runoff from the site area during the 5-year through the 100-year, 24-hour storm events to the lesser of the following values:

    a. Runoff rates equivalent to those from a storm event of the same intensity and duration based on predevelopment conditions.

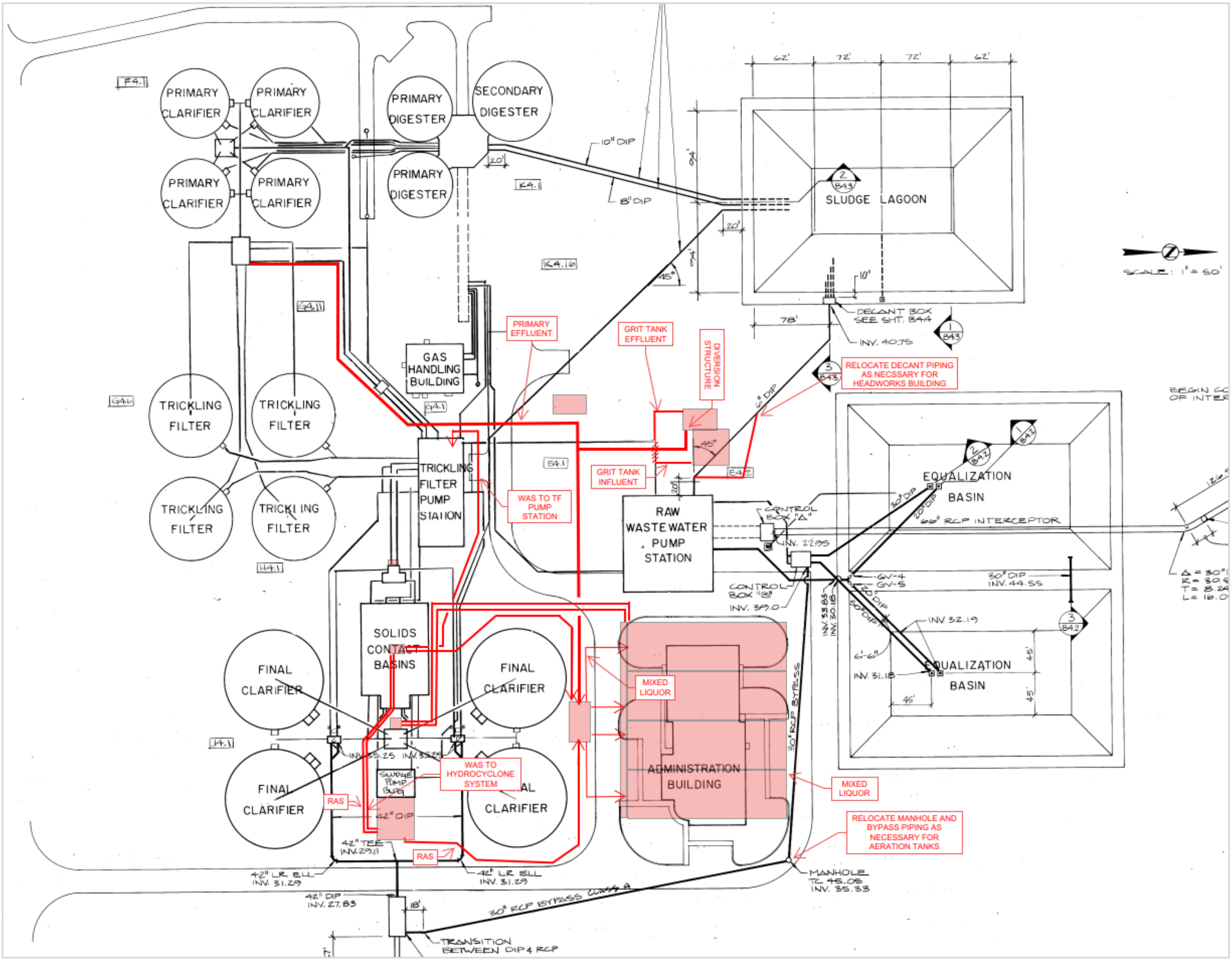
    b. Runoff rates equivalent to those from the 5-year storm event based on conditions which exist as of the date of the proposed improvement plans (row crop agriculture cover, contoured in good condition and surface soil types as identified from County Soil Maps; unless otherwise approved).

BMP's will be required to reduce the post development stormwater outflow from the site to the predevelopment meadow condition for the storm events indicated in the Story County Land Development Regulations. Approximately 10,400 cubic feet of water quality volume will be required for the planned phases of improvements. The type and location of Best Management Practices (BMP's) that will be incorporated into the development plan to accommodate the stormwater requirements will be determined as part of the preliminary design phase of the project. For the purposes of this Plan, $340,000 was included for stormwater management improvements.

C. Yard Piping

A preliminary review of existing record drawings was conducted to evaluate potential routing for new major yard piping for the project. A preliminary yard piping plan, depicting preliminary piping routes for major piping for the proposed project, is presented in Figure 10.04-1. This figure excludes piping associated with the sludge thickening process, as that is not anticipated to be included in the first phase of the proposed project. As a result, the hydrocyclone systems is located at the ML Splitter Structure in the first phase with the preliminary plan to relocate it to the WAS storage tank in a later phase.

Figure 10.04-1 Preliminary Major Yard Piping Plan



Source: Rieke Carroll Muller Associates, Inc.

D. Electrical

A new, dedicated Electrical Building is recommended for service-entrance equipment based on the age and location of the existing main switchgear as discussed in Section 8–Evaluation of Raw Wastewater Pump Station. There is also no room available in the existing buildings to install new service entrance equipment while keeping the existing main switchgear in service during construction. The main switchgear directly feeds most of the MCCs throughout the plant; therefore, the ideal location is in the center of the plant. Refer to Figures 10.03-1 and 10.03-2 for a potential location of the Electrical Building for each alternative. These locations are also near the existing utility transformer and metering equipment as well as the Trickling Filter Complex, which will reduce costs associated with reconnecting power to the utility equipment, standby generator, and existing MCCs not being modified as part of this Plan.

The building will be constructed with driveway access for maintenance and the addition of equipment. It will also contain an accessible lower-level vault, through which feeders to other structures will be routed. The vault will also facilitate future replacement of wiring or the addition of new feeders without routing conduits along the building exterior or through the occupied areas of the building. This layout is similar to the main switchgear installation in the Trickling Filter Complex, except that large junction boxes will not be required because it will be an unoccupied area dedicated to electrical conduit and wiring.

E. Floodplain

The project area is located adjacent to the Skunk River. The proposed improvements will be designed such that no portion of the buildings are located in the floodway. The Federal Emergency Management Administration (FEMA) National Flood Insurance Program (NFIP) mapping for the site, dated January 15, 2021, is presented in Figure 10.04-2.

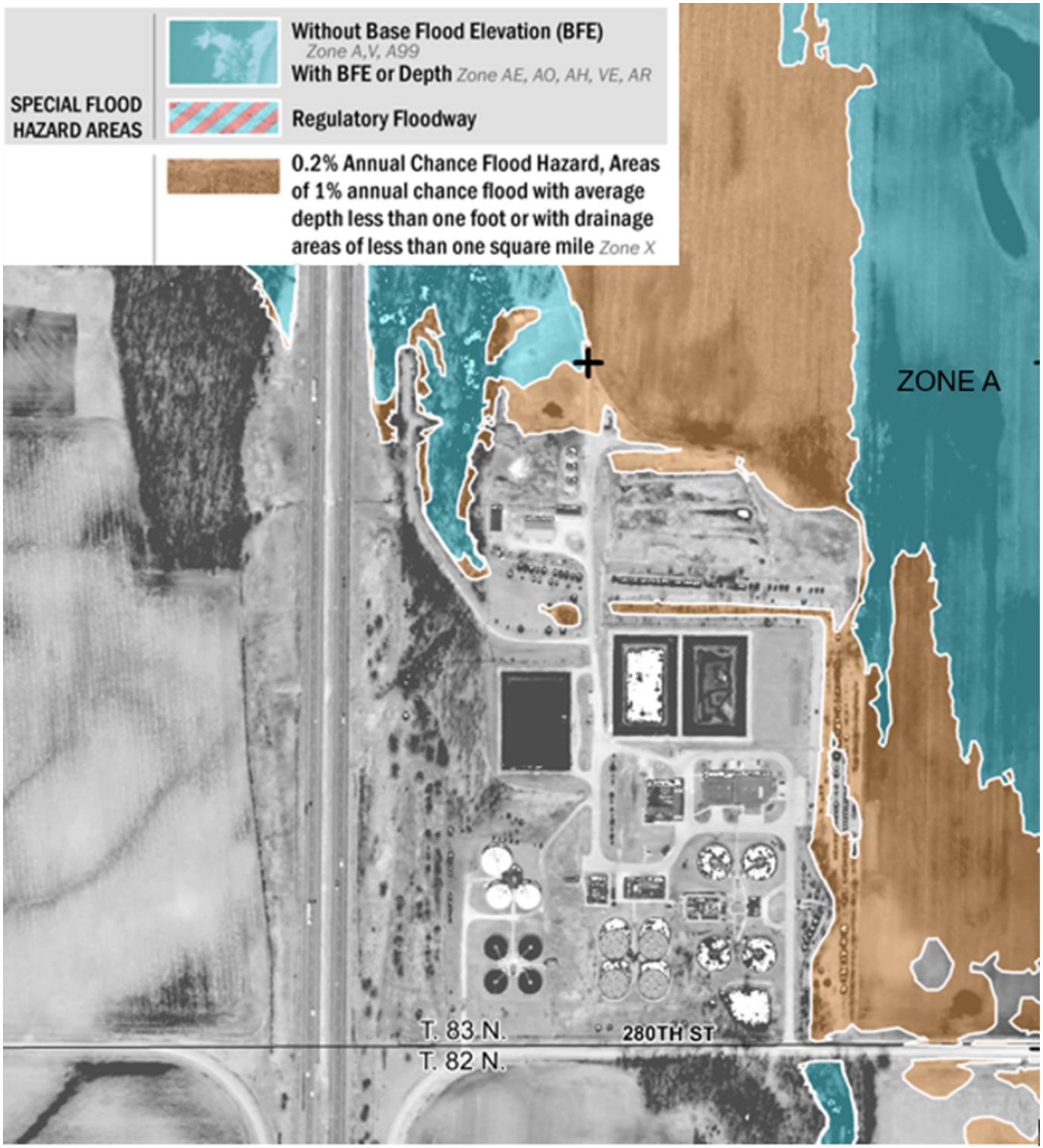


Figure 10.04-2 FEMA NFIP Map for Ames WPCF Site

The following is a summary of select portions of the Story County Floodplain Management Program:

- New or substantially improved structures shall be constructed with an electric meter, electrical service panel box, hot water heater, HVAC equipment (including ductwork), and other similar machinery and equipment elevated or floodproofed to a minimum of 3 feet above the base flood elevation.
- New or substantially improved structures shall be constructed with plumbing, gas lines, water and gas meters and other similar services utilities elevated or floodproofed to a minimum of 3 feet above the base flood elevation or be designed to be watertight and withstand inundation to such a level.
- Wastewater treatment facilities shall be provided with a level of flood protection equal to or greater than 3 feet above the 1 percent annual chance or greater flood elevation.

Flood Elevation determinations will be completed as part of the preliminary design phase to verify 100- and 500-year flood elevations in the vicinity of the site and to verify compliance with local and state requirements. The development site area selected may extend into the 0.2 percent annual chance flood hazard area.

SECTION 11
PROJECT PHASING AND IMPLEMENTATION PLAN

11.01 INTRODUCTION

The selected nutrient removal and headworks alternatives were presented in Section 10. As discussed in previous sections, these alternatives were evaluated based on fourth quarter 2022 dollars with a cost escalation assuming an implementation plan that includes three phases for the nutrient reduction alternatives. This evaluation approach allowed a comparison of the present worth of the alternatives on a common cost basis. The City intends to implement the proposed project in phases to replace the existing trickling filters as they reach the end of their service lives while reducing the immediate impact on user rates. In this section, phasing options for the implementation of the selected alternatives are evaluated and a preliminary implementation schedule and fiscal impact analysis are presented.

11.02 WPCF IMPROVEMENT PHASING EVALUATION

In this section, two project implementation phasing alternatives for the nutrient reduction and headworks improvements are evaluated based on monetary and nonmonetary considerations.

A. Phasing Alternative 1–Three-Phase Implementation With One Activated Sludge Train in First Phase

In this alternative, the nutrient removal improvements are implemented in three phases, with one of the four proposed activated sludge trains constructed in Phase 1, a second activated sludge train constructed in Phase 2, and the third and fourth trains constructed in Phase 3. The activated sludge system in the first phase will be configured for TN removal through either conventional BNR operation (as a modified Ludzack-Ettinger [MLE] process) or low DO SNDN activated sludge. It is anticipated that the new activated sludge system would be operated in parallel to the existing trickling filters and receive degritted raw wastewater, with ML from the activated sludge system combined with either first- or second-stage trickling filter effluent upstream of the final clarifiers. Because the activated sludge train in Phase 1 is anticipated to treat flow that did not receive primary treatment, the added capacity of the activated sludge system for Phase 1 would be less than 25 percent of the completed activated sludge system (at which time the activated sludge system will treat primary effluent) at the completion of Phase 3. The Phase 1 activated sludge system provides an additional maximum month treatment capacity of approximately 3,350 pounds of 5-day biochemical oxygen demand per day (BOD_5/day) for a total Phase 1 maximum month capacity (including the trickling filters) of approximately 19,500 pounds BOD_5/day. This maximum month influent loading is anticipated to be exceeded between 2035 and 2040 based on the 5-year increment projections presented in Section 4 (Table 4.06-2). The effluent from the parallel trickling filter and activated sludge systems would both be disinfected using the existing UV disinfection system and discharged together.

The first phase of this alternative also includes the selected headworks modifications and a new Administration Building and Maintenance Garage while the biosolids thickening and BPR improvements are postponed into Phase 3 when the existing trickling filters are demolished. The activated sludge system would also begin to receive primary effluent rather than de-gritted raw wastewater after the trickling filters are demolished.

The project components included in each phase are as follows:

1. Phase 1

   a. Construction of one 1.25-MG activated sludge basin with baffle wall, mixer, and nitrate recycle pump to create a swing anoxic/aerated zone and allow operation in conventional BNR or SNDN modes.

   b. Construction of a new ML Splitter Structure with control gates to combine influent/primary effluent with RAS and split flow between future activated sludge trains.

   c. Installation of aeration equipment for a new activated sludge system (including two blowers, piping, fine bubble diffusers, and associated controls).

   d. Demolition of the existing grit removal equipment and modification to the Raw Wastewater Pump Station to house new blowers and electrical equipment associated with the new activated sludge system.

   e. Expansion of the existing solids contact splitter box to receive ML from the new BNR activated sludge system.

   f. Construction of a RAS pumping station adjacent to the existing Sludge Pump Building to house the new RAS pumps.

   g. Installation of five new centrifugal RAS pumps and modifications to the existing RAS piping.

   h. Installation of a sludge densification hydrocyclone system and associated piping in a small structure adjacent to the new ML Splitter Structure.

   i. Installation of a new 3/8-inch multirake bar screen in the east channel of the Raw Wastewater Pump Station.

   j. Installation of a screenings wash press on the first floor of the Raw Wastewater Pump Station to receive screenings from the new multirake bar screen.

   k. Installation of manual bar rack in the west channel of the Raw Wastewater Pump Station.

   l. Replacement of slide gates within the Raw Wastewater Pump Station.

   m. Construction of the Grit Removal Building to house the new grit handling equipment.

n. Construction of two 22.5-MGD stacked-tray grit removal units in concrete tanks outside of the new Grit Removal Building.

o. Installation of two grit pumps and two grit washers in the new Grit Removal Building.

p. Demolition of the existing Administration Building and construction of a new Administration Building and Maintenance Garage on the northeast portion of the site.

q. Construction of a new Electrical Building to house the new service-entrance equipment.

r. Construct various site improvements (including driveways, sidewalks, landscaping, and stormwater BMPs) as required by Story County (sized for the complete buildout of all three phases).

2. Phase 2

a. Construction of one 1.25-MG activated sludge basin with baffle wall, mixer, and nitrate recycle pump to create a swing anoxic/aerated zone and allow operation in conventional BNR or SNDN modes.

b. Installation of aeration equipment for the new activated sludge system, including one blower, piping, fine bubble diffusers, and associated controls.

3. Phase 3

a. Demolition of the Trickling Filter Complex and second-stage trickling filter pumps.

b. Construction of two 1.25-MG activated sludge basins with baffle walls, mixers, and nitrate recycle pumps to create swing anoxic/aerated zones and allow operation in conventional BNR or SNDN modes.

c. Conversion of the existing solids contact basins to two 0.3-MG sidestream anaerobic zones for S2EBPR, including structural modifications and the installation of new mixers and process-monitoring equipment.

d. Installation of the aeration equipment for the new activated sludge system, including one blower for each aeration basin, piping, fine bubble diffusers, and associated controls.

e. Construction of an aerated WAS storage tank and associated diffusers and blowers.

f. Construction of a new WAS Storage/Thickening Building located near the anaerobic digester complex to house WAS thickening equipment and WAS storage blowers.

g. Installation of two sludge thickeners (for planning, assumed to be GBTs) and associated pumps and controls to thicken WAS before digestion.

h. Construct additional driveways, sidewalks, and other site improvements corresponding to the expanded activated sludge system and new WAS facilities.

