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Report for

City of Beloit, Wisconsin

Water Pollution Control Facility Facilities Plan

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EXECUTIVE SUMMARY

ES.01 INTRODUCTION

This report reviews the existing City of Beloit (City) Water Pollution Control Facility (WPCF) and provides a basis of design for improvements at the WPCF. These recommended improvements allow the City to continue to meet the requirements of its discharge permit through the design year of 2045 at the lowest practical costs to the users, while also allowing for growth of residential, commercial, institutional, and industrial user bases.

There are ten sections in this report. Section 1 introduces the report. Section 2 describes the collection and conveyance system. Section 3 describes the existing WPCF. Section 4 reviews existing flows and loads to the WPCF and develops flow and load projections for the 10- and 25-year planning periods. Section 5 describes the current and potential future regulatory requirements for the WPCF. Section 6 provides an evaluation of the existing facilities and describes alternatives that were considered to identify the most cost-effective treatment and biosolids management options. Section 7 provides monetary and nonmonetary evaluations of each of the alternatives and provides descriptions and costs for common project elements required to address deficiencies at the WPCF. Section 8 describes the recommended plan and provides and overall cost summary, preliminary financing plan for the proposed improvements, an analysis of the financial impact of the project, and the expected projects schedule. Section 9 provides a summary of the environmental impacts resulting from the project. Section 10 (to be developed following completion of the public hearing and public comment period) documents public comment through the public hearing and public comment period.

ES.02 SUMMARY OF WASTEWATER CONVEYANCE SYSTEMS

The City presently operates and maintains collection and conveyance facilities that serve residential, commercial, and industrial users in the City. Conveyance facilities owned and operated by the City include 11 lift stations, more than 172 miles of sanitary sewer, approximately six miles of force main, and 3,500 manholes. The City's sanitary sewer collection system is mapped in a geographical information system (GIS). After treatment, the WPCF effluent is pumped through an effluent return pipe to the Rock River where it is discharged.

The City significantly reduced infiltration and inflow (I/I) in the late 1990s and early 2000s as the result of several collection system rehabilitation and I/I removal projects. I/I at the WPCF dropped significantly as a result of these efforts. However, an upward trend in flows, especially during periods of high water levels in the Rock River, has been experienced in the last two to three years. The City suspects that these increases in I/I induced by high river levels is the result of previously grouted sanitary sewer defects near the river that have begun to fail. The City is actively investigating these sources of I/I and continues to place a high priority on removing I/I from its collection system.

The United States Environmental Protection Agency (USEPA) criteria for maximum per capita flows during periods of high ground water conditions is 120 gallons per capita per day (gpcd). USEPA criteria for maximum per capita flow rates during peak rainfall events is 275 gpcd. Because per capita flows in the City are less than USEPA thresholds for excessive I/I during periods of high groundwater as well as the total per capita flows during rainfall events, no additional I/I, or sanitary sewer evaluation studies (SSES) are included in this facilities plan.

ES.03 EVALUATION OF EXISTING FACILITIES

Figure ES.03-1 shows the current WPCF, which was originally constructed in 1992 replacing the previous WPCF located on the west bank of the Rock River near the Illinois border. The WPCF consists of influent raw wastewater screening, vortex grit removal, primary sedimentation, activated sludge treatment, secondary clarification, liquid sodium hypochlorite disinfection, dechlorination, thickening of primary and waste activated sludge (WAS) by means of a gravity belt thickener (GBT), anaerobic digestion of primary sludge and WAS, gravity belt thickening of digested sludge, storage of thickened digested sludge, and land application of thickened digested sludge. A portion of the thickened digested sludge is also dewatered using a belt filter press (BFP) and disposed of at the City of Janesville landfill. Biogas generated during anaerobic digestion is used to fire boilers that provide heat to the digestion process and buildings and excess biogas is flared. Treated effluent is discharged to the Rock River.

In 1997, a second liquid biosolids storage tank was constructed. Additional odor control, serving the Process Building, was constructed in 2010 in anticipation of a possible casino development adjacent to the WPCF site. A BFP was also constructed as part of the 2010 project. Construction of a new digester mixing system and building is currently underway and nearly complete.