B. Phasing Alternative 2–Two-Phase Implementation With Two Activated Sludge Trains in First Phase

In this alternative, the nutrient removal improvements are implemented in two phases with two of the four proposed activated sludge trains constructed in Phase 1, and the third and fourth trains constructed in Phase 2. The activated sludge system in the first phase will be configured for TN removal through either conventional BNR operation (as an MLE process) or low DO SNDN activated sludge. It is anticipated that the new activated sludge system would be operated in parallel to the existing trickling filters and receive grit tank effluent, with ML from the activated sludge system combined with either first- or second-stage trickling filter effluent upstream of the final clarifiers. Because the activated sludge system in Phase 1 is anticipated to treat flow that did not receive primary treatment, the added capacity of the activated sludge system for Phase 1 would be less than 50 percent of the completed activated sludge system (at which time the activated sludge system will treat primary effluent) at the end of Phase 2. The Phase 1 activated sludge system provides an additional maximum month treatment capacity of approximately 6,700 pounds BOD_5/day for a total Phase 1 maximum month capacity (including the trickling filters) of approximately 22,850 pounds BOD_5/day. This is greater than the projected 2045 design maximum month load (20,560 pounds BOD_5/day), providing flexibility to construct Phase 2 as necessary based on trickling filter condition. The effluent from the parallel trickling filter and activated sludge systems would both be disinfected, using the existing UV disinfection system, and discharged together.

The first phase of this alternative also includes the selected headworks modifications and a new Administration Building and Maintenance Garage while the biosolids thickening and BPR improvements are included in Phase 2 when the existing trickling filters are demolished.

The project components included in each phase are as follows:

1. Phase 1:

a. Construction of two 1.25-MG activated sludge basins with baffle walls, mixers, and nitrate recycle pumps to create swing anoxic/aerated zones and allow operation in conventional BNR or SNDN modes.

b. Construction of a new ML Splitter Structure with control gates to combine influent/primary effluent with RAS and split flow between the new activated sludge trains.

c. Installation of aeration equipment for the new activated sludge system, including three blowers, piping, fine bubble diffusers, and associated controls.

d. Demolition of the existing grit removal equipment and modification to Raw Wastewater Pump Station to house the new blowers and electrical equipment associated with the new activated sludge system.

e. Expansion of the existing solids contact splitter box to receive ML from the new BNR activated sludge system.

f. Construction of a RAS pumping station adjacent to the existing Sludge Pump Building to house the new RAS pumps.

g. Installation of five new centrifugal RAS pumps and modifications to the existing RAS piping.

h. Installation of a sludge densification hydrocyclone system and associated piping in a small structure adjacent to the new ML Splitter Structure.

i. Installation of a new 3/8-inch multirake bar screen in the east channel of the Raw Wastewater Pump Station.

j. Installation of a screenings wash press on the first floor of the Raw Wastewater Pump Station to receive screenings from the new multirake bar screen.

k. Installation of a manual bar rack in the west channel of the Raw Wastewater Pump Station.

l. Replacement of slide gates within the Raw Wastewater Pump Station.

m. Construction of a Grit Removal Building to house the new grit handling equipment.

n. Construction of two 22.5-MGD stacked-tray grit removal units in concrete tanks outside of the new Grit Removal Building.

o. Installation of two grit pumps and two grit washers in a new Grit Removal Building.

p. Demolition of the existing Administration Building and construction of a new Administration Building and Maintenance Garage on the northeast portion of the site.

q. Construction of new Electrical Building to house new service-entrance equipment.

r. Construct various site improvements, including driveways, sidewalks, landscaping, and stormwater BMPs as required by Story County (sized for the complete buildout of both phases).

2. Phase 2

   a. Demolition of the Trickling Filter Complex and second-stage trickling filter pumps.

   b. Construction of two 1.25-MG activated sludge basins with baffle walls, mixers, and nitrate recycle pumps to create swing anoxic/aerated zones and allow operation in conventional BNR or SNDN modes.

   c. Conversion of the existing solids contact basins to two 0.3-MG sidestream anaerobic zones for S2EBPR, including structural modifications and the installation of new mixers and process-monitoring equipment.

   d. Installation of aeration equipment for the new activated sludge system, including one blower, piping, fine bubble diffusers, and associated controls.

   e. Construction of an aerated WAS storage tank and associated diffusers and blowers.

   f. Construction of a new WAS Storage/Thickening Building located near the anaerobic digester complex to house the WAS thickening equipment and WAS storage blowers. Relocation of the sludge densification system.

   g. Installation of two sludge thickeners (GBTs assumed for planning) and associated pumps and controls to thicken WAS before digestion.

   h. Construct additional driveways, sidewalks, and other site improvements corresponding to the expanded activated sludge system and new WAS facilities.

C. <u>Monetary Comparison</u>

Table 11.02-1 summarizes the OPCC of each of the phasing alternatives presented earlier. While all of the OPCCs are based on the fourth quarter of 2022, the costs are adjusted to account for differing costs associated with implementing the project in two or three phases, including contractor mobilization, project management and supervision, engineering, and other costs that are incurred when projects are split into several smaller projects. For the purposes of this Plan, a phasing cost escalator of 10 percent (compared to the OPCC for a single project) was used for the three-phase project while an escalator 5 percent was used for the two-phase project. Therefore, while Alternative 1 has lower capital costs associated with the first phase than Alternative 2, the overall project cost for Alternative 1 is higher. Furthermore, Alternative 2 includes the construction of more treatment capacity in the first phase, providing additional redundancy for the aging trickling filters.

		Phasing Alternative 1 Three-Phase Implementation with One Activated Sludge Train in First Phase	**Phasing Alternative 2** Two-Phase Implementation with Two Activated Sludge Trains in First Phase
Phase 1	Nutrient Reduction	$18,300,000	$27,390,000
	Screening	$4,800,000	$4,800,000
	Grit Removal	$8,070,000	$8,070,000
	Switchgear Replacement	$2,830,000	$2,830,000
	Administration Building	$6,350,000	$6,350,000
	Stormwater Management	$340,000	$340,000
	Total	**$40,690,000**	**$49,780,000**
Phase 2	Nutrient Reduction	$10,340,000	$30,230,000
	Total	**$10,340,000**	**$30,230,000**
Phase 3	Nutrient Reduction	$32,840,000	
	Total	**$32,840,000**	

Note: All costs are in fourth quarter 2022 dollars.

Table 11.02-1 Project Phasing Alternative Evaluation Summary

11.03 SELECTED IMPLEMENTATION PLAN

Based on the evaluation for the phasing alternatives presented in this section, the City has selected to proceed with Phasing Alternative 2. This alternative includes more treatment capacity in the first phase compared to Phasing Alternative 1, providing important additional redundancy for the aging trickling filters. Constructing the proposed project in two phases also reduces overall project costs as well as the overall project duration, which results in less disruption to WPCF operations during construction. Design criteria for the proposed project in presented in Appendix E.

The preliminary project implementation schedule for the first phase of the selected WPCF modifications is presented in Table 11.03-1.

Milestone	Date
Facility Plan Submittal to IDNR	March 2023
Submit Plans and Specifications to IDNR	November 2023
IDNR Plans and Specifications Approval	February 2024
Advertise for Bids	February 2024
Construction Bid Date	March 2024
Construction Start Date	May 2024
Construction Substantial Completion	February 2027
Construction Final Completion	May 2027

Table 11.03-1 Phase 1 Preliminary Implementation Schedule

11.02 FISCAL IMPACT ANALYSIS

As presented in Table 11.02-1, the opinion of probable capital cost for the first phase of the selected WPCF modifications is approximately $49.78 million (fourth quarter of 2022 costs basis). Projecting this amount to an anticipated first quarter of 2024 bid date and applying a construction inflation rate of 3.5 percent annually, the anticipated opinion of probable project cost is $51.97 million.

The project is anticipated to be funded through the Iowa State Revolving Fund (SRF) loan program. The SRF program provides 0 percent interest financing for planning and design services for up to 3 years, and these costs are typically rolled into a SRF construction loan. Construction loans are offered at 1.75 percent interest, typically for 20-year terms. In addition to the 1.75 percent interest rate, an administrative fee of 0.25 percent is added each year to the outstanding principal balance for administering the loan. Also, an additional 0.5 percent of the loan amount (up to $100,000) is included as a loan initiation fee.

Assuming a loan amount of $51.61 million, plus the initiation fee of $100,000, the annual debt service payment (principal and interest) is expected to be approximately $3,184,000.

Table 11.01-1 presents a preliminary wastewater utility budget impact reflecting the projected changes to the budget as a result of the proposed project. Additional energy use and maintenance is anticipated as a result of the implementation of the new equipment and processes.

Additional Annual O&M	$89,000
Debt Service Payment	$3,184,000
Total	**$3,273,000**

Table 11.04-1 Anticipated Annual Budget Impact

APPENDIX A
NPDES PERMIT

IOWA DEPARTMENT OF NATURAL RESOURCES

National Pollutant Discharge Elimination System (NPDES) Permit

OWNER NAME & ADDRESS

CITY OF AMES
1800 E 13TH STREET
AMES, IA 50010

FACILITY NAME & ADDRESS

AMES WATER POLLUTION
CONTROL FACILITY
76797 280TH STREET
AMES, IA 50010

Section 31, T83N, R23W
Story County

IOWA NPDES PERMIT NUMBER: 8503001
DATE OF ISSUANCE: 03/01/2022
DATE OF EXPIRATION: 02/28/2027

YOU ARE REQUIRED TO FILE FOR RENEWAL OF THIS PERMIT BY: 09/01/2026
EPA NUMBER: IA0035955

This permit is issued pursuant to the authority of section 402(b) of the Clean Water Act (33 U.S.C. 1342(b)), Iowa Code section 455B.174, and rule 567-64.3, Iowa Administrative Code. You are authorized to operate the disposal system and to discharge the pollutants specified in this permit in accordance with the effluent limitations, monitoring requirements and other terms set forth in this permit.

Pursuant to rule 561-7.4, Iowa Administrative Code, you may appeal any condition of this permit by filing a written notice of appeal and request for administrative hearing with the director of the department within 60 days of permit issuance.

Any existing, unexpired Iowa operation permit or Iowa NPDES permit previously issued by the department for the facility identified above is revoked by the issuance of this permit. This provision does not apply to any authorization to discharge under the terms and conditions of a general permit issued by the department or to any permit issued exclusively for the discharge of stormwater.

FOR THE DEPARTMENT OF NATURAL RESOURCES

By Ben Hucka Digitally signed by Ben Hucka Date: 2022.02.10 09:07:14 -06'00'

Ben Hucka
NPDES Section, Environmental Services Division

Outfall No.: 001 DISCHARGE FROM TRICKLING FILTER/SOLIDS CONTACT WASTEWATER TREATMENT FACILITY.

Receiving Stream: SOUTH SKUNK RIVER

Route of Flow: SOUTH SKUNK RIVER

Class A1 waters are primary contact recreational use waters in which recreational or other uses may result in prolonged and direct contact with the water, involving considerable risks of ingesting water in quantities sufficient to pose a health hazard. Such activities would include, but not be limited to, swimming, diving, water skiing, and water contact recreational canoeing.

Waters designated Class B(WW2) are those in which flow or other physical characteristics are capable of supporting a resident aquatic community that includes a variety of native nongame fish and invertebrate species. The flow and other physical characteristics limit the maintenance of warm water game fish populations. These waters generally consist of small perennially flowing streams.

Outfall No.: 003 BYPASS AT THE INVERTED SIPHON LOCATED ON IOWAY CREEK EAST OF DUFF AVENUE.

Receiving Stream: IOWAY CREEK

Route of Flow: IOWAY CREEK

Class A1 waters are primary contact recreational use waters in which recreational or other uses may result in prolonged and direct contact with the water, involving considerable risks of ingesting water in quantities sufficient to pose a health hazard. Such activities would include, but not be limited to, swimming, diving, water skiing, and water contact recreational canoeing.

Waters designated Class B(WW2) are those in which flow or other physical characteristics are capable of supporting a resident aquatic community that includes a variety of native nongame fish and invertebrate species. The flow and other physical characteristics limit the maintenance of warm water game fish populations. These waters generally consist of small perennially flowing streams.

Outfall No.: 004 BYPASS AT THE ORCHARD DRIVE LIFT STATION.

Receiving Stream: IOWAY CREEK

Route of Flow: IOWAY CREEK

Class A1 waters are primary contact recreational use waters in which recreational or other uses may result in prolonged and direct contact with the water, involving considerable risks of ingesting water in quantities sufficient to pose a health hazard. Such activities would include, but not be limited to, swimming, diving, water skiing, and water contact recreational canoeing.

Waters designated Class B(WW2) are those in which flow or other physical characteristics are capable of supporting a resident aquatic community that includes a variety of native nongame fish and invertebrate species. The flow and other physical characteristics limit the maintenance of warm water game fish populations. These waters generally consist of small perennially flowing streams.

Facility Name: AMES WATER POLLUTION CONTROL FACILITY

Permit Number: 8503001

Outfall No.: 005 BYPASS AT EQUALIZATION BASIN.

Receiving Stream: SOUTH SKUNK RIVER

Route of Flow: SOUTH SKUNK RIVER

Class A1 waters are primary contact recreational use waters in which recreational or other uses may result in prolonged and direct contact with the water, involving considerable risks of ingesting water in quantities sufficient to pose a health hazard. Such activities would include, but not be limited to, swimming, diving, water skiing, and water contact recreational canoeing.

Waters designated Class B(WW2) are those in which flow or other physical characteristics are capable of supporting a resident aquatic community that includes a variety of native nongame fish and invertebrate species. The flow and other physical characteristics limit the maintenance of warm water game fish populations. These waters generally consist of small perennially flowing streams.

Bypasses from any portion of a treatment facility or from a sanitary sewer collection system designed to carry only sewage are prohibited.

Effluent Limitations:

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

001 DISCHARGE FROM TRICKLING FILTER/SOLIDS CONTACT WASTEWATER TREATMENT FACILITY.

Outfall: 001 Effective Dates: 03/01/2022 to 02/28/2027			
Parameter	**Season**	**Limit Type**	**Limits**
CBOD5			**85% Removal Required**
	JAN	7 Day Average	30 MG/L 3027 LBS/DAY
	JAN	30 Day Average	20 MG/L 2018 LBS/DAY
	FEB	7 Day Average	30 MG/L 3027 LBS/DAY
	FEB	30 Day Average	20 MG/L 2018 LBS/DAY
	MAR	7 Day Average	30 MG/L 3027 LBS/DAY
	MAR	30 Day Average	20 MG/L 2018 LBS/DAY
	APR	7 Day Average	30 MG/L 3027 LBS/DAY
	APR	30 Day Average	20 MG/L 2018 LBS/DAY
	MAY	7 Day Average	30 MG/L 3027 LBS/DAY
	MAY	30 Day Average	20 MG/L 2018 LBS/DAY
	JUN	30 Day Average	20 MG/L 2018 LBS/DAY
	JUN	Daily Maximum	30 MG/L 3027 LBS/DAY
	JUL	30 Day Average	20 MG/L 2018 LBS/DAY
	JUL	Daily Maximum	30 MG/L 3027 LBS/DAY
	AUG	30 Day Average	20 MG/L 2018 LBS/DAY
	AUG	Daily Maximum	30 MG/L 3027 LBS/DAY
	SEP	30 Day Average	20 MG/L 2018 LBS/DAY
	SEP	Daily Maximum	30 MG/L 3027 LBS/DAY
	OCT	7 Day Average	30 MG/L 3027 LBS/DAY
	OCT	30 Day Average	20 MG/L 2018 LBS/DAY
	NOV	7 Day Average	30 MG/L 3027 LBS/DAY
	NOV	30 Day Average	20 MG/L 2018 LBS/DAY
	DEC	7 Day Average	30 MG/L 3027 LBS/DAY
	DEC	30 Day Average	20 MG/L 2018 LBS/DAY

Outfall: 001 Effective Dates: 03/01/2022 to 02/28/2027			
Parameter	**Season**	**Limit Type**	**Limits**
TOTAL SUSPENDED SOLIDS			**85% Removal Required**
	Yearly	7 Day Average	45 MG/L 4541 LBS/DAY
	Yearly	30 Day Average	30 MG/L 3027 LBS/DAY
AMMONIA NITROGEN (N)			
	JAN	30 Day Average	3.4 MG/L 343.6 LBS/DAY
	JAN	Daily Maximum	15.2 MG/L 1532.7 LBS/DAY
	FEB	30 Day Average	4.0 MG/L 398.8 LBS/DAY
	FEB	Daily Maximum	14.2 MG/L 1432.7 LBS/DAY
	MAR	30 Day Average	3.4 MG/L 343.6 LBS/DAY
	MAR	Daily Maximum	14.7 MG/L 1482 LBS/DAY
	APR	30 Day Average	1.5 MG/L 153.8 LBS/DAY
	APR	Daily Maximum	15.7 MG/L 1584 LBS/DAY
	MAY	30 Day Average	1.7 MG/L 175.4 LBS/DAY
	MAY	Daily Maximum	15.2 MG/L 1532.7 LBS/DAY
	JUN	30 Day Average	1.3 MG/L 131 LBS/DAY
	JUN	Daily Maximum	11.5 MG/L 1161 LBS/DAY
	JUL	30 Day Average	1.0 MG/L 101.4 LBS/DAY
	JUL	Daily Maximum	8.5 MG/L 858 LBS/DAY
	AUG	30 Day Average	1.0 MG/L 96.3 LBS/DAY
	AUG	Daily Maximum	10.0 MG/L 1009 LBS/DAY
	SEP	30 Day Average	1.1 MG/L 106.6 LBS/DAY
	SEP	Daily Maximum	14.0 MG/L 1382.5 LBS/DAY
	OCT	30 Day Average	1.6 MG/L 157.0 LBS/DAY
	OCT	Daily Maximum	15.7 MG/L 1584 LBS/DAY
	NOV	30 Day Average	2.3 MG/L 234.1 LBS/DAY
	NOV	Daily Maximum	14.7 MG/L 1482 LBS/DAY
	DEC	30 Day Average	2.5 MG/L 249.7 LBS/DAY
	DEC	Daily Maximum	16.0 MG/L 1610.8 LBS/DAY

Outfall: 001 Effective Dates: 03/01/2022 to 02/28/2027			
Parameter	**Season**	**Limit Type**	**Limits**
ACUTE TOXICITY, CERIODAPHNIA			
	Yearly	Daily Maximum	1 NO TOXICITY
ACUTE TOXICITY, PIMEPHALES			
	Yearly	Daily Maximum	1 NO TOXICITY
DISSOLVED OXYGEN			
	Yearly	Daily Minimum	5.0 MG/L
PH			
	Yearly	Daily Maximum	9.0 STD UNITS
	Yearly	Daily Minimum	6.5 STD UNITS
E. COLI			
	MAR	Geometric Mean	126 #/100 ML
	APR	Geometric Mean	126 #/100 ML
	MAY	Geometric Mean	126 #/100 ML
	JUN	Geometric Mean	126 #/100 ML
	JUL	Geometric Mean	126 #/100 ML
	AUG	Geometric Mean	126 #/100 ML
	SEP	Geometric Mean	126 #/100 ML
	OCT	Geometric Mean	126 #/100 ML
	NOV	Geometric Mean	126 #/100 ML

Outfall: 001 Effective Dates: 02/01/2027 to 02/28/2027			
Parameter	**Season**	**Limit Type**	**Limits**
CYANIDE, TOTAL (AS CN)			
	Yearly	30 Day Average	0.0052 MG/L 0.5248 LBS/DAY
	Yearly	Daily Maximum	0.0220 MG/L 2.220 LBS/DAY
COPPER, TOTAL (AS CU)			
	Yearly	30 Day Average	0.01687 MG/L 1.702 LBS/DAY
	Yearly	Daily Maximum	0.02690 MG/L 2.714 LBS/DAY

Monitoring and Reporting Requirements

(a) Samples and measurements taken shall be representative of the volume and nature of the monitored wastewater.

(b) Analytical and sampling methods specified in 40 CFR Part 136 or other methods approved in writing by the department shall be utilized. All effluent samples for which a limit applies must be analyzed using sufficiently sensitive methods (i.e. testing procedures) approved under 567 IAC Chapter 63 and 40 CFR Part 136 for the analysis of pollutants or pollutant parameters or as required under 40 CFR chapter I, subchapter N or O.

For the purposes of this paragraph, an approved method is sufficiently sensitive when:
(1) the method minimum level (ML) is at or below the level of the effluent limit established in the permit for the measured pollutant or pollutant parameter; or
(2) the method has the lowest ML of the approved analytical methods for the measured pollutant or pollutant parameter.

Samples collected for operational testing need not be analyzed by approved analytical methods; however, commonly accepted test methods should be used.

(c) You are required to report all data including calculated results needed to determine compliance with the limitations contained in this permit. The results of any monitoring not specified in this permit performed at the compliance monitoring point and analyzed according to 40 CFR Part 136 shall be included in the calculation and reporting of any data submitted in accordance with this permit. This includes daily maximums and minimums, 30-day averages and 7-day averages for all parameters that have concentration (mg/l) and mass (lbs/day) limits. In addition, flow data shall be reported in million gallons per day (MGD).

(d) Records of monitoring activities and results shall include for all samples: the date, exact place and time of the sampling; the dates the analyses were performed; who performed the analyses; the analytical techniques or methods used; and the results of such analyses.

(e) Results of all monitoring shall be recorded on forms provided by, or approved by, the department, and shall be submitted to the appropriate regional field office of the department by the fifteenth day following the close of the reporting period. Your reporting period is on a MONTHLY basis, ending on the last day of each reporting period.

(f) Operational performance monitoring for treatment unit process control shall be conducted to ensure that the facility is properly operated in accordance with its design. The results of any operational performance monitoring need not be reported to the department, but shall be maintained in accordance with rule 567 IAC 63.2 (455B). The results of any operational performance monitoring specified in this permit shall be submitted to the department in accordance with these reporting requirements.

(g) Chapter 63 of the rules provides you with further explanation of your monitoring requirements.

Outfall	Wastewater Parameter	Sample Frequency	Sample Type	Monitoring Location
The following monitoring requirements shall be in effect from 03/01/2022 to 02/28/2027				
001	BIOCHEMICAL OXYGEN DEMAND (BOD5)	5 TIMES PER WEEK	24 HOUR COMPOSITE	RAW INFLUENT PRIOR TO DIVERSION TO THE EQUALIZATION BASIN
001	FLOW	7/WEEK OR DAILY	24 HOUR TOTAL	RAW INFLUENT PRIOR TO DIVERSION TO THE EQUALIZATION BASIN
001	NITROGEN, TOTAL (AS N)	1 TIME PER WEEK	24 HOUR COMPOSITE	RAW INFLUENT PRIOR TO DIVERSION TO THE EQUALIZATION BASIN
001	NITROGEN, TOTAL KJELDAHL (AS N)	1 EVERY MONTH	24 HOUR COMPOSITE	RAW INFLUENT PRIOR TO DIVERSION TO THE EQUALIZATION BASIN
001	PH	5 TIMES PER WEEK	GRAB	RAW INFLUENT PRIOR TO DIVERSION TO THE EQUALIZATION BASIN
001	PHOSPHORUS, TOTAL (AS P)	1 TIME PER WEEK	24 HOUR COMPOSITE	RAW INFLUENT PRIOR TO DIVERSION TO THE EQUALIZATION BASIN
001	TEMPERATURE	5 TIMES PER WEEK	GRAB	RAW INFLUENT PRIOR TO DIVERSION TO THE EQUALIZATION BASIN
001	TOTAL SUSPENDED SOLIDS	5 TIMES PER WEEK	24 HOUR COMPOSITE	RAW INFLUENT PRIOR TO DIVERSION TO THE EQUALIZATION BASIN
001	FLOW	7/WEEK OR DAILY	CALCULATED	FINAL EFFLUENT
001	DISSOLVED OXYGEN	5 TIMES PER WEEK	GRAB	MANHOLE DOWNSTREAM OF CASCADE AERATOR
001	PH	5 TIMES PER WEEK	GRAB	MANHOLE DOWNSTREAM OF CASCADE AERATOR
001	TEMPERATURE	5 TIMES PER WEEK	GRAB	MANHOLE DOWNSTREAM OF CASCADE AERATOR

Outfall	Wastewater Parameter	Sample Frequency	Sample Type	Monitoring Location
The following monitoring requirements shall be in effect from 03/01/2022 to 02/28/2027				
001	ACUTE TOXICITY, CERIODAPHNIA	1 EVERY 12 MONTHS	24 HOUR COMPOSITE	CONTROL BOX DOWNSTREAM FROM FINAL CLARIFIERS (PRIOR TO DISINFECTION)
001	ACUTE TOXICITY, PIMEPHALES	1 EVERY 12 MONTHS	24 HOUR COMPOSITE	CONTROL BOX DOWNSTREAM FROM FINAL CLARIFIERS (PRIOR TO DISINFECTION)
001	AMMONIA NITROGEN (N)	5 TIMES PER WEEK	24 HOUR COMPOSITE	CONTROL BOX DOWNSTREAM FROM FINAL CLARIFIERS (PRIOR TO DISINFECTION)
001	CBOD5	5 TIMES PER WEEK	24 HOUR COMPOSITE	CONTROL BOX DOWNSTREAM FROM FINAL CLARIFIERS (PRIOR TO DISINFECTION)
001	COPPER, TOTAL (AS CU)	1 EVERY MONTH	24 HOUR COMPOSITE	CONTROL BOX DOWNSTREAM FROM FINAL CLARIFIERS (PRIOR TO DISINFECTION)
001	NITROGEN, TOTAL (AS N)	1 TIME PER WEEK	24 HOUR COMPOSITE	CONTROL BOX DOWNSTREAM FROM FINAL CLARIFIERS (PRIOR TO DISINFECTION)
001	PHOSPHORUS, TOTAL (AS P)	1 TIME PER WEEK	24 HOUR COMPOSITE	CONTROL BOX DOWNSTREAM FROM FINAL CLARIFIERS (PRIOR TO DISINFECTION)
001	TOTAL SUSPENDED SOLIDS	5 TIMES PER WEEK	24 HOUR COMPOSITE	CONTROL BOX DOWNSTREAM FROM FINAL CLARIFIERS (PRIOR TO DISINFECTION)
001	CYANIDE, TOTAL (AS CN)	1 EVERY MONTH	GRAB	EFFLUENT AFTER DISINFECTION
001	E. COLI	GEO. MEAN 1/3 MONTHS	GRAB	EFFLUENT AFTER DISINFECTION

Special Monitoring Requirements

Outfall # **Description**

001 **E. COLI**

The limit for E. coli specified in the limit pages of this permit is a geometric mean. The disinfection season is established in the Iowa Administrative Code, Subparagraph 567 IAC 61.3(3)"a"(1), and is in effect from March 15 to November 15. Any disinfection system (chlorine, UV light, etc.) shall be operated to comply with the limit during the entire disinfection season.

The facility must collect and analyze a minimum of five samples in one calendar month during each 3-month period from March 15 to November 15. The 3-month periods are March – May, June – August, and September – November. The collection of five samples in each 3-month period will result in a minimum of 15 samples being collected during a calendar year. For example, for the first 3-month period, the operator may choose April as the calendar month to collect the 5 individual E. coli samples to determine compliance with the limits. The operator may also choose the months of March or May as well, as long as each of the 5 samples is collected during a single calendar month. The same principle applies to the other two 3-month periods during the disinfection season. The following requirements apply to the individual samples collected in one calendar month:

Samples must be spaced over one calendar month.
No more than one sample can be collected on any one day.
There must be a minimum of two days between each sample.
No more than two samples may be collected in a period of seven consecutive days.

If the effluent has been disinfected using chlorine, ultraviolet light (UV), or any other process intended to disrupt the biological integrity of the E. coli, the samples shall be analyzed using the Most Probable Number method found in Standard Method 9223B (Colilert® or Colilert-18® made by IDEXX Laboratories, Inc.). If the effluent has not been disinfected the samples may be analyzed using either the MPN method above or EPA Method 1603: Escherichia coli (E. coli) in water by membrane filtration using modified membrane-thermotolerant E. coli agar (modified mTEC) or mColiBlue-24® made by the Hach Company.

The geometric mean must be calculated using all valid sample results collected during a month. The geometric mean formula is as follows: Geometric Mean = (Sample one * Sample two * Sample three * Sample four *Sample five…Sample N)^(1/N), which is the Nth root of the result of the multiplication of all of the sample results where N = the number of samples. If a sample result is a less than value, the value reported by the lab without the less than sign should be used in the geometric mean calculation.

The geometric mean can be calculated in one of the following ways:

Use a scientific calculator that can calculate the powers of numbers.
Enter the samples in Microsoft Excel and use the function "GEOMEAN" to perform the calculation.
Use the geometric mean calculator on the Iowa DNR webpage at:
https://www.iowadnr.gov/Environmental-Protection/Water-Quality/NPDES-Wastewater-Permitting/NPDES-Operator-Information/Bacteria-Sampling

NITROGEN, TOTAL (AS N)

Total nitrogen shall be determined by testing for Total Kjeldahl Nitrogen (TKN) and nitrate + nitrite nitrogen and reporting the sum of the TKN and nitrate + nitrite results (reported as N). Nitrate + nitrite can be analyzed together or separately.

Special Monitoring Requirements continued

Outfall #	Description
001	**FLOW – FINAL EFFLUENT**
	Final effluent flow is a calculation using raw waste and equalization (EQ) basin flow meters and shall be calculated using the following equation: Raw waste flow - flow to EQ basin + EQ basin return flow = final effluent flow

Outfall Number: 001

Ceriodaphnia and Pimephales Toxicity Effluent Testing

1. For facilities that have not been required to conduct toxicity testing by a previous NPDES permit, the initial annual toxicity test shall be conducted within three (3) months of permit issuance. For facilities that have been required to conduct toxicity testing by a previous NPDES permit, the initial annual toxicity test shall be conducted within twelve months (12) of the last toxicity test.

2. The test organisms that are to be used for acute toxicity testing shall be Ceriodaphnia dubia and Pimephales promelas. The acute toxicity testing procedures used to demonstrate compliance with permit limits shall be those listed in 40 CFR Part 136 and adopted by reference in rule 567 IAC 63.1(1). The method for measuring acute toxicity is specified in USEPA, October 2002, Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition. USEPA, Office of Water, Washington, D.C., EPA 821-R-02-012.

3. The diluted effluent sample must contain a minimum of 100.00 % effluent and no more than 0.00 % of culture water.

4. One valid positive toxicity result will require, at a minimum, quarterly testing for effluent toxicity until three successive tests are determined not to be positive.

5. Two successive valid positive toxicity results or three positive results out of five successive valid effluent toxicity tests will require a toxicity reduction evaluation to be completed to eliminate the toxicity.

6. A non-toxic test result shall be indicated as a "1" on the monthly operation report. A toxic test result shall be indicated as a "2" on the monthly operation report. DNR Form 542-1381 shall also be submitted to the DNR field office along with the monthly operation report.

Ceriodaphnia and Pimephales Toxicity Effluent Limits

The maximum limit of "1" for the parameters Acute Toxicity, Ceriodaphnia and Acute Toxicity, Pimephales means no positive toxicity results.

Definition: "Positive toxicity result" means a statistical difference of mortality rate between the control and the diluted effluent sample. For more information, see USEPA, October 2002, Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition, USEPA, Office of Water, Washington, D.C., EPA 821-R-02-012.

Design Capacity

Design: 1

The design capacity for the treatment works is specified in Construction Permit Number 87-242-S, issued Tuesday,22 Sep 1987. The treatment plant is designed to treat:

* An average dry weather (ADW) flow of 8.6000 Million Gallons Per Day (MGD).
* An average wet weather (AWW) flow of 12.1000 Million Gallons Per Day (MGD).
* A maximum wet weather (MWW) flow of 20.4000 Million Gallons Per Day (MGD).
* A design 5-day biochemical oxygen demand (BOD5) load of 16150.0000 lbs/day.
* A design Total Kjeldahl Nitrogen (TKN) load of 4950.0000 lbs/day.

Operator Certification Type/Grade: WW/IV

Wastes in such volumes or quantities as to exceed the design capacity of the treatment works or reduce the effluent quality below that specified in the operation permit of the treatment works are considered to be a waste which interferes with the operation or performance of the treatment works and are prohibited by subrule IAC 567-62.1(7).

SEWAGE SLUDGE HANDLING AND DISPOSAL REQUIREMENTS

"Sewage sludge" is solid, semisolid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Sewage sludge does not include the grit and screenings generated during preliminary treatment.

1. The permittee shall comply with all existing Federal and State laws and regulations that apply to the use and disposal of sewage sludge and with technical standards developed pursuant to Section 405(d) of the Clean Water Act when such standards are promulgated. If an applicable numerical limit or management practice for pollutants in sewage sludge is promulgated after issuance of this permit that is more stringent than a sludge pollutant limit or management practice specified in existing Federal or State laws or regulations, this permit shall be modified, or revoked and reissued, to conform to the regulations promulgated under Section 405(d) of the Clean Water Act. The permittee shall comply with the limitation no later than the compliance deadline specified in the applicable regulations.

2. The permittee shall provide written notice to the Department of Natural Resources prior to any planned changes in sludge disposal practices.

3. Land application of sewage sludge shall be conducted in accordance with criteria established in rule IAC 567 67.1 through 67.11 (455B).

SIGNIFICANT INDUSTRIAL USER LIMITATIONS, MONITORING AND REPORTING REQUIREMENTS

1. You shall require all users of your facility to comply with Sections 204(b), 307, and 308 of the Clean Water Act.

   Section 204(b) requires that all users of the treatment works constructed with funds provided under Sections 201(g) or 601 of the Act to pay their proportionate share of the costs of operation, maintenance and replacement of the treatment works.

   Section 307 of the Act requires users to comply with pretreatment standards promulgated by EPA for pollutants that would cause interference with the treatment process or would pass through the treatment works.

   Section 308 of the Act requires users to allow access at reasonable times to state and EPA inspectors for the purpose of sampling the discharge, reviewing, and copying records.

2. You shall continue to implement the pretreatment program approved **October 11, 1983** and any amendments thereto.

3. An annual report in the form prescribed by the Department is to be submitted by March 1st of each year describing the pretreatment program activities for the preceding calendar year.

4. The City shall evaluate the adequacy of its local limits to meet the general prohibitions against interference and pass through listed in 40 CFR 403.5(a) and the specific prohibitions listed in 40 CFR 403.5(b). At a minimum this evaluation shall consist of the following:

   (a) Identify each pollutant with the potential to cause process inhibition, pass through the treatment plant in concentrations that will violate NPDES permit limits of water quality standards, endanger POTW worker health and safety or degrade sludge quality.

   (b) For each treatment plant, determine the maximum allowable headworks loading for each pollutant identified in item #4(a). that will prevent interference or a pass through.

   (c) After accounting for the contribution of each pollutant from uncontrolled (i.e.: domestic/commercial) sources to each treatment plant, determine the maximum allowable industrial loading for each pollutant identified in item #4(a).

   (d) Complete the evaluation and submit to the Department, by **March 1, 2023** a report containing the following information:
      1) A list of pollutants identified in item #4(a). For each pollutant, state the reason(s) for its inclusion (e.g. potential to cause interference, potential to cause pass through, etc.).
      2) The report shall contain all calculations used to determine the maximum allowable headworks loadings and shall identify the source(s) of all data used (e.g. literature value, site specific measurement, etc.).
      3) The contribution of each pollutant identified in item #4(d)1 to each treatment plant from uncontrolled sources and an explanation of how each contribution was determined.
      4) The allocation of the maximum allowable headworks loading for each pollutant to each treatment plant, and an explanation of how the allowable loadings will be allocated to significant industrial users regulated by the City's pretreatment program.

Compliance Schedule – Copper and Cyanide

1. The facility shall meet the final copper and cyanide limits listed on the limits page of this permit according to the following schedule:

   - The facility shall submit a compliance strategy, by **September 1, 2022**. The compliance strategy must describe the steps the facility will take to comply with the copper and cyanide effluent limits as soon as possible, but no later than **February 1, 2027.**

   - The facility shall submit progress reports every 12 months until compliance with final effluent limits is achieved, with the first progress report due **September 1, 2023**.

   - Achieve compliance with final effluent limits by **February 1, 2027**.