The facilities were designed to provide complete treatment for flows and loads up to those presented in Table ES.03-1

The Wisconsin Pollution Discharge Elimination System (WPDES) permit currently in effect contains monthly and weekly carbonaceous biochemical oxygen demand (CBOD) limits of 25 milligrams per liter (mg/L) and 40 mg/L, respectively. The WPDES permit also contains monthly and weekly average total suspended solids limits of 30 mg/L and 45 mg/L, respectively, as well as daily mass limits that vary from 845 pounds per day (lbs/day) to 3,255 lbs/day. An ammonia limit of 17 mg/L and phosphorus limit of 2.0 mg/L are also included in the WPDES permit. The Wisconsin Department of Natural Resources (WDNR) is currently in the process of reissuing the City's WPDES permit.

Figure ES.03-1 Existing WPCF Site Plan

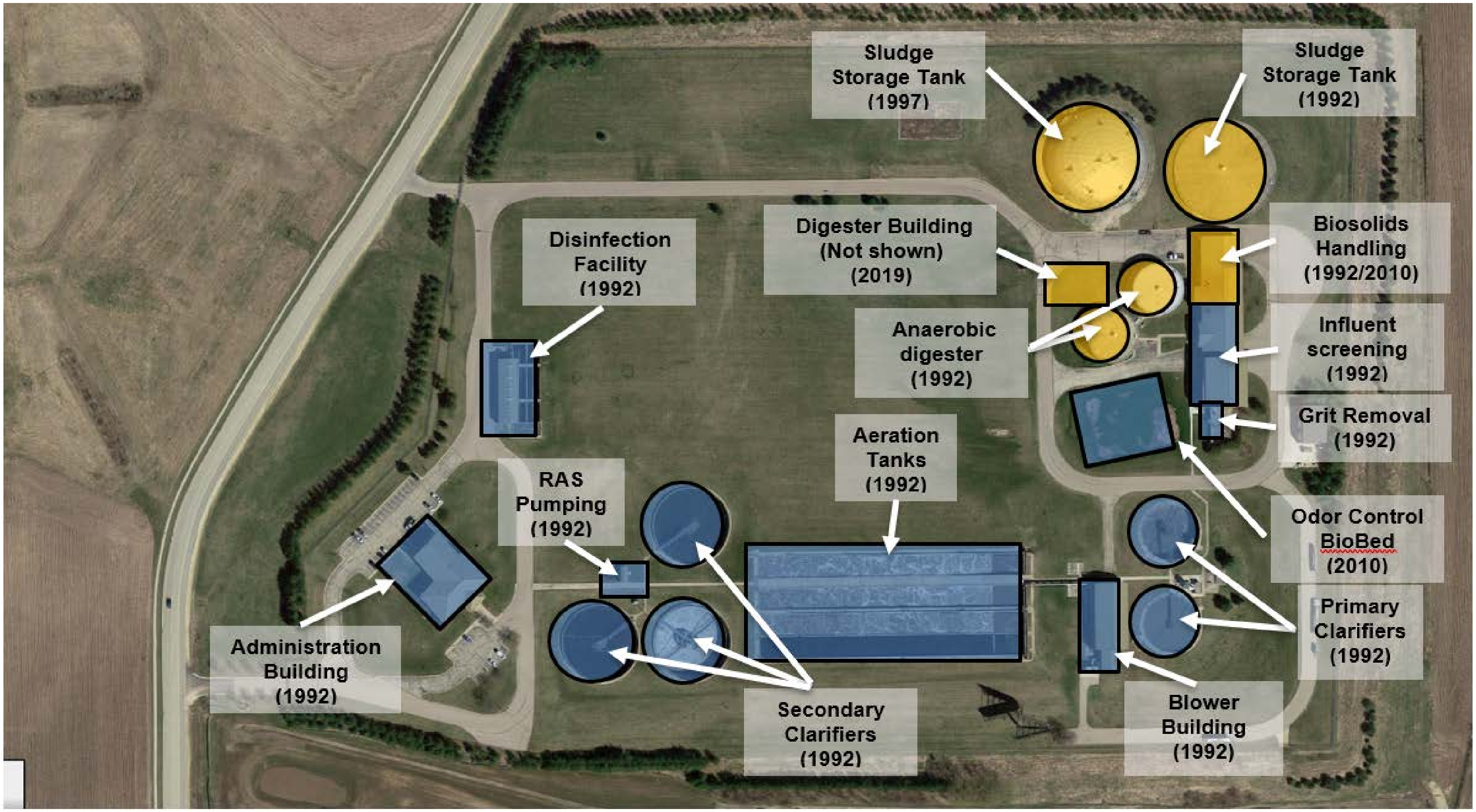

Table ES.03-1 WPCF Processes Summary

Current Rated WPCF Capacity	
Design Average Flow (DAF)[A]	11.0 MGD
Maximum Month Flow (MMF)[E]	13.2 MGD
Maximum Day Flow (DMF)[B]	22.4 MGD
Peak Hourly Flow (PHF)[D]	28.3 MGD
Maximum Month Five-Day Biochemical Oxygen Demand (BOD_5)[C]	60,400 lbs/day
Maximum Month Total Suspended Solids (TSS)[B]	37,310 lbs/day
Maximum Month Ammonia Nitrogen (NH_3-N)[B]	3,515 lbs/day

Notes:
[A]Information from Wisconsin Pollutant Discharge Elimination System (WPDES) permit.
[B]Information from July 1989 WPCF Record Drawings by CH2MHILL
[C]Information from May 31, 2018 WPCF re-rating acceptance letter from Wisconsin Department of Natural Resources (WDNR)
[D]Information from 1991 Operations and Maintenance Manual.
[E]Information from WDNR letter dated May 31, 2018.
MGD = million gallons per day
lbs/day = pounds per day

Description	Unit Specifications
Screening	
Number	Two
Type	Mechanically-cleaned bar screen
Opening	6 millimeters
Capacity	14.0 MGD
Screenings Wash Press	
Number	One
Grit Removal and Processing	
Number	Two
Type	Vortex
Capacity	14.0 MGD (each)
Grit Pumping	Centrifugal
Number of Grit Pumps	Two
Grit Processing	Classifier
Number of Grit Classifiers	Two
Influent Flow Measurement	
Number	Two (one on each influent force main)
Type	Magnetic Flow Meter
Size	30-inch
Primary Clarification	
Number	Two
Type	Circular
Size, each	100-foot-diameter
Side Water Depth	12 feet
Volume, Total	1,400,000 gallons
Surface Area, Total	15,700 square feet

Surface Overflow Rate	
@ DAF (11.0 MGD)	700 gpd/sq ft
@ PHF (28.3 MGD)	1,800 gpd/sq ft
Weir Length (Total)	582 feet
Weir Overflow Rate	
@ DAF (11.0 MGD)	17,500 gal/ft/day
Aeration Basins	
Number	Four
Size (Selectors)	50 feet x 38 feet x 15.9 feet SWD
Volume, total (Selectors)	904,000 gallons
Size (Aeration Basins)	385 feet x 38 feet x 15.9 feet SWD
Volume, total (Aeration Basins)	6,960,000 gallons
Volume, total (Selectors and Aeration Basins)	7,864,000 gallons
Detention Time (Total, Selectors and Aeration Basins)	
@ DAF (11.0 MGD)	17.2 hours
@ DMF (22.4 MGD)	8.4 hours
Aeration Blowers	
Number	5 centrifugal
Capacity, Each	Two at 6,700 scfm, three at 10,000 scfm
Capacity, Firm	33,400 scfm
Secondary Clarification	
Number	Three
Type	Circular, Center Feed
Diameter	125 feet
SWD	16.1 feet
Surface Area–Total	36,800 square feet
Volume, Total	4,432,000 gallons
Surface Overflow Rate	
@DAF (11 MGD)	300 gpd/sq ft
@ PHF (28.3 MGD)	770 gpd/sq ft
Weir Length, Total	1,105 feet
Weir Overflow Rate @ DAF (11.0 MGD)	9,955 gal/ft
Chlorine Contact Tank	
Number	Two
Volume (total)	496,000 gallons
Chlorination	Sodium Hypochlorite
Dechlorination	Sodium Bisulfite
Anaerobic Digestion Tanks	
Number	Two
Size, each	80-foot-diameter x 36-foot SWD
Volume, total	2,700,000 gallons

Digester Mixing	
Number	Three pumps, one mixing system per digester
Type	Pumped, Jet Mix
GBT	
Number	Three (two typically used for WAS thickening, one typically used for digested sludge thickening)
Size	2 meters
WAS Loading Rate, Each GBT	450 gpm, 1,800 lb TS/hr
Digested Sludge Thickening Loading Rate, Each GBT	250 gpm, 3,750 lb TS/hr
BFP	
Number	One
Size	2 meters
Loading Rate	Intermittent use only as needed
Biosolids Storage Tanks	
Number	Two
Diameter, Tank 1	160 feet
SWD, Tank 1	25 feet
Volume, tank 1	3,900,000 gallons
Diameter, Tank 2	160 feet
SWD, Tank 2	28 feet
Volume, Tank 2	4,200,000 gallons
Volume, Total	8,100,000 gallons

Notes:
gpd/sq ft = gallons per day per square foot
gal/ft/day = gallons per foot per day
SWD = side water depth
scfm = standard cubic feet per minute
gpm = gallons per minute
lb TS/hr = pounds total solids per hour

ES.04 WASTELOAD AND FLOW FORECASTS

A total year 2045 population of 40,276 (which includes some areas of the Town of Beloit that would be served by City sewer if developed) was used to project future flows and loadings. It is anticipated that institutional and light commercial flows will rise proportionately with residential growth.