Within fourteen (14) days following all dates of compliance, the permittee shall provide written notice of compliance with the scheduled event. All written notices and progress reports shall be sent to the following address:

Iowa Department of Natural Resources
DNR Field Office 5
502 E. 9th Street
Des Moines, Iowa 50319

Nutrient Reduction Requirements

In support of the Iowa Nutrient Reduction Strategy you shall prepare and submit an update to the city's approved feasibility study (approved December 20, 2019) that evaluated the feasibility and reasonableness of reducing the amounts of nitrogen and phosphorus discharged into surface water. The report shall be submitted no later than **January 1, 2025** and shall address the following:

- Progress towards completion of the projects identified in the city's approved feasibility study.
- A description of any changes from the city's approved feasibility study.
- An update on non-point nutrient reduction efforts as the city has committed $200,000/year for non-point water quality improvements and executed a Memorandum of Understanding (MOU) with the department to register those practices for future nutrient removal credits, if/when a nutrient trading program is established.
- The report must include an updated schedule for making operational changes and/or installing new or additional treatment technologies to achieve the concentration and/or percentage removal goals listed above. Additional financial justification must be included in the report if no operational changes or treatment technologies are feasible or reasonable.

The schedule will be incorporated into the NPDES permit by amendment. Effluent discharge limits will be based on one full year of operating data after implementation of the operational changes or completion of plant modifications and a six-month optimization period.

The report shall be sent to the following address:

Npdes.mail@dnr.iowa.gov
Subject: NRS Feasibility Report (facility# 8503001)

STANDARD CONDITIONS

1. ADMINISTRATIVE RULES

Rules of this Department that govern the operation of your facility in connection with this permit are published in Part 567 of the Iowa Administrative Code (IAC) in Chapters 60-65, 67, and 121. Reference to the term "rule" in this permit means the designated provision of Part 567 of the IAC. Reference to the term "CFR" means the Code of Federal Regulations.

2. DEFINITIONS

(a) 7 day average means the sum of the total daily discharges by mass, volume, or concentration during a 7 consecutive day period, divided by the total number of days during the period that measurements were made. Four 7 consecutive day periods shall be used each month to calculate the 7-day average. The first 7-day period shall begin with the first day of the month.

(b) 30 day average means the sum of the total daily discharges by mass, volume, or concentration during a calendar month, divided by the total number of days during the month that measurements were made.

(c) Daily maximum means the total discharge by mass, volume, or concentration during a twenty-four hour period.

3. DUTY TO PROVIDE INFORMATION

You must furnish to the Director, within a reasonable time, any information the Director may request to determine compliance with this permit or determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, in accordance with 567 IAC 64.3(11)"*c*". You must also furnish to the Director, upon request, copies of any records required to be kept by this permit.

4. MONITORING AND RECORDS OF OPERATION

(a) Maintenance of records. You shall retain for a minimum of three years all paper and electronic records of monitoring activities and results including all original strip chart recordings for continuous monitoring instrumentation and calibration and maintenance records. ***{See 567 IAC 63.2(3)}***

(b) Any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 or by imprisonment for not more than two years, or both. ***{See 40 CFR 122.41(j)(5)}***

5. SIGNATORY REQUIREMENTS

Applications, reports or other information submitted to the Department in connection with this permit must be signed and certified in accordance with 567 IAC 64.3(8).

6. OTHER INFORMATION

Where you become aware that you failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application, you must promptly submit such facts or information. Where you become aware that you failed to submit any relevant facts in the submission of in any report to the director, including records of operation, you shall promptly submit such facts or information. ***{See 567 IAC 60.4(2)"a" and 567 IAC 63.7}***

7. TRANSFER OF TITLE OR OWNER ADDRESS CHANGE

If title to your facility, or any part of it, is transferred the new owner shall be subject to this permit. You are required to notify the new owner of the requirements of this permit in writing prior to any transfer of title. The Director shall be notified in writing within 30 days of the transfer. No transfer of the authorization to discharge from the facility represented by the permit shall take place prior to notifying the department of the transfer of title. Whenever the address of the owner is changed, the department shall be notified in writing within 30 days of the address change. Electronic notification is not sufficient; all title transfers or address changes must be reported to the department by mail. ***{See 567 IAC 64.14}***

8. PROPER OPERATION AND MAINTENANCE

All facilities and control systems shall be operated as efficiently as possible and maintained in good working order. A sufficient number of staff, adequately trained and knowledgeable in the operation of your facility shall be retained at all times and adequate laboratory controls and appropriate quality assurance procedures shall be provided to maintain compliance with the conditions of this permit.
{See 40 CFR 122.41(e) and 567 IAC 64.7(7)"f"}

9. PERMIT MODIFICATION, SUSPENSION OR REVOCATION

(a) This permit may be modified, suspended, or revoked and reissued for cause including but not limited to those specified in 567 IAC 64.3(11).

(b) This permit may be modified due to conditions or information on which this permit is based, including any new standard the department may adopt that would change the required effluent limits. ***{See 567 IAC 64.3(11)}***

(c) If a toxic pollutant is present in your discharge and more stringent standards for toxic pollutants are established under Section 307(a) of the Clean Water Act, this permit will be modified in accordance with the new standards.
{See 40 CFR 122.62(a)(6) and 567 IAC 64.7(7)"g"}

The filing of a request for a permit modification, revocation or suspension, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

10. DUTY TO REAPPLY AND PERMIT CONTINUATION

If you wish to continue to discharge after the expiration date of this permit, you must file a complete application for reissuance at least 180 days prior to the expiration date of this permit. If a timely and sufficient application is submitted, this permit will remain in effect until the Department makes a final determination on the permit application. ***{See 567 IAC 64.8(1) and Iowa Code 17A.18}***

11. DUTY TO COMPLY

You must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; permit termination, revocation and reissuance, or modification; or denial of a permit renewal application. Issuance of this permit does not relieve you of the responsibility to comply with all local, state and federal laws, ordinances, regulations or other legal requirements applying to the operation of your facility. ***{See 40 CFR 122.41(a) and 567 IAC 64.7(4)"e"}***

12. DUTY TO MITIGATE

You shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment. ***{See 40 CFR 122.41(d) and 567 IAC 64.7(7)"i"}***

13. TWENTY-FOUR HOUR REPORTING

You shall report any noncompliance that may endanger human health or the environment, including, but not limited to, violations of maximum daily limits for any toxic pollutant (listed as toxic under 307(a)(1) of the Clean Water Act) or hazardous substance (as designated in 40 CFR Part 116 pursuant to 311 of the Clean Water Act). Information shall be provided orally within 24 hours from the time you become aware of the circumstances. A written submission that includes a description of noncompliance and its cause; the period of noncompliance including exact dates and times, whether the noncompliance has been corrected or the anticipated time it is expected to continue; and the steps taken or planned to reduce, eliminate, and prevent a reoccurrence of the noncompliance must be provided within 5 days of the occurrence. ***{See 567 IAC 63.12}***

14. OTHER NONCOMPLIANCE

You shall report all instances of noncompliance not reported under Condition #13 at the time monitoring reports are submitted. You shall give advance notice to the appropriate regional field office of the department of any planned activity which may result in noncompliance with permit requirements. ***{See 567 IAC 63.14}***

15. INSPECTION OF PREMISES, RECORDS, EQUIPMENT, METHODS AND DISCHARGES

You are required to permit authorized personnel to:

(a) Enter upon the premises where a regulated facility or activity is located or conducted or where records are kept under conditions of this permit;

(b) Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

(c) Inspect, at reasonable times, any facilities, equipment, practices or operations regulated or required under this permit; and

(d) Sample or monitor, at reasonable times, to assure compliance or as otherwise authorized by the Clean Water Act.

16. FAILURE TO SUBMIT FEES

This permit may be revoked, in whole or in part, if the appropriate permit fees are not submitted within thirty (30) days of the date of notification that such fees are due. ***{See 567 IAC 64.16(1)}***

17. NEED TO HALT OR REDUCE ACTIVITY

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. ***{See 40 CFR 122.41(c) and 567 IAC 64.7(7)"j"}***

18. NOTICE OF CHANGED CONDITIONS

You are required to notify the director of any changes in existing conditions or information on which this permit is based. This includes, but is not limited to, the following:

(a) If your facility is a publicly owned treatment works (POTW) or otherwise may accept waste for treatment from an indirect discharger or industrial contributor (See 567 IAC 64.3(5) for further notice requirements).

(b) If your facility is a POTW and there is any substantial change in the volume or character of pollutants being introduced to the POTW by a source introducing pollutants into the POTW at the time of issuance of the permit. ***{See 40 CFR 122.42(b)}***

(c) As soon as you know or have reason to believe that any activity has occurred or will occur which would result in the discharge of any toxic pollutant which is not limited in this permit. ***{See 40 CFR 122.42(a)}***

(d) If you have begun or will begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant which was not reported in the permit application.

19. PLANNED CHANGES

The permittee shall give notice to the appropriate regional field office of the department 30 days prior to any planned physical alterations or additions to the permitted facility. Notice is required only when:

(a) Notice has not been given to any other section of the department. (Note: Facility expansions, production increases, or process modifications which may result in new or increased discharges of pollutants must be reported to the Director in advance. If such discharges will exceed effluent limitations, your report must include an application for a new permit. If any modification of, addition to, or construction of a disposal system is to be made, you must first obtain a written permit from this Department. In addition, no construction activity that will result in disturbance of one acre or more shall be initiated without first obtaining coverage under NPDES General Permit No. 2 for "Storm water discharge associated with construction activity.") ***{See 567 IAC 64.7(7)"a" and 64.2}***

(b) The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source as defined in 567 IAC 60.2;

(c) The alteration or addition results in a significant change in the permittee's sludge use or disposal practices; or

(d) The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants that are not subject to effluent limitations in the permit. ***{See 567 IAC 63.13 and 63.14}***

20. USE OF CERTIFIED LABORATORIES

Analyses of wastewater, groundwater or sewage sludge that are required to be submitted to the department as a result of this permit must be performed by a laboratory certified by the State of Iowa. Routine, on-site monitoring for pH, temperature, dissolved oxygen, total residual chlorine and other pollutants that must be analyzed immediately upon sample collection, settleable solids, physical measurements, and operational monitoring tests specified in 567 IAC 63.3(4) are excluded from this requirement.

21. BYPASSES

(a) Definition. "Bypass" means the diversion of waste streams from any portion of a treatment facility or collection system. A bypass does not include internal operational waste stream diversions that are part of the design of the treatment facility, maintenance diversions where redundancy is provided, diversions of wastewater from one point in a collection system to another point in a collection system, or wastewater backups into buildings that are caused in the building lateral or private sewer line.

(b) Prohibitions.

i. Bypasses from any portion of a treatment facility or from a sanitary sewer collection system designed to carry only sewage are prohibited.

ii. Bypass is prohibited and the department may not assess a civil penalty against a permittee for bypass if the permittee has complied with all of the following:

(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 backup 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 by paragraph (d) of this section.

(c) The Director may approve an anticipated bypass after considering its adverse effects if the Director determines that it will meet the three conditions listed above and a request for bypass has been submitted to the Department in accordance with 567 IAC 63.6(2).

(d) Reporting bypasses. Bypasses shall be reported in accordance with 567 IAC 63.6.

22. UPSET PROVISION

(a) Definition. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

(b) Effect of an upset. An upset constitutes an affirmative defense in an action brought for noncompliance with such technology based permit effluent limitations if the requirements of paragraph *"c"* of this condition are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

(c) Conditions necessary for demonstration of an upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate through properly signed operating logs or other relevant evidence that;

i. An upset occurred and that the permittee can identify the cause(s) of the upset;

ii. The permitted facility was at the time being properly operated;

iii. The permittee submitted notice of the upset to the Department in accordance with 567 IAC 63.6(3); and

iv. The permittee complied with any remedial measures required in accordance with 567 IAC 63.6(6)"*b*".

(d) Burden of Proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

23. PROPERTY RIGHTS

This permit does not convey any property rights of any sort or any exclusive privilege. ***{See 567 IAC 64.4(3)"b"}***

24. EFFECT OF A PERMIT

Compliance with a permit during its term constitutes compliance, for purposes of enforcement, with Sections 301, 302, 306, 307, 318, 403 and 405(a)-(b) of the Clean Water Act, and equivalent limitations and standards set out in 567 IAC Chapters 61 and 62. ***{See 567 IAC 64.4(3)"a"}***

25. SEVERABILITY

The provisions of this permit are severable and if any provision or application of any provision to any circumstance is found to be invalid by this department or a court of law, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected by such finding.

APPENDIX B
SPECIAL SAMPLING DATA

City of Ames, Iowa
Nutrient Reduction Facility Plan
Special Sampling Data

Date: 7/17/2022

Sample Location	Influent	Primary Effluent	1st Stg TF Effluent	Int. Clarifier Effluent	Final Effluent	Supernatant
Sample Type	Composite	Composite	Composite	Composite	Composite	Grab
Total P	4.5	4.2			2.9	
Ortho P	1.5	2.5			2.8	
Ammonia	22	15	3.2	0.22	0.1	
TKN	37	25			0.72	
Nitrate+Nitrite	<2	1.76			18	
COD	370	190			26	
cBOD	200	86	43	8	5	
BOD	208					
1.2 micron GF Filtered COD	110	97				
Flocculated and Filtered COD	74	53			14	
TSS	190	86	18	12	6.1	
VSS	160	78				
Alkalinity	280	230	130	100	100	
pH	7.2	7.02	7.15	7.11	7.71	
VFA	53	32				

Date: 7/20/2022

Sample Location	Influent	Primary Effluent	1st Stg TF Effluent	Int. Clarifier Effluent	Final Effluent	Supernatant
Sample Type	Composite	Composite	Composite	Composite	Composite	Grab
Total P	4	4.7			3.3	
Ortho P	1.8	3.1			2.9	
Ammonia	24	11	3.6	0.48	0.16	
TKN	36	21			1	
Nitrate+Nitrite	<2	3.66			14.1	
COD	310	170			27	
BOD	179					
cBOD	164	63	57	10	4	
1.2 micron GF Filtered COD	110	82				
Flocculated and Filtered COD	73	49			16	
TSS	160	55	64	11	3.4	
VSS	140	45				
Alkalinity	270	200	130	100	96	
pH	7.2	7.09	7.33	7.05	8.17	
VFA	59	31				

Date: 7/31/2022 8/1/2022

Sample Location	Influent	Primary Effluent	1st Stg TF Effluent	Int. Clarifier Effluent	Final Effluent	Supernatant
Sample Type	Composite	Composite	Composite	Composite	Composite	Grab
Total P	4.7	4.5			3.7	470
Ortho P	2.5	2.9				
Ammonia	28	18	3.5	0.15	0.11	1,200
TKN	43	27			0.5	2,100
Nitrate+Nitrite	<2	1.56			17	<10
COD	450	230			21	24,000
BOD	209					
cBOD	160	72	51	7	4	1,658
1.2 micron GF Filtered COD	110	110				
Flocculated and Filtered COD	110	82			13	
TSS	200	73	120	11	5.4	20,000
VSS	180	60				15,000
Alkalinity	270	220	120	88	80	
pH	7.2	7.1	7.11	6.7	7.96	
VFA	32	16				

Date: 8/14/2022

Sample Location	Influent	Primary Effluent	1st Stg TF Effluent	Int. Clarifier Effluent	Final Effluent	Supernatant
Sample Type	Composite	Composite	Composite	Composite	Composite	Grab
Total P	4.8	4.6			3.9	480
Ortho P	2.4	2.9				
Ammonia	32	20	3.8	0.39	0.14	1,100
TKN	43	28			0.5	
Nitrate+Nitrite	<2	<3			25	2,000
COD	460	260			28	25,000
BOD	186					
cBOD	191	78	53	7	4	1,470
1.2 micron GF Filtered COD	170	150				
Flocculated and Filtered COD	120	71			12	
TSS	230	60	86	8	5.3	25,000
VSS	200	53				17,000
Alkalinity	240	200	90	62	57	
pH	7.3	6.98	6.87	6.37	7.50	
VFA	53	20				

Date: 8/17/2022 8/18/2022

Sample Location	Influent	Primary Effluent	1st Stg TF Effluent	Int. Clarifier Effluent	Final Effluent	Supernatant
Sample Type	Composite	Composite	Composite	Composite	Composite	Grab
Total P	5.8	5.7			3.9	510
Ortho P	2.7	3.2			4.4	
Ammonia	35	20	8.9	1.8	0.1	1,100
TKN	52	29			0.5	2,100
Nitrate+Nitrite	<2	<2			25	
COD	460	250			24	23,000
BOD	217					1633
cBOD	215	94	84	10	4	
1.2 micron GF Filtered COD	170	110				
Flocculated and Filtered COD	110	80			15	
TSS	240	86	180	10	3.6	25,000
VSS	210	80				15,000
Alkalinity	260	210	122	84	71	
pH	7.3	7	7	6.5	7.61	
VFA	63	30				

Date: 8/28/2022

Sample Location	Influent	Primary Effluent	1st Stg TF Effluent	Int. Clarifier Effluent	Final Effluent	Supernatant
Sample Type	Composite	Composite	Composite	Composite	Composite	Grab
Total P	4.8	4.8			4.5	
Ortho P	2.4	2.7			4.1	
Ammonia	37	24	9.5	2.3	0.1	
TKN	41	32			0.5	
Nitrate+Nitrite	<2	1			27	
COD	430	250			30	
BOD	181					
cBOD	200	90	69	9	4	
1.2 micron GF Filtered COD	140	120				
Flocculated and Filtered COD	94	69			13	
TSS	240	88	120	13	8.7	
VSS	200	67				
Alkalinity	210	190	100	63	48	
pH	7.1	7	7.03	6.64	7.09	
VFA	51	28				

Date: 8/31/2022

Sample Location	Influent	Primary Effluent	1st Stg TF Effluent	Int. Clarifier Effluent	Final Effluent	Supernatant
Sample Type	Composite	Composite	Composite	Composite	Composite	Grab
Total P	5.3	6.1			4.8	126
Ortho P	2.7	3.9			4.2	
Ammonia	39	32	18	9.7	0.3	1,000
TKN	52	45			0.5	1,100
Nitrate+Nitrite	<2	1.76			37	
COD	400	230			43	2,900
BOD	187					
cBOD	203	76	119	17	6	142
1.2 micron GF Filtered COD	130	120				
Flocculated and Filtered COD	89	80			15	
TSS	170	59	220	44	9	1,300
VSS	170	51				970
Alkalinity	300	250	170	94	52	
pH	7.1	6.81	6.7	6.64	7.39	
VFA	46	22				

Average

Sample Location	Influent	Primary Effluent	1st Stg TF Effluent	Int. Clarifier Effluent	Final Effluent	Supernatant
Sample Type	Composite	Composite	Composite	Composite	Composite	Grab
Total P	4.8	4.9			3.9	397
Ortho P	2.3	3.0			3.7	
Ammonia	31.0	20.0	7.2	2.1	0.1	1,100
TKN	43.4	29.6			0.6	1,767
Nitrate+Nitrite	<2	1.9			23.3	
COD	411	226			28.4	18,725
BOD	194	86	43	8.0	5.0	
cBOD	192	79	72	10.0	4.3	1,090
1.2 micron GF Filtered COD	134	113				
Flocculated and Filtered COD	96	69			14.0	
TSS	204	72	115	15.6	5.9	17,825
VSS	180	62				11,993
Alkalinity	261	214	123	84.4	72.0	
pH	7.2	7.0	7.0	6.7	7.6	
VFA	51	26				

APPENDIX C
PRESENT WORTH ANALYSIS

City of Ames, Iowa
Nutrient Reduction Facility Plan
Opinion of Present Worth Cost

Discount Rate 2.875%

Alternative BNR1 - Conventional BNR Activated Sludge

ITEM	Initial Capital Cost	Future Capital Cost	Replacement Year	Replacement Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Demolition	$ 250,000	$ -	-	$ -	$ -	$ -
Influent Control Structure						
Structure	$ 100,000	$ -	40	$ -	$ 50,000	$ 30,000
Gates	$ 20,000	$ -	20	$ -	$ -	$ -
Activated Sludge						
Activated Sludge Tanks	$ 7,500,000	$ -	40	$ -	$ 3,750,000	$ 2,130,000
Baffle Walls	$ 150,000	$ -	40	$ -	$ 80,000	$ 50,000
Gates	$ 160,000	$ -	20	$ -	$ -	$ -
Fine Bubble Diffusers	$ 900,000	$ 900,000	15	$ 590,000	$ 600,000	$ 340,000
Mixers	$ 290,000	$ -	20	$ -	$ -	$ -
Mixed Liquor Recycle Pumps	$ 400,000	$ -	20	$ -	$ -	$ -
Solids Contact Basin Modifications for AN Zone	$ 300,000	$ -	40	$ -	$ 150,000	$ 90,000
Final Clarifiers						
Solids Contact Basin Splitter Modifications	$ 100,000	$ -	40	$ -	$ 50,000	$ 30,000
Splitter Structure Gates	$ 20,000	$ -	20	$ -	$ -	$ -
Blower Building						
Structure	$ 400,000	$ -	40	$ -	$ 200,000	$ 110,000
Aeration Blowers	$ 870,000	$ -	20	$ -	$ -	$ -
RAS Pump Station						
Structure	$ 600,000	$ -	40	$ -	$ 300,000	$ 170,000
RAS Pumps	$ 510,000	$ -	20	$ -	$ -	$ -
WAS Storage/Thickening						
Structure	$ 1,600,000	$ -	40	$ -	$ 800,000	$ 450,000
Thickening Equipment	$ 850,000	$ -	20	$ -	$ -	$ -
Thickener Feed Pumps (3)	$ 200,000	$ -	20	$ -	$ -	$ -
Polymer Feed Equipment	$ 160,000	$ -	20	$ -	$ -	$ -
Thickened Sludge Transfer Pumps (2)	$ 140,000	$ -	20	$ -	$ -	$ -
WAS Storage Diffusers	$ 50,000	$ 50,000	15	$ 30,000	$ 30,000	$ 20,000
WAS Storage Blowers	$ 80,000	$ -	20	$ -	$ -	$ -
Subtotal	$ 15,650,000	$ 950,000		$ 620,000	$ 5,960,000	$ 3,390,000
Mechanical (25%)	$ 3,920,000	$ -				
Influent Piping Modifications	$ 300,000	$ -				
Aeration Piping	$ 600,000	$ -				
Mixed Liquor Piping	$ 200,000	$ -				
RAS Piping	$ 500,000	$ -				
Primary Effluent Piping	$ 600,000	$ -				
WAS and TWAS Piping	$ 300,000					
Electrical and Controls (30%)	$ 4,700,000	$ -				
Sitework (15%)	$ 2,350,000	$ -				
Undefined Scope	$ 3,130,000	$ -				
Subtotal	$ 32,250,000	$ -				
General Conditions	$ 4,840,000	$ -				
Subtotal	$ 37,090,000	$ -				
Phasing	$ 3,710,000					
Supply Chain Escalator	$ 5,570,000					
Subtotal	$ 46,370,000	$ -				
Contingencies	$ 6,960,000					
Technical Services	$ 9,280,000	$ -				
Total Capital Costs	$ 62,610,000	$ -		$ 620,000	$ 5,960,000	$ 3,390,000
Present Worth of Capital Costs	**$ 62,610,000**			**$ 620,000**		**$ 3,390,000**

Estimated Annual O&M Costs	
Relative Labor	$ -
Maintenance	$ 90,000
Chemical	$ -
Power	$ 206,000
Total O&M Costs	$ 296,000
Present Worth of O&M	**$ 4,460,000**

Summary of Present Worth Costs	
Capital Cost	$ 62,610,000
Future Capital Costs/Replacement	$ 620,000
O&M Cost	$ 4,460,000
Salvage Value	$ (3,390,000)
Total Present Worth	**$ 64,300,000**

City of Ames, Iowa
Nutrient Reduction Facility Plan
Opinion of Present Worth Cost **Discount Rate** 2.875%

Alternative BNR2 - Simultaneous Nitrification-Denitrification BNR Activated Sludge

ITEM	Initial Capital Cost	Future Capital Cost	Replacement Year	Replacement Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Demolition	$ 250,000	$ -	-	$ -	$ -	$ -
Influent Control Structure						
Structure	$ 100,000	$ -	40	$ -	$ 50,000	$ 30,000
Gates	$ 20,000	$ -	20	$ -	$ -	$ -
Activated Sludge						
Activated Sludge Tanks	$ 7,500,000	$ -	40	$ -	$ 3,750,000	$ 2,130,000
Baffle Walls	$ 150,000	$ -	40			
Gates	$ 160,000	$ -	20	$ -	$ -	$ -
Fine Bubble Diffusers	$ 1,130,000	$ 900,000	15	$ 590,000	$ 750,000	$ 430,000
Mixers	$ 290,000	$ -	20	$ -	$ -	$ -
Mixed Liquor Recycle Pumps	$ 400,000	$ -	20	$ -	$ -	$ -
Solids Contact Basin Modifications for AN Zone	$ 300,000	$ -	40	$ -	$ 150,000	$ 90,000
Final Clarifiers						
Solids Contact Basin Splitter Modifications	$ 100,000	$ -	40	$ -	$ 50,000	$ 30,000
Splitter Structure Gates	$ 20,000	$ -	20	$ -	$ -	$ -
Blower Building						
Structure	$ 400,000	$ -	40	$ -	$ 200,000	$ 110,000
Aeration Blowers	$ 870,000	$ -	20	$ -	$ -	$ -
RAS Pump Station						
Structure	$ 600,000	$ -	40	$ -	$ 300,000	$ 170,000
RAS Pumps	$ 510,000	$ -	20	$ -	$ -	$ -
Sludge Densification						
InDense System	$ 190,000	$ -	20	$ -	$ -	$ -
WAS Storage/Thickening						
Structure	$ 1,600,000	$ -	40	$ -	$ 800,000	$ 450,000
Thickening Equipment	$ 850,000	$ -	20	$ -	$ -	$ -
Thickener Feed Pumps (3)	$ 200,000	$ -	20	$ -	$ -	$ -
Polymer Feed Equipment	$ 160,000	$ -	20	$ -	$ -	$ -
Thickened Sludge Transfer Pumps (2)	$ 140,000	$ -	20	$ -	$ -	$ -
WAS Storage Diffusers	$ 50,000	$ 50,000	15	$ 30,000	$ 33,333	$ 20,000
WAS Storage Blowers	$ 80,000	$ -	20	$ -	$ -	$ -
Subtotal	$ 16,070,000	$ 950,000		$ 620,000	$ 6,083,333	$ 3,460,000
Mechanical (25%)	$ 4,020,000	$ -				
Influent Piping Modifications	$ 300,000	$ -				
Aeration Piping	$ 600,000	$ -				
Mixed Liquor Piping	$ 200,000	$ -				
RAS Piping	$ 500,000					
Primary Effluent Piping	$ 600,000					
WAS and TWAS Piping	$ 300,000	$ -				
Electrical and Controls (30%)	$ 4,830,000	$ -				
Sitework (15%)	$ 2,420,000					
Undefined Scope	$ 3,130,000	$ -				
Subtotal	$ 32,970,000	$ -				
General Conditions	$ 4,840,000	$ -				
Subtotal	$ 37,810,000	$ -				
Phasing	$ 3,710,000					
Supply Chain Escalator	$ 5,570,000					
Subtotal	$ 47,090,000	$ -				
Contingencies	$ 6,960,000					
Technical Services	$ 9,280,000	$ -				
Total Capital Costs	$ 63,330,000	$ -		$ 620,000	$ 6,083,333	$ 3,460,000
Present Worth of Capital Costs	**$ 63,330,000**			**$ 620,000**		**$ 3,460,000**

Estimated Annual O&M Costs	
Relative Labor ($90/hr)	$ -
Maintenance (~2% of equipment)	$ 100,000
Chemical	$ -
Power ($0.06/kWh)	$ 164,000
Total O&M Costs	$ 264,000
Present Worth of O&M	**$ 3,970,000**

Summary of Present Worth Costs	
Capital Cost	$ 63,330,000
Future Capital Costs/Replacement	$ 620,000
O&M Cost	$ 3,970,000
Salvage Value	$ (3,460,000)
Total Present Worth	**$ 64,460,000**

City of Ames, Iowa
Nutrient Reduction Facility Plan
Opinion of Present Worth Cost **Discount Rate** 2.875%

Alternative BNR3a - Aerobic Granular Sludge with Primary Clarification

ITEM	Initial Capital Cost	Future Capital Cost	Replacement Year	Replacement Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Demolition	$ 450,000	$ -	-	$ -	$ -	$ -
Influent Control Structure						
Structure	$ 100,000	$ -	40	$ -	$ 50,000	$ 30,000
Gates	$ 20,000	$ -	20	$ -	$ -	$ -
Aerobic Granular Sludge System						
AGS Equipment	$ 22,700,000	$ -	20	$ -	$ -	$ -
AGS Reactors	$ 4,660,000	$ -	40	$ -	$ 2,330,000	$ 1,320,000
Solids Contact Basin Modifications	$ 200,000	$ -	40	$ -	$ 100,000	$ 60,000
Blower Building						
Structure	$ 400,000	$ -	40	$ -	$ 200,000	$ 110,000
Aeration Blowers	Included in AGS System Scope					
WAS Storage/Thickening						
Structure	$ 1,600,000	$ -	40	$ -	$ 800,000	$ 450,000
Thickening Equipment	$ 850,000	$ -	20	$ -	$ -	$ -
Thickener Feed Pumps (3)	$ 200,000	$ -	20			
Polymer Feed Equipment	$ 160,000	$ -	20	$ -	$ -	$ -
Thickened Sludge Transfer Pumps (2)	$ 140,000	$ -	20	$ -	$ -	$ -
WAS Storage Diffusers	$ 50,000	$ 50,000	15	$ 30,000	$ 30,000	$ 20,000
WAS Storage Blowers	$ 80,000	$ -	20	$ -	$ -	$ -
Subtotal	$ 31,610,000	$ -		$ 30,000	$ 2,680,000	$ 1,520,000
Piping and Mechanical	$ 3,100,000					
Influent Piping Modifications	$ 500,000	$ -				
Aeration Piping	$ 1,200,000	$ -				
Secondary Effluent Piping	$ 600,000	$ -				
Primary Effluent Piping	$ 1,400,000	$ -				
WAS and TWAS Piping	$ 700,000					
Electrical and Controls	$ 3,820,000					
Sitework	$ 1,910,000					
Undefined Scope	$ 3,130,000	$ -				
Subtotal	$ 47,970,000					
General Conditions	$ 4,840,000					
Subtotal	$ 52,810,000	$ -				
Phasing	$ 3,710,000					
Supply Chain Escalator	$ 5,570,000					
Subtotal	$ 62,090,000	$ -				
Contingencies	$ 6,960,000					
Technical Services	$ 9,280,000	$ -				
Total Capital Costs	$ 78,330,000			$ 30,000	$ 2,680,000	$ 1,520,000
Present Worth of Capital Costs	**$ 78,330,000**			**$ 30,000**		**$ 1,520,000**

Estimated Annual O&M Costs	
Relative Labor	$ -
Maintenance	$ 90,000
Chemical	$ -
Power	$ 165,000
Total O&M Costs	$ 255,000
Present Worth of O&M	**$ 3,840,000**

Summary of Present Worth Costs	
Capital Cost	$ 78,330,000
Future Capital Costs/Replacement	$ 30,000
O&M Cost	$ 3,840,000
Salvage Value	$ (1,520,000)
Total Present Worth	**$ 80,680,000**

City of Ames, Iowa
Nutrient Reduction Facility Plan
Opinion of Present Worth Cost

Discount Rate 2.875%

Alternative BNR3b - Aerobic Granular Sludge without Primary Clarification

ITEM	Initial Capital Cost	Future Capital Cost	Replacement Year	Replacement Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Demolition	$ 450,000					
Influent Control Structure						
Structure	$ 100,000	$ -	40	$ -	$ 50,000	$ 30,000
Gates	$ 20,000	$ -	20	$ -	$ -	$ -
Aerobic Granular Sludge System						
AGS Equipment	$ 23,300,000	$ -	20	$ -	$ -	$ -
AGS Reactors	$ 4,660,000	$ -	40	$ -	$ 2,330,000	$ 1,320,000
Solids Contact Basin Modifications	$ 200,000	$ -	40	$ -	$ 100,000	$ 60,000
Blower Building						
Structure	$ 400,000	$ -	40	$ -	$ 200,000	$ 110,000
Aeration Blowers	Included in AGS System Scope					
WAS Storage/Thickening						
Structure	$ 1,450,000	$ -	40	$ -	$ 730,000	$ 410,000
Thickening Equipment	$ 1,280,000	$ -	20	$ -	$ -	$ -
Thickener Feed Pumps (3)	$ 200,000	$ -	20			
Polymer Feed Equipment	$ 160,000	$ -	20	$ -	$ -	$ -
Thickened Sludge Transfer Pumps (2)	$ 140,000	$ -	20	$ -	$ -	$ -
WAS Storage Diffusers	$ 100,000	$ 50,000	15	$ 30,000	$ 70,000	$ 40,000
WAS Storage Blowers	$ 160,000	$ -	20	$ -	$ -	$ -
Subtotal	$ 32,620,000	$ -		$ 30,000	$ 2,680,000	$ 1,520,000
Piping and Mechanical	$ 3,410,000					
Influent Piping Modifications	$ 500,000					
Aeration Piping	$ 1,200,000					
Secondary Effluent Piping	$ 600,000					
Primary Effluent Piping	$ 1,400,000					
WAS and TWAS Piping	$ 700,000					
Electrical and Controls (15%)	$ 3,820,000					
Sitework	$ 1,910,000					
Undefined Scope	$ 3,130,000					
Subtotal	$ 49,290,000					
General Conditions	$ 4,840,000					
Subtotal	$ 54,130,000	$ -				
Phasing	$ 3,710,000					
Supply Chain Escalator	$ 5,570,000					
Subtotal	$ 63,410,000	$ -				
Contingencies	$ 6,960,000					
Technical Services	$ 9,280,000					
Total Capital Costs	$ 79,650,000			$ 30,000	$ 2,680,000	$ 1,520,000
Present Worth of Capital Costs	**$ 79,650,000**			**$ 30,000**		**$ 1,520,000**

Estimated Annual O&M Costs	
Relative Labor	$ -
Maintenance	$ 100,000
Chemical	$ -
Power	$ 149,000
Total O&M Costs	$ 249,000
Present Worth of O&M	**$ 3,750,000**

Summary of Present Worth Costs	
Capital Cost	$ 79,650,000
Future Capital Costs/Replacement	$ 30,000
O&M Cost	$ 3,750,000
Salvage Value	$ (1,520,000)
Total Present Worth	**$ 81,910,000**

City of Ames, Iowa
Nutrient Reduction Facility Plan
Opinion of Present Worth Cost

Discount Rate 2.875%

Alternative S1 - 6 mm Perforated Plate Screens

ITEM	Initial Capital Cost	Future Capital Cost	Replacement Year	Replacement Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Influent Control Structure						
Gates	$ 106,700	$ -	20	$ -	$ -	$ -
Installation	$ 32,010	$ -	20	$ -	$ -	$ -
Bypass Pumping	$ 120,000	$ -	20	$ -	$ -	$ -
Raw Wastewater Pump Station						
Demolition of Existing Screens	$ 50,000	$ -	20	$ -	$ -	$ -
Structural Modifications - roofing, panel removal/replacement	$ 20,000	$ -	20	$ -	$ -	$ -
Remove precast hollowcore	$ 22,500	$ -	20	$ -	$ -	$ -
Replace precast hollowcore	$ 27,200	$ -	20	$ -	$ -	$ -
New roof membrane	$ 8,250	$ -	20	$ -	$ -	$ -
12'x8' roof hatches (3)	$ 80,000	$ -	20	$ -	$ -	$ -
Demolition of Floor Grout	$ 30,000	$ -	20	$ -	$ -	$ -
Misc. Demolition (Flume Removal)	$ 25,000	$ -	20	$ -	$ -	$ -
Two (2) 6 mm Perforated Plate Screens	$ 1,080,000	$ -	20	$ -	$ -	$ -
Installation	$ 324,000	$ -	20	$ -	$ -	$ -
Two (2) Wash Presses	$ 240,000	$ -	20	$ -	$ -	$ -
Installation	$ 72,000	$ -	20	$ -	$ -	$ -
New Floor Opening & access hatch	$ 50,000	$ -	20	$ -	$ -	$ -
Pick point & Hoist	$ 20,000	$ -	20	$ -	$ -	$ -
one(1) Coarse Bar Rack	$ 25,000	$ -	20	$ -	$ -	$ -
Installation	$ 7,500	$ -	20	$ -	$ -	$ -
Six (6) 72" wide x 90" tall slide gates	$ 119,460	$ -	20	$ -	$ -	$ -
Installation	$ 35,838	$ -	20	$ -	$ -	$ -
Four (4) 60" wide x 90" tall slide gates	$ 74,860	$ -	20	$ -	$ -	$ -
Installation	$ 22,458	$ -	20	$ -	$ -	$ -
Two (2) 60" wide x 90" tall slide gates	$ 55,000	$ -	20	$ -	$ -	$ -
Installation	$ 16,500	$ -	20	$ -	$ -	$ -
New Grout Floor	$ 20,000	$ -	20	$ -	$ -	$ -
NFPA 820 Upgrades	$ 100,000	$ -	20	$ -	$ -	$ -
Subtotal	$ 2,790,000	$ -		$ -	$ -	$ -
Mechanical (20%)	$ 560,000	$ -				
Electrical and Controls (30%)	$ 840,000	$ -				
Painting (1.5%)	$ 50,000	$ -				
Sitework (0%)		$ -				
Undefined Scope (20%)	$ 560,000					
Construction Cost Subtotal	$ 4,800,000	$ -				
General Conditions (15%)	$ 720,000	$ -				
Subtotal	$ 5,520,000	$ -				
Supply Chain Escalator (15%) - move under GC subtotal	$ 830,000					
Subtotal	$ 6,350,000	$ -				
Contingencies	$ 960,000	$ -				
Technical Services	$ 1,270,000					
Total Capital Costs	$ 8,580,000	$ -		$ -	$ -	$ -
Present Worth of Capital Costs	**$ 8,580,000**			**$ -**		**$ -**

Estimated Annual O&M Costs	
Relative Labor ($90/hr)	
Maintenance (~2% of equipment)	$ 30,000
Power ($0.06/kWh)	$ 2,000
Total O&M Costs	$ 32,000
Present Worth of O&M	**$ 480,000**

Summary of Present Worth Costs	
Capital Cost	$ 8,580,000
Future Capital Costs/Replacement	$ -
O&M Cost	$ 480,000
Salvage Value	$ -
Total Present Worth	**$ 9,060,000**

City of Ames, Iowa
Nutrient Reduction Facility Plan
Opinion of Present Worth Cost **Discount Rate** 2.875%

Alternative S1A - Raw Wastewater Pumping Station Addition

ITEM	Initial Capital Cost	Future Capital Cost	Replacement Year	Replacement Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Influent Control Structure						
Gates	$ 106,700	$ -	20	$ -	$ -	$ -
Installation	$ 32,010	$ -	20	$ -	$ -	$ -
Bypass Pumping	$ 120,000	$ -	20	$ -	$ -	$ -
Raw Wastewater Pump Station						
Demolition of Existing Screens	$ 75,000	$ -	20	$ -	$ -	$ -
Demolition of Floor Grout	$ 30,000	$ -	20	$ -	$ -	$ -
Misc. Demolition (Flume Removal)	$ 25,000	$ -	20	$ -	$ -	$ -
Site Process Piping and Fittings	$ 60,000	$ -	40	$ -	$ 30,000	$ 20,000
Structural Modifications - roofing, panel removal/replacement	$ 20,000	$ -	20	$ -	$ -	$ -
Remove precast hollowcore	$ 15,075	$ -	20	$ -	$ -	$ -
Replace precast hollowcore	$ 18,224	$ -	20	$ -	$ -	$ -
New roof membrane	$ 8,250	$ -	20	$ -	$ -	$ -
12'x8' roof hatches (2)	$ 53,333	$ -	20	$ -	$ -	$ -
One (2) Short 6 mm Perforated Plate Screen	$ 400,000	$ -	20	$ -	$ -	$ -
Installation (30%)	$ 120,000	$ -	20	$ -	$ -	$ -
One (2) Wash Press for Perforated Plate Screen	$ 250,000	$ -	20	$ -	$ -	$ -
Installation (30%)	$ 75,000	$ -	20	$ -	$ -	$ -
two (2) Coarse Bar Rack	$ 20,000	$ -	20	$ -	$ -	$ -
Installation (30%)	$ 6,000	$ -	20	$ -	$ -	$ -
Six (6) 72" wide x 90" tall slide gates	$ 119,460	$ -	20	$ -	$ -	$ -
Installation (30%)	$ 35,838	$ -	20	$ -	$ -	$ -
Two (2) 60" wide x 90" tall slide gates	$ 55,000	$ -	20	$ -	$ -	$ -
Installation	$ 16,500	$ -	20	$ -	$ -	$ -
Four (4) 36" wide x 84" tall slide gates	$ 66,480	$ -	20	$ -	$ -	$ -
Installation (30%)	$ 19,944	$ -	20	$ -	$ -	$ -
Two (2) 28" wide x 84" tall slide gates	$ 32,500	$ -	20	$ -	$ -	$ -
Installation (30%)	$ 9,750	$ -	20	$ -	$ -	$ -
Channel Grout Floor in existing RWPS	$ 20,000	$ -	20	$ -	$ -	$ -
40 ft x 40 ft CIP/Precast Wall Building	$ 550,000	$ -	40	$ -	$ 280,000	$ 160,000
Misc Metals (Handrail, grating, etc.)	$ 60,000	$ -	40	$ -	$ 30,000	$ 20,000
Doors + OH doors	$ 26,000	$ -	40	$ -	$ 10,000	$ 10,000
NFPA 820 Upgrades	$ 100,000					
Subtotal	$ 2,550,000	$ -		$ -	$ 350,000	$ 210,000
Mechanical (20%)	$ 510,000	$ -				
Electrical and Controls (30%)	$ 770,000	$ -				
Painting (1.5%)	$ 40,000	$ -				
Sitework (10%)	$ 260,000	$ -				
Undefined Scope (20%)	$ 510,000	$ -				
Subtotal	$ 4,640,000	$ -				
General Conditions (15%)	$ 700,000	$ -				
Subtotal	$ 5,340,000	$ -				
Supply Chain Escalator (15%) - move under GC subtotal	$ 810,000					
Subtotal	$ 6,150,000	$ -				
Contingencies	$ 930,000	$ -				
Technical Services	$ 1,230,000					
Total Capital Costs	$ 8,310,000	$ -		$ -	$ 350,000	$ 210,000
Present Worth of Capital Costs	**$ 8,310,000**			**$ -**		**$ 210,000**

Estimated Annual O&M Costs	
Relative Labor ($90/hr)	
Maintenance (~2% of equipment)	$ 20,000
Power ($0.06/kWh)	$ 2,000
Total O&M Costs	$ 22,000
Present Worth of O&M	**$ 330,000**

Summary of Present Worth Costs	
Capital Cost	$ 8,310,000
Future Capital Costs/Replacement	$ -
O&M Cost	$ 330,000
Salvage Value	$ (210,000)
Total Present Worth	**$ 8,430,000**

City of Ames, Iowa
Nutrient Reduction Facility Plan
Opinion of Present Worth Cost — **Discount Rate** 2.875%

Alternative S2 - 3/8-inch Multi-Rake Screens

ITEM	Initial Capital Cost	Future Capital Cost	Replacement Year	Replacement Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Influent Control Structure						
Gates	$ 106,700	$ -	20	$ -	$ -	$ -
Installation	$ 32,010	$ -	20	$ -	$ -	$ -
Bypass Pumping	$ 120,000	$ -	20	$ -	$ -	$ -
Raw Wastewater Pump Station						
Demolition of Existing Screens	$ 75,000	$ -	20	$ -	$ -	$ -
Structural Modifications - roofing, panel removal/replacement	$ 20,000	$ -	20	$ -	$ -	$ -
Remove precast hollowcore	$ 15,075	$ -	20	$ -	$ -	$ -
Replace precast hollowcore	$ 18,224	$ -	20	$ -	$ -	$ -
New roof membrane	$ 8,250	$ -	20	$ -	$ -	$ -
12'x8' roof hatches (2)	$ 53,333	$ -	20	$ -	$ -	$ -
Demolition of Floor Grout	$ 30,000	$ -	20	$ -	$ -	$ -
Misc. Demolition (Flume Removal)	$ 25,000	$ -	20	$ -	$ -	$ -
One (1) 3/8" Multi-Rake Screen	$ 362,500	$ -	20	$ -	$ -	$ -
Installation (30%)	$ 108,750	$ -	20	$ -	$ -	$ -
One (1) Wash Presses	$ 60,000	$ -	20	$ -	$ -	$ -
Installation (30%)	$ 18,000	$ -	20	$ -	$ -	$ -
One (1) Coarse Bar Rack	$ 10,000	$ -	20	$ -	$ -	$ -
Installation (30%)	$ 3,000	$ -	20	$ -	$ -	$ -
Six (6) 72" wide x 90" tall slide gates	$ 119,460	$ -	20	$ -	$ -	$ -
Installation (30%)	$ 35,838	$ -	20	$ -	$ -	$ -
Four (4) 36" wide x 84" tall slide gates	$ 66,480	$ -	20	$ -	$ -	$ -
Installation (30%)	$ 19,944	$ -	20	$ -	$ -	$ -
Two (2) 28" wide x 84" tall slide gates	$ 32,500	$ -	20	$ -	$ -	$ -
Installation (30%)	$ 9,750	$ -	20	$ -	$ -	$ -
Two (2) 60" wide x 90" tall slide gates	$ 55,000	$ -	20	$ -	$ -	$ -
Installation	$ 16,500	$ -	20	$ -	$ -	$ -
Channel Grout Floor in existing RWPS	$ 20,000	$ -	20	$ -	$ -	$ -
NFPA 820 Upgrades	$ 100,000					
Subtotal	$ 1,550,000	$ -		$ -	$ -	$ -
Mechanical (20%)	$ 310,000	$ -				
Electrical and Controls (30%)	$ 470,000	$ -				
Painting (1.5%)	$ 30,000	$ -				
Sitework (0%)		$ -				
Undefined Scope (20%)	$ 310,000					
Subtotal	$ 2,670,000	$ -				
General Conditions (15%)	$ 410,000	$ -				
Subtotal	$ 3,080,000	$ -				
Supply Chain Escalator (15%) - move under GC subtotal	$ 470,000					
Subtotal	$ 3,550,000	$ -				
Contingencies	$ 540,000	$ -				
Technical Services	$ 710,000					
Total Capital Costs	$ 4,800,000	$ -		$ -	$ -	$ -
Present Worth of Capital Costs	**$ 4,800,000**			**$ -**		**$ -**

Estimated Annual O&M Costs	
Relative Labor ($90/hr)	
Maintenance (~2% of equipment)	$ 10,000
Power ($0.06/kWh)	$ 2,000
Total O&M Costs	$ 12,000
Present Worth of O&M	**$ 180,000**

Summary of Present Worth Costs	
Capital Cost	$ 4,800,000
Future Capital Costs/Replacement	$ -
O&M Cost	$ 180,000
Salvage Value	$ -
Total Present Worth	**$ 4,980,000**

City of Ames, Iowa
Nutrient Reduction Facility Plan
Opinion of Present Worth Cost

Discount Rate 2.875%

Alternative S3 - 1/4-inch Laced Linked Screens

ITEM	Initial Capital Cost	Future Capital Cost	Replacement Year	Replacement Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Influent Control Structure						
Gates	$ 106,700	$ -	20	$ -	$ -	$ -
Installation	$ 32,010	$ -	20	$ -	$ -	$ -
Bypass Pumping	$ 120,000	$ -	20	$ -	$ -	$ -
Raw Wastewater Pump Station						
Demolition of Existing Screens	$ 75,000	$ -	20	$ -	$ -	$ -
Structural Modifications - roofing, panel removal/replacement	$ 20,000	$ -	20	$ -	$ -	$ -
Remove precast hollowcore	$ 22,500	$ -	20	$ -	$ -	$ -
Replace precast hollowcore	$ 27,200	$ -	20	$ -	$ -	$ -
New roof membrane	$ 8,250	$ -	20	$ -	$ -	$ -
12'x8' roof hatches (3)	$ 80,000	$ -	20	$ -	$ -	$ -
Demolition of Floor Grout	$ 30,000	$ -	20	$ -	$ -	$ -
Misc. Demolition (Flume Removal)	$ 25,000	$ -	20	$ -	$ -	$ -
Two (2) 1/4" Traveling Water Screens	$ 795,000	$ -	20	$ -	$ -	$ -
Installation (30%)	$ 238,500	$ -	20	$ -	$ -	$ -
Two (2) Wash Presses	$ 120,000	$ -	20	$ -	$ -	$ -
Installation (30%)	$ 36,000	$ -	20	$ -	$ -	$ -
Six (6) 72" wide x 90" tall slide gates	$ 119,460	$ -	20	$ -	$ -	$ -
Installation (30%)	$ 35,838	$ -	20	$ -	$ -	$ -
Four (4) 36" wide x 84" tall slide gates	$ 66,480	$ -	20	$ -	$ -	$ -
Installation (30%)	$ 19,944	$ -	20	$ -	$ -	$ -
Two (2) 28" wide x 84" tall slide gates	$ 32,500	$ -	20	$ -	$ -	$ -
Installation (30%)	$ 9,750	$ -	20	$ -	$ -	$ -
Two (2) 60" wide x 90" tall slide gates	$ 55,000	$ -	20	$ -	$ -	$ -
Installation	$ 16,500	$ -	20	$ -	$ -	$ -
Channel Grout Floor in existing RWPS	$ 20,000	$ -	20	$ -	$ -	$ -
NFPA 820 Upgrades	$ 100,000					
Subtotal	$ 2,220,000	$ -		$ -	$ -	$ -
Mechanical (20%)	$ 450,000	$ -				
Electrical and Controls (30%)	$ 670,000	$ -				
Painting (1.5%)	$ 40,000	$ -				
Sitework (0%)		$ -				
Undefined Scope (20%)	$ 450,000					
Subtotal	$ 3,830,000	$ -				
General Conditions (15%)	$ 580,000	$ -				
Subtotal	$ 4,410,000	$ -				
Supply Chain Escalator (15%) - move under GC subtotal	$ 670,000					
Subtotal	$ 5,080,000	$ -				
Contingencies	$ 770,000	$ -				
Technical Services	$ 1,020,000					
Total Capital Costs	$ 6,870,000	$ -		$ -	$ -	$ -
Present Worth of Capital Costs	**$ 6,870,000**			**$ -**		**$ -**

Estimated Annual O&M Costs	
Relative Labor ($90/hr)	
Maintenance (~2% of equipment)	$ 20,000
Power ($0.06/kWh)	$ 2,000
Total O&M Costs	$ 12,000
Present Worth of O&M	**$ 180,000**

Summary of Present Worth Costs	
Capital Cost	$ 6,870,000
Future Capital Costs/Replacement	$ -
O&M Cost	$ 180,000
Salvage Value	$ -
Total Present Worth	**$ 7,050,000**

City of Ames, Iowa
Nutrient Reduction Facility Plan
Opinion of Present Worth Cost — **Discount Rate** 2.875%

Alternative G1 - Hydro-International's HeadCell

ITEM	Initial Capital Cost	Future Capital Cost	Replacement Year	Replacement Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Raw Wastewater Pump Station						
Demolition of TeaCups and Header Box	$ 160,000	$ -	20	$ -	$ -	$ -
Demolition of Conveyor	$ 65,000	$ -	20	$ -	$ -	$ -
Demolition of GritSnails	$ 40,000	$ -	20	$ -	$ -	$ -
New Roof for Equipment Changes						
Structural modifications	$ 20,000	$ -	40	$ -	$ 10,000	$ 10,000
Structural Modifications - roofing, panel removal/replacement		$ -	40	$ -	$ -	$ -
Remove precast hollowcore	$ 40,200	$ -	20	$ -	$ -	$ -
Replace precast hollowcore	$ 67,000	$ -	20	$ -	$ -	$ -
New roof membrane	$ 36,000	$ -	20	$ -	$ -	$ -
Bypass Pumping	$ 80,000	$ -	20	$ -	$ -	$ -
Grit Equipment	$ 620,000	$ -	20	$ -	$ -	$ -
Installation	$ 186,000	$ -	20	$ -	$ -	$ -
Grit Classifier	$ 150,000	$ -	20	$ -	$ -	$ -
Installation	$ 45,000	$ -	20	$ -	$ -	$ -
Stainless Steel Tank	$ 1,638,000	$ -	20	$ -	$ -	$ -
Grit Pumps	$ 40,000	$ -	20	$ 40,000	$ -	$ -
Installation	$ 12,000	$ -	20	$ -	$ -	$ -
Piping and Fittings for Grit Alternatives	$ 220,800	$ -	20	$ -	$ -	$ -
Valves	$ 100,000	$ -	20	$ -	$ -	$ -
Subtotal	$ 3,520,000	$ -		$ 40,000	$ 10,000	$ 10,000
Mechanical (15%)	$ 530,000	$ -				
Electrical and Controls (20%)	$ 710,000	$ -				
Painting (1.5%)	$ 53,000	$ -				
Sitework (0%)		$ -				
Undefined Scope (20%)	$ 710,000					
Subtotal	$ 5,530,000	$ -				
General Conditions (15%)	$ 830,000	$ -				
Subtotal	$ 6,360,000	$ -				
Supply Chain Escalator (15%)	$ 960,000					
Subtotal	$ 7,320,000	$ -				
Contingencies	$ 1,100,000	$ -				
Technical Services	$ 1,470,000					
Total Capital Costs	$ 9,890,000	$ -		$ 40,000	$ 10,000	$ 10,000
Present Worth of Capital Costs	**$ 9,890,000**			**$ 40,000**		**$ 10,000**

Estimated Annual O&M Costs	
Relative Labor ($90/hr)	
Maintenance (~2% of equipment)	$ 20,000
Power ($0.06/kWh)	$ 7,000
Total O&M Costs	$ 27,000
Present Worth of O&M	**$ 410,000**

Summary of Present Worth Costs	
Capital Cost	$ 9,890,000
Future Capital Costs/Replacement	$ 40,000
O&M Cost	$ 410,000
Salvage Value	$ (10,000)
Total Present Worth	**$ 10,330,000**

City of Ames, Iowa
Nutrient Reduction Facility Plan
Opinion of Present Worth Cost — **Discount Rate** 2.875%

Alternative G1A - Raw Wastewater Pumping Station Addition

ITEM	Initial Capital Cost	Future Capital Cost	Replacement Year	Replacement Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Raw Wastewater Pump Station						
Demolition of TeaCups and Header Box	$ 160,000	$ -	20	$ -	$ -	$ -
Demolition of Conveyor	$ 65,000	$ -	20	$ -	$ -	$ -
Demolition of GritSnails	$ 40,000	$ -	20	$ -	$ -	$ -
Grit Equipment	$ 620,000	$ -	20	$ -	$ -	$ -
Installation	$ 186,000	$ -	20	$ -	$ -	$ -
Grit Classifier	$ 150,000	$ -	20	$ -	$ -	$ -
Installation	$ 45,000	$ -	20	$ -	$ -	$ -
Grit Pumps	$ 40,000	$ -	20	$ 40,000	$ -	$ -
Installation	$ 12,000	$ -	20	$ -	$ -	$ -
Grit Tank walls, foundations, earthwork	$ 260,000	$ -	40	$ -	$ 130,000	$ 70,000
Valves	$ 100,000	$ -	20	$ -	$ -	$ -
Gates	$ 60,000	$ -	20	$ -	$ -	$ -
Subtotal	$ 1,740,000	$ -		$ 40,000	$ 130,000	$ 70,000
Mechanical (15%)	$ 270,000	$ -				
Electrical and Controls (40%)	$ 700,000	$ -				
Painting (1.5%)	$ 30,000	$ -				
Sitework (10%)	$ 180,000	$ -				
Undefined Scope (20%)	$ 350,000					
Subtotal	$ 3,270,000	$ -				
General Conditions (15%)	$ 500,000	$ -				
Subtotal	$ 3,770,000	$ -				
Supply Chain Escalator (15%)	$ 570,000					
Subtotal	$ 4,340,000	$ -				
Contingencies	$ 660,000	$ -				
Technical Services	$ 870,000					
Total Capital Costs	$ 5,870,000	$ -		$ 40,000	$ 130,000	$ 70,000
Present Worth of Capital Costs	**$ 5,870,000**			**$ 40,000**		**$ 70,000**

Estimated Annual O&M Costs	
Relative Labor ($90/hr)	
Maintenance (~2% of equipment)	$ 20,000
Power ($0.06/kWh)	$ 7,000
Total O&M Costs	$ 27,000
Present Worth of O&M	**$ 410,000**

Summary of Present Worth Costs	
Capital Cost	$ 5,870,000
Future Capital Costs/Replacement	$ 40,000
O&M Cost	$ 410,000
Salvage Value	$ (70,000)
Total Present Worth	**$ 6,250,000**

City of Ames, Iowa
Nutrient Reduction Facility Plan
Opinion of Present Worth Cost

Discount Rate 2.875%

Alternative G1B - New Grit Building

ITEM	Initial Capital Cost	Future Capital Cost	Replacement Year	Replacement Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Influent Control Structure						
Gates		$ -	20	$ -	$ -	$ -
Installation		$ -	20	$ -	$ -	$ -
Bypass Pumping		$ -	20	$ -	$ -	$ -
Raw Wastewater Pump Station						
Demolition of TeaCups and Header Box	$ 160,000	$ -	20	$ -	$ -	$ -
Demolition of Conveyor	$ 65,000	$ -	20	$ -	$ -	$ -
Demolition of GritSnails	$ 40,000	$ -	20	$ -	$ -	$ -
Grit Equipment	$ 620,000	$ -	20	$ -	$ -	$ -
Installation	$ 186,000	$ -	20	$ -	$ -	$ -
Grit Classifier	$ 150,000	$ -	20	$ -	$ -	$ -
Installation	$ 45,000	$ -	20	$ -	$ -	$ -
Grit Pumps	$ 40,000	$ -	20	$ 40,000	$ -	$ -
Installation	$ 12,000	$ -	20	$ -	$ -	$ -
Grit Tank walls, foundations, earthwork	$ 260,000	$ -	20	$ -	$ -	$ -
Valves	$ 100,000	$ -	20	$ -	$ -	$ -
Gates	$ 60,000	$ -	20	$ -	$ -	$ -
Grit Pad	$ 50,000	$ -	40	$ -	$ 30,000	$ 20,000
40 ft x 40 ft CIP/Precast Wall Building	$ 550,000	$ -	40	$ -	$ 280,000	$ 160,000
Misc Metals (Handrail, grating, etc.)	$ 60,000	$ -	40	$ -	$ 30,000	$ 20,000
Doors + OH doors	$ 26,000	$ -	40	$ -	$ 10,000	$ 10,000
NFPA 820 Upgrades						
Subtotal	$ 2,430,000	$ -		$ 40,000	$ 350,000	$ 210,000
Mechanical (20%)	$ 400,000	$ -				
Electrical and Controls (30%)	$ 900,000	$ -				
Painting (1.5%)	$ 40,000	$ -				
Sitework (10%)	$ 250,000	$ -				
Undefined Scope (20%)	$ 490,000	$ -				
Subtotal	$ 4,510,000	$ -				
General Conditions (15%)	$ 680,000	$ -				
Subtotal	$ 5,190,000	$ -				
Supply Chain Escalator (15%) - move under GC subtotal	$ 780,000					
Subtotal	$ 5,970,000	$ -				
Contingencies	$ 900,000	$ -				
Technical Services	$ 1,200,000					
Total Capital Costs	$ 8,070,000	$ -		$ 40,000	$ 350,000	$ 210,000
Present Worth of Capital Costs	**$ 8,070,000**			**$ 40,000**		**$ 210,000**

Estimated Annual O&M Costs	
Relative Labor ($90/hr)	
Maintenance (~2% of equipment)	$ 20,000
Power ($0.06/kWh)	$ 7,000
Total O&M Costs	$ 27,000
Present Worth of O&M	**$ 410,000**

Summary of Present Worth Costs	
Capital Cost	$ 8,070,000
Future Capital Costs/Replacement	$ 40,000
O&M Cost	$ 410,000
Salvage Value	$ (210,000)
Total Present Worth	**$ 8,310,000**

City of Ames, Iowa
Nutrient Reduction Facility Plan
Opinion of Present Worth Cost

Discount Rate 2.875%

Alternative G2 - Smith and Loveless's INVORSOR

ITEM	Initial Capital Cost	Future Capital Cost	Replacement Year	Replacement Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Raw Wastewater Pump Station						
Demolition of TeaCups and Header Box	$ 160,000	$ -	20	$ -	$ -	$ -
Demolition of Conveyor	$ 65,000	$ -	20	$ -	$ -	$ -
Demolition of GritSnails	$ 40,000	$ -	20	$ -	$ -	$ -
New Roof for Equipment Changes						
Structural modifications	$ 20,000	$ -	40	$ -	$ 10,000	$ 10,000
Structural Modifications - roofing, panel removal/replacement		$ -	20	$ -	$ -	$ -
Remove precast hollowcore	$ 40,200	$ -	20	$ -	$ -	$ -
Replace precast hollowcore	$ 67,000	$ -	20	$ -	$ -	$ -
New roof membrane	$ 36,000	$ -	20	$ -	$ -	$ -
Bypass Pumping	$ 80,000	$ -	20	$ -	$ -	$ -
Grit Equipment	$ 714,000	$ -	20	$ -	$ -	$ -
Installation	$ 214,200	$ -	20	$ -	$ -	$ -
Grit Classifier	$ 150,000	$ -	20	$ -	$ -	$ -
Installation	$ 45,000	$ -	20	$ -	$ -	$ -
Stainless Steel Tank	$ 1,170,000	$ -	20	$ -	$ -	$ -
Grit Pumps	$ 40,000	$ -	20	$ 40,000	$ -	$ -
Installation	$ 12,000	$ -	20	$ -	$ -	$ -
Piping and Fittings for Grit Alternatives	$ 80,000	$ -	20	$ -	$ -	$ -
Valves	$ 80,000	$ -	20	$ -	$ -	$ -
Grit Piping	$ 22,400	$ -	40	$ -	$ 10,000	$ 10,000
Grit valves	$ 5,000	$ -	20	$ -	$ -	$ -
Grit removal influent & effluent piping	$ 220,800	$ -	20	$ -	$ -	$ -
Valves	$ 100,000	$ -	20	$ -	$ -	$ -
Gates	$ 10,000	$ -	20	$ -	$ -	$ -
Subtotal	$ 3,380,000	$ -		$ 40,000	$ 20,000	$ 20,000
Mechanical (15%)	$ 510,000	$ -				
Electrical and Controls (20%)	$ 680,000	$ -				
Painting (1.5%)	$ 51,000	$ -				
Sitework (0%)		$ -				
Undefined Scope (20%)	$ 680,000					
Subtotal	$ 5,310,000	$ -				
General Conditions (15%)	$ 800,000	$ -				
Subtotal	$ 6,110,000	$ -				
Supply Chain Escalator (15%)	$ 920,000					
Subtotal	$ 7,030,000	$ -				
Contingencies	$ 1,060,000					
Technical Services	$ 1,410,000					
Total Capital Costs	$ 9,500,000	$ -		$ 40,000	$ 20,000	$ 20,000
Present Worth of Capital Costs	**$ 9,500,000**			**$ 40,000**		**$ 20,000**

Estimated Annual O&M Costs	
Relative Labor ($90/hr)	
Maintenance (~2% of equipment)	$ 19,000
Power ($0.06/kWh)	$ 9,000
Total O&M Costs	$ 28,000
Present Worth of O&M	**$ 420,000**

Summary of Present Worth Costs	
Capital Cost	$ 9,500,000
Future Capital Costs/Replacement	$ 40,000
O&M Cost	$ 420,000
Salvage Value	$ (20,000)
Total Present Worth	**$ 9,940,000**

APPENDIX D
NFPA 820 CLASSIFICATION

RAW WASTEWATER PUMPING STATION

		NFPA 820						TEN STATES STANDARDS FOR WASTEWATER FACILITIES				SAI DESIGN CRITERIA		
Room Number	**Description**	**NFPA 820 Section**	**NFPA Location and Function**	**NEC-Area Electrical Classification**	**Extent of Classified Area**	**Other Requirements**	**Ventilation Requirement to obtain NEC Area Electrical Classification**	**Code Article**	**NEC-Area Electrical Classification**	**Ventilation Requirement**	**Other Requirements**	**NEC-Area Electrical Classification**	**Ventilation Rate**	**Remarks**
EB03	Screenings Room	5.2.2 - Row 2	Coarse and Fine Screen Facilities Grit-Handling	Class I, Division 2, Group D	Entire Space	Fire Extinguister, Hydrant, Combustible Gas Detection	B - Continuously ventilated at 12 ACH	TEN STATES STANDARDS 2014 63.22 TEN STATES STANDARDS 2014 61.13	Class I, Division 1, Groups C & D	12 ACH continuously or 30 ACH intermittently per hour.	Combustible Gas Detection. 100% fresh air.	Class I, Division 1, Groups C & D	12 ACH continuously or 30 ACH intermittently per hour.	This room is connected to the lower and upper level screenings room. The grit removal area is also connected to the upper level screenings area and the grit loadout area. The space also includes a stairwell in the pump room and a stairwell in the screenings area.
E103/EB03	Stair "B"	5.2.2 - Row 2	Coarse and Fine Screen Facilities Grit-Handling	Class I, Division 2, Group D	Entire Space	Fire Extinguister, Hydrant, Combustible Gas Detection	B - Continuously ventilated at 12 ACH	TEN STATES STANDARDS 2014 63.22 TEN STATES STANDARDS 2014 61.13	Class I, Division 1, Groups C & D	12 ACH continuously or 30 ACH intermittently per hour.	Combustible Gas Detection. 100% fresh air.	Class I, Division 1, Groups C & D	12 ACH continuously or 30 ACH intermittently per hour.	This room is connected to the lower and upper level screenings room. The grit removal area is also connected to the upper level screenings area and the grit loadout area. The space also includes a stairwell in the pump room and a stairwell in the screenings area.
EB05	Sample Room	5.2.2 - Row 2	Coarse and Fine Screen Facilities Grit-Handling	Class I, Division 2, Group D	Entire Space	Fire Extinguister, Hydrant, Combustible Gas Detection	B - Continuously ventilated at 12 ACH	TEN STATES STANDARDS 2014 63.22 TEN STATES STANDARDS 2014 61.13	Class I, Division 1, Groups C & D	12 ACH continuously or 30 ACH intermittently per hour.	Combustible Gas Detection. 100% fresh air.	Class I, Division 1, Groups C & D	12 ACH continuously or 30 ACH intermittently per hour.	This room is connected to the lower and upper level screenings room. The grit removal area is also connected to the upper level screenings area and the grit loadout area. The space also includes a stairwell in the pump room and a stairwell in the screenings area.
E104	Grit Removal Room	5.2.2 - Row 5	Coarse and Fine Screen Facilities Grit-Handling	Class I, Division 2, Group D	Entire Space	Fire Extinguister, Hydrant, Combustible Gas Detection	B - Continuously ventilated at 12 ACH	TEN STATES STANDARDS 2014 63.22 TEN STATES STANDARDS 2014 61.13	Class I, Division 1, Groups C & D	12 ACH continuously or 30 ACH intermittently per hour.	Combustible Gas Detection. 100% fresh air.	Class I, Division 1, Groups C & D	12 ACH continuously or 30 ACH intermittently per hour.	This room is connected to the lower and upper level screenings room. The grit removal area is also connected to the upper level screenings area and the grit loadout area. The space also includes a stairwell in the pump room and a stairwell in the screenings area.
EB04	Raw Wastewater Pumping Room	4.2.2 - Row 17a	Abovegrade Wastewater Pumping Station	Class I, Division 2, Group D	Entire Space	Fire Extinguister, Hydrant, Combustible Gas Detection	B - Continuously ventilated at 12 ACH	TEN STATES STANDARDS 2014 42.46	Class I, Division 1, Groups C & D	6 ACH continuously or 30 ACH intermittently per hour.	Air change based on 100% fresh air.	Class I, Division 1, Groups C & D	12 ACH continuously or 30 ACH intermittently per hour.	This room is physically isolated from the wet well from below. There are two "sealed access hatches" in the floor which gain access to the wet well. The space also includes a stairwell in the pump room and a stairwell in the screenings area.
E101/EB01	Stair "A"	4.2.2 - Row 17a	Abovegrade Wastewater Pumping Station	Class I, Division 2, Group D	Entire Space	Fire Extinguister, Hydrant, Combustible Gas Detection	B - Continuously ventilated at 12 ACH	TEN STATES STANDARDS 2014 42.46	Class I, Division 1, Groups C & D	6 ACH continuously or 30 ACH intermittently per hour.	Air change based on 100% fresh air.	Class I, Division 1, Groups C & D	12 ACH continuously or 30 ACH intermittently per hour.	This room is physically isolated from the wet well from below. There are two "sealed access hatches" in the floor which gain access to the wet well. The space also includes a stairwell in the pump room and a stairwell in the screenings area.
E105	Pump Hatch Room	4.2.2 - Row 17a	Abovegrade Wastewater Pumping Station	Class I, Division 2, Group D	Entire Space	Fire Extinguister, Hydrant, Combustible Gas Detection	B - Continuously ventilated at 12 ACH	TEN STATES STANDARDS 2014 42.46	Class I, Division 1, Groups C & D	6 ACH continuously or 30 ACH intermittently per hour.	Air change based on 100% fresh air.	Class I, Division 1, Groups C & D	12 ACH continuously or 30 ACH intermittently per hour.	This room is physically isolated from the wet well from below. There are two "sealed access hatches" in the floor which gain access to the wet well. The space also includes a stairwell in the pump room and a stairwell in the screenings area.
--	Raw Wastewater Wet Well	4.2.2 - Row 14	Wastewater Pumping Station Wet Wells	Class I, Division 1, Group D	Entire Space	Fire Extinguister, Hydrant, Combustible Gas Detection	A- No ventilation or less than 12 ACH	TEN STATES STANDARDS 2014 42.75	Class I, Division 1, Groups C & D	12 ACH continuously or 30 ACH intermittently per hour.	Air shall be mechanically forced into wet well. 100% fresh air.	Class I, Division 1, Groups C & D	12 ACH continuously or 30 ACH intermittently per hour.	This room is physically isolated from the wet well from below. There are two "sealed access hatches" in the floor which gain access to the wet well. The space also includes a stairwell in the pump room and a stairwell in the screenings area.
E102	Grit Loadout Room and Grit Hopper Mezzanine	5.2.2 - Row 5	Grit-Handling Building	Class I, Division 2, Group D	Entire Space	Fire Extinguister, Hydrant, Combustible Gas Detection	B - Continuously ventilated at 12 ACH	TEN STATES STANDARDS 2014 63.22	Class I, Division 1, Groups C & D	12 ACH continuously or 30 ACH intermittently per hour.	Combustible Gas Detection. 100% fresh air.	Class I, Division 1, Groups C & D	12 ACH continuously or 30 ACH intermittently per hour.	This room is connected to the lower and upper level screenings room. The grit removal area is also connected to the upper level screenings area and the grit loadout area and grit hopper mezzanine. The space also includes a stairwell in the pump room and a stairwell in the screenings area.
E106	Electrical Room		Electrical Room	Unclassified	Entire Space				Unclassified			Unclassified		The interior doors to the Electric Room are from a rated space. The interior doors would be required to be blocked and sealed to achieve an Unclassified space. The grit influent line would also need to be relocated out of the electric room.

GRIT REMOVAL

		NFPA 820						TEN STATES STANDARDS FOR WASTEWATER FACILITIES				SAI DESIGN CRITERIA		
Room Number	**Description**	**NFPA 820 Section**	**NFPA Location and Function**	**NEC-Area Electrical Classification**	**Extent of Classified Area**	**Other Requirements**	**Ventilation Requirement to obtain NEC Area Electrical Classification**	**Code Article**	**NEC-Area Electrical Classification**	**Ventilation Requirement**	**Other Requirements**	**NEC-Area Electrical Classification**	**Ventilation Rate**	**Remarks**
New Building, Alternative 1A	Grit Removal	5.2.2 - Row 5c	Grit Removal Tanks	Class I, Division 2, Groups C & D	Within a 3m (10 ft) envelope around equipment and open channel	Fire Extinguisher, Hydrant	Not enclosed, open to atmosphere	TEN STATES STANDARDS 2014 63.23	Class I, Division 2, Groups C & D	N/A	Requires freeze protection	Class I, Division 2, Groups C & D	Not enclosed, open to atmosphere	Classifications apply to Alternative 1A in S9 with outdoor grit removal units.

APPENDIX E
DESIGN CRITERIA

Design Criteria

Parameter	Existing Design Criteria/Current Operation	Phase 1	Phase 2
		Assumes 33% of Influent Flow to BNR AS System	
Wastewater Flow			
Average Dry Weather Flow, MGD	8.6	8.6	8.6
Average Wet Weather Flow, MGD	12.1	15.8	15.8
Maximum Wet Weather Flow, MGD	20.4	24.5	24.5
Peak Hourly Flow, MGD	34.0	40.3	40.3
Wastewater Load			
BOD_5			
Average Day, lb/d	12,430	16,100	16,100
Maximum Month, lb/d	16,150	20,580	20,580
Maximum Day, lb/d	23,740	26,710	26,710
TSS			
Average Day, lb/d	11,560	18,560	18,560
Maximum Month, lb/d	16,190	25,470	25,470
Maximum Day, lb/d	25,440	52,250	52,250
TKN			
Average Day, lb/d	3,540	2,820	2,820
Maximum Month, lb/d	4,950	3,780	3,780
Maximum Day, lb/d	6,930	5,330	5,330
NH_3-N			
Average Day, lb/d	1,970	1,840	1,840
Maximum Month, lb/d	2,750	2,400	2,400
Maximum Day, lb/d	3,850	3,430	3,430
Screening			
Mechanically Raked	1	1	1
Bar Spacing, in.	3/8	3/8	3/8
Capacity, MGD	13.3	20.2	20.2
Mechanically Raked	2	**1**	1
Bar Spacing, in.	1/2	**3/8**	3/8
Capacity, MGD	13.3	**20.2**	20.2
Raw Wastewater Pumping			
Number of Pumps	3 + 1 standby	3 + 1 standby	3 + 1 standby
Type	Vertical Turbine	Vertical Turbine	Vertical Turbine
Capacity - each, MGD	7.9	8.2	8.2
Capacity - firm, MGD	20.4	24.5	24.5
Equalization Pumping			
Number of Pumps	2	2	2
Type	Vertical Turbine	Vertical Turbine	Vertical Turbine
Capacity - each, MGD	7.9	7.9	7.9
Capacity - total, MGD	15.8	15.8	15.8
Equalization Basins			
Number	2	2	2
Volume - each, MG	2.2	2.2	2.2
Grit Removal			
Number of Units	4	**2**	2
Type	Free Vortex Centrifugal	**Stacked Tray**	Stacked Tray
Capacity - total, MGD	20.4	**24.5**	24.5
Primary Clarification			
Number of Units	4	4	4
Feed type	Center Feed	Center Feed	Center Feed
Diameter, ft	70	70	70
Sidewater Depth, ft	9	9	9
Surface Area, sq ft per unit	3,848	3,848	3,848
Design Hydraulic Loading Rate, gal/day/sq ft			
Average Day Weather	559	559	559
Average Wet Weather	786	1,027	1,027
Maximum Wet Weather	1,325	1,592	1,592
Trickling Filter Pumping			
First-Stage Trickling Filter Pumps			
Number of Pumps	3 + 1 standby	3 + 1 standby	4 + 1 standby
Type	Vertical Turbine	Vertical Turbine	Vertical Turbine
Capacity - total, MGD	20.4	20.4	24.5
Second-Stage Trickling Filter Pumps			
Number of Pumps	3 + 1 standby	3 + 1 standby	Trickling Filters Out of Service
Type	Vertical Turbine	Vertical Turbine	-
Capacity - total, MGD	23.4	23.4	-
Trickling Filters			Trickling Filters Out of Service
First-Stage Trickling Filters			
Number of Units	2	2	-
Diameter, ft	80	80	-
Media Depth, ft	26	26	-
Media			
Type	Plastic	Plastic	-
Orientation	60 degree Cross Flow	60 degree Cross Flow	-
Density, sq ft/cu ft	30	30	-
Media Area - each, sf	3,920,000	3,920,000	-
Media Volume - each, cf	130,690	130,690	-
Hydraulic Loading, gal/min/sq ft			
Minimum	0.5	0.5	-
Maximum	2.09	2.09	-
Organic Loading, lb/day/1,000 cu ft			
Average Annual	34.0	26.4	-
Average Day Maximum Month	46.3	33.8	-
Maximum Day	68.9	43.8	-
Hydraulic Application			
Type	Rotary Distributor	Rotary Distributor	-

Application Rate per Distributor, gpm			
Minimum	2,500	2,500	-
Maximum	10,500	10,500	-
Second-Stage Trickling Filters			Trickling Filters Out of Service
Number of Units	2	2	-
Diameter, ft	80	80	-
Media Depth, ft	26	26	-
Media			
Type	Plastic	Plastic	-
Orientation	60 deg Cross Flow	60 deg Cross Flow	-
Density, sq ft/cu ft	50	50	-
Media Area - each, sf	6,530,000	6,530,000	-
Media Volume - each, cf	130,690	130,690	-
Hydraulic Loading, gal/min/sq ft			
Minimum	1	1	-
Maximum	2.09	2.09	-
Hydraulic Application			
Type	Rotary Distributor	Rotary Distributor	-
Application Rate per Distributor, gpm			
Minimum	5,000	5,000	-
Maximum	10,500	10,500	-
Solids Contact Process			Solids Contact Basins Converted
Solids Contact Basins			To Anaerobic Zones.
Number of Basins	2	2	See BNR Activated Sludge Below.
Number of Cells per Basin	5	5	-
Cell Width, ft	18	18	-
Cell Length, ft	18	18	-
Sidewater Depth, ft	15	15	-
Total Basin Volume, cu ft (gallons)	48,600 (364,000)	48,600 (364,000)	-
Hydraulic Retention Time, minutes			
Average Dry Weather	61	92	-
Average Wet Weather	43	50	-
Maximum Wet Weather	26	32	-
Aeration Equipment			
Type	Fine Bubble	Fine Bubble	-
Sludge Reaeration Basins			
Number of Basins	2	2	-
Basin Width, ft	14	14	-
Basin Length, ft	28	28	-
Sidewater Depth, ft	15	15	-
Total Basin Volume, cu ft (gallons)	11,760 (88,000)	11,760 (88,000)	-
Aeration Equipment			
Type	Fine Bubble	Fine Bubble	-
Solids Contact Aeration Blowers			
Number of Blowers	2 + 1 standby	2 + 1 standby	Out of Service
Type	Centrifugal	Centrifugal	-
Capacity - Each, scfm	1,300	1,300	-
Capacity - Total, scfm	3,300	3,300	-
Biological Nutrient Removal Activated Sludge			
Process	-	**MLE/SNDN**	**MLE/SNDN with S2EBPR**
Number of Activated Sludge Trains	-	**2**	**4**
Total Anaerobic Zone Volume, gal	-	**-**	**600,000**
Dimensions of Each Anoxic Zone, ft x ft x ft	-	**66 x 22.5 x 22**	**66 x 22.5 x 22**
Total Anoxic Zone Volume, gal	-	**490,000**	**980,000**
Dimensions of Each Aerated Zone, ft x ft x ft	-	**254 x 22.5 x 22**	**254 x 22.5 x 22**
Total Aerated Zone Volume, gal	-	**1,880,000**	**3,760,000**
Total Activated Sludge System Volume, gal	-	**2,370,000**	**4,740,000**
Total HRT at ADWF, hr	-	**20.0**	**13.2**
Total HRT at AWWF, hr	-	**10.9**	**7.2**
Total HRT at MWWF, hr	-	**7.0**	**4.6**
Aerobic HRT at ADWF, hr	-	**15.9**	**10.5**
Aerobic HRT at AWWF, hr	-	**8.7**	**5.7**
Aerobic HRT at MWWF, hr	-	**5.6**	**3.7**
Anoxic HRT at ADWF, hr	-	**4.1**	**2.7**
Anoxic HRT at AWWF, hr	-	**2.3**	**1.5**
Anoxic HRT at MWWF, hr	-	**1.5**	**1.0**
Minimum Design Wastewater Temperature, degrees Celsius	-	**10**	**10**
Nitrification Design SRT (Coefficients from *Wastewater Engineering* by Metcalf and Eddy, 5th Edition)	-		
Maximum Specific Nitrifier Growth Rate at 10C, g VSS /g VSS*day	-	**0.38**	**0.38**
Nitrifier Half-Velocity Constant at 10C, g NH_3-N/m^3	-	**0.44**	**0.44**
Nitrifier Decay Rate at 10C, g VSS /g VSS*day	-	**0.05**	**0.05**
Reactor Dissolved Oxygen Concentration, mg/L	-	**2**	**2**
Half-Velocity Constant for Dissolved Oxygen, mg/L	-	**0.5**	**0.5**
Minimum SRT for nitrification, d	-	**6.3**	**6.3**
Safety Factor	-	**2**	**2**
Design SRT, d	-	**12.6**	**12.6**
Aeration Requirements			
Annual Average assuming 35% BOD_5 and 10% TKN removal in PCs, 350 lb TKN/d in return flow			
BOD, lbs Oxygen per Day, Oxygen Req. 1.1 lb O_2/lb BOD	-	**5,844**	**11,512**
TKN, lb Oxygen per Day, Oxygen Req. 4.6 lb O_2/lb TKN	-	**4,812**	**13,124**
Denitrification Credit , lb Oxygen per Day, Assuming 10 mg/L effluent NO_3-N	-	**2,315**	**6,208**
Maximum Month assuming 35% BOD_5 and 10% TKN removal in PCs, 350 lb TKN/d in return flow			
BOD, lbs Oxygen per Day, Oxygen Req. 1.1 lb O_2/lb BOD	-	**7,471**	**14,715**
TKN, lb Oxygen per Day, Oxygen Req. 4.6 lb O_2/lb TKN	-	**6,269**	**17,098**
Denitrification Credit , lb Oxygen per Day, Assuming 10 mg/L effluent NO_3-N	-	**3,898**	**6,962**
Standard Oxygen Transfer Efficiency, SOTE	-	**42%**	**42%**
Barometric Pressure at Site, in Hg	-	**28.97**	**28.97**
Barometric Pressure at Sea Level, in Hg	-	**29.92**	**29.92**
Target DO, mg/L	-	**2.0 (Conventional BNR); 0.5-1.0 (SNDN)**	**2.0 (Conventional BNR); 0.5-1.0 (SNDN)**
C^{sat20}	-	**9.09**	**9.09**
C^{T}	-	**9.09**	**9.09**
Alpha	-	**0.5**	**0.5**
Beta	-	**0.98**	**0.98**
Temperature, °C	-	**20**	**20**
$Theta^{(T-20)}$	-	**1.0**	**1.0**
Field Correction Factor	-	**0.36**	**0.36**
Standard Oxygen Required			
Average Loading, (b/day	-	**22,900**	**50,600**

Maximum Monthly Loading, lb/day	-	**27,000**	**68,200**
Air Required - Average Day Loading, scfm	-	**2,180**	**4,810**
Air Required - Maximum Month Loading, scfm	-	**2,570**	**6,480**
Peaking Factor to Maximum Airflow	-	**1.6**	**1.6**
Biological Nutrient Removal Aeration Blowers			
Type	-	**High Speed Turbo**	**High Speed Turbo**
Number	-	**3**	**4**
Capacity, firm, scfm	-	**6,400**	**10,400**
Diffusers			
Type	-	**Fine Bubble Membrane**	**Fine Bubble Membrane**
Nitrified Mixed Liquor Recycle Pumps			
Type	-	**Submersible**	**Submersible**
Number	-	**2**	**4**
Capacity, each (MGD)	-	**10.5**	**10.5**
Final Clarifiers			
Number of Units	4	4	4
Type	Flocculation	Flocculation	Flocculation
Feed Type	Center Feed	Center Feed	Center Feed
Diameter, ft	100	100	100
Sidewater Depth, ft	14	14	14
Surface Area, sq ft per unit	7,854	7,854	7,854
Design Hydraulic Loading Rate, gal/day/sq ft			
Four Intermediate or Four Final Clarifiers			
Average Dry Weather	274	274	274
Average Wet Weather	385	385	385
Maximum Wet Weather	649	649	649
Two Intermediate and Two Final Clarifiers			
Average Dry Weather	547	547	547
Average Wet Weather	770	770	770
Maximum Wet Weather	1,299	1,299	1,299
Maximum Solids Loading, lb/day/sq ft	50	50	50
Waste Sludge Pumping			
Number of Units	2 + 1 standby	2 + 1 standby	2 + 1 standby
Type	Centrifugal (two), Air-Operated Diaphragm (one)	Centrifugal (two), Air-Operated Diaphragm (one)	Centrifugal (two), Air-Operated Diaphragm (one)
Capacity - Each, gpm	55 to 550	55 to 550	55 to 550
Capacity - Total, gpm	1,500	1,500	1,500
Return Sludge Pumping - Solids Contact			
Number of Units	2 + 1 standby	2 + 1 standby	Solids Contact Basins Out of Service
Type	Screw	Screw	-
Capacity - Each, gpm	4,200	4,200	-
Capacity - Total, gpm	8,400	8,400	-
Lift, ft	22.92	22.92	-
Screw Diameter, in.	54	54	-
Return Sludge Pumping - Biological Nutrient Removal Activated Sludge			
Number of Units	-	**5**	5
Type	-	**Centrifugal**	Centrifugal
Capacity - Each, gpm	-	**2,743**	2,743
Capacity - Firm, gpm	-	**10,972**	10,972
Disinfection			
Type	Ultraviolet	Ultraviolet	Ultraviolet
Orientation	Horizontal Parallel Flow	Horizontal Parallel Flow	Horizontal Parallel Flow
Number of Banks	2	2	2
Capacity - MGD	25	25	25
Effluent Reaeration Structure			
Number of Units	1	1	1
Type	Cascade	Cascade	Cascade
Selective Wasting System			
Type	-	**Hydrocyclone Densification**	**Hydrocyclone Densification**
WAS Thickening			
Type	Cothickening in Primary Clarifiers	Cothickening in Primary Clarifiers	**Gravity Belt Thickener**
Number	-	-	**2**
Capacity- each, lb/hr	-	-	**2,000**
WAS Storage			
Total Volume	-	-	**350,000**
Days of Storage at Maximum Month Loading	-	-	**3**
Mixing Type	-	-	**Diffused Air**
Primary Anaerobic Digesters			
Number	2	2	2
Cover Type	Fixed	Fixed	Fixed
Diameter, ft	65	65	65
Sidewater Depth, ft	29	29	29
Volume - Each, cf (w/o cone)	96,000	96,000	96,000
Volume - Each, gal (w/o cone)	720,000	720,000	720,000
Hydraulic Detention Time, days			
Annual Average	91	31	25
Maximum Month	67	39	18
Solids Loading Rate, lb VS/1,000 cf/day			
Annual Average	27	54	66
Maximum Month	37	74	92
Digester Mixing			
Type	Draft Tubes		
Digester Heating			
Type	Draft Tube Heating Jackets	Draft Tube Heating Jackets	Draft Tube Heating Jackets
Number of Units per Digester	1	1	1
Digester Operating Temperature, deg F	95	95	95
Hot Water Recirculation Pumps			
Type	Centrifugal	Centrifugal	Centrifugal
Number of Units	2	2	2
Capacity, gpm	350	350	350
Secondary Anaerobic Digester			
Number	1	1	1
Cover Type	Floating Gasholder	Floating Gasholder	Floating Gasholder
Diameter, ft	80	80	80
Sidewater Depth, ft	24.6	24.6	24.6

Volume Each, cf (w/o cone)	124,000	124,000	124,000
Volume Each, gal (w/o cone)	925,000	925,000	925,000
Gasholder			
Depth of Usable Storage, ft	7.4	7.4	7.4
Storage Volume, cf	36,000	36,000	36,000
Vertical Movement	Spiral-guided	Spiral-guided	Spiral-guided
Digested Sludge Pumps			
Type	Progressing Cavity	Progressing Cavity	Progressing Cavity
Number	2	2	2
Capacity - Each, gpm	600	600	600
Sludge Storage Lagoon			
Number	1	1	1
Minimum Depth, ft	2	2	2
Length, ft x Width, ft at 2 ft	80 x 160	80 x 160	80 x 160
Maximum Liquid Depth, ft	17	17	17
Freeboard, ft	3	3	3
Sideslopes, Horizontal: Vertical	3:01	3:01	3:01
Volume, cf	415,000	415,000	415,000
Volume gal	3,100,000	3,100,000	3,100,000