The City's WPCF also serves several significant industrial users (SIUs). Meetings were held with each SIU early in the planning process to understand how their plans for growth may impact the projected flows and loads at the WPCF. In addition to the SIUs, it is anticipated that the Ho-Chunk Nation will develop the parcel immediately north of the WPCF site with a casino, hotel, convention center, and possibly a water park, all of which could generate significant additional flows and loads to the WPCF.

Table ES.04-1 presents the year 2045 design flows and loads, resulting from anticipated growth from the residential, commercial, institutional, and industrial users.

	Average Day	Maximum Month	Maximum Week	Maximum Day	Peak Hourly
Flow (MGD)	7.44[2]	12.35[4]	14.95[5]	20.53[3]	28.30
COD Load (lbs/day)	76,490	119,620	130,030	188,170	
BOD Load (lbs/day)[1]	38,250	59,810[6]	65,020	94,090	
TSS Load (lbs/day)	16,360	36,310	36,310	78,860	
NH_3-N Load (lbs/day)	1,623	2,698	2,698	2,726	
TP Load (lbs/day)	674	1,593	1,630	3,786	

[1]BOD load converted from COD using ratio of 0.50 lb BOD to 1 lb COD
[2]Existing WPCF is rated for a daily average flow of 11.0 MGD, which will remain as the rated capacity and design flow.
[3]Existing WPCF is rated for a maximum day flow of 22.4 MGD, which will remain as the rated maximum day capacity and design flow.
[4]Existing WPCF is rated for a maximum month flow of 13.2 MGD, which will remain as the rated maximum month capacity and design flow
[5]Existing WPCF is rated for a maximum week flow of 19.2 MGD, which will remain as the rated maximum week capacity and design flow.
[6]Current rated maximum month WPCF BOD capacity is 60,400 lb/day, which will remain as the rated maximum month BOD capacity and design load.

Table ES.04-1 Design Flow and Load Summary (Year 2045)

ES.05 WATER QUALITY STANDARDS AND DISCHARGE PERMIT REQUIREMENTS

The current WPDES permit was issued July 1, 2020, and expired June 30, 2020. WDNR was in the process of reissuing the WPDES permit at the time of this report writing. A review of current and anticipated future national and state regulatory strategies identified the following major areas that may be affected by changes:

1. The Final Compliance Alternatives Plan for phosphorus identified water quality trading (WQT) with nonpoint sources as a cost-effective compliance method. It appears likely that the City will need to have best management practices (BMPs) in place and generating credits by around mid-2022.

2. New ammonia-nitrogen and total nitrogen (TN) limits appear likely within the next decade or so.

3. The WPCF will have *E. coli*, instead of fecal coliform, effluent limits in its next reissued permit.

4. Per- and polyfluoroalkyl substances (PFAS) and other compounds of emerging concern are likely to affect the City's pretreatment program scope in the short term and may require tertiary treatment in the long term.

5. Programs and regulations related to phosphorus and PFAS in surface waters and groundwater may reduce the allowable biosolids application rate or may make land application site criteria more restrictive. This will likely result in the need for more land and/or longer hauling distances over the next several years and associated higher biosolids disposal costs. Changing weather patterns and farming practices may also adversely impact the biosolids land application program.

6. To the extent practical, any tertiary treatment technologies that are considered for one pollutant, such as PFAS, should also consider removal of other pollutants, like nutrients and pathogens, to improve the benefit-to-cost ratio.

ES.06 EVALUATION OF EXISTING FACILITIES AND SCREENING OF POTENTIAL ALTERNATIVES

Each process (including ancillary major electrical and heating, ventilation, and air conditioning [HVAC] components) at the WPCF was evaluated for its ability to provide reliable treatment for the projected flows and loads, through the design year 2045. During this process, each piece of equipment was evaluated and assigned a condition and importance score. The product of the condition and importance scores were used to prioritize equipment for replacement. In general, several pieces of equipment have reached the end of their useful life and will require replacement with the 0- to 5-year, 6- to 10-year, or 11- to 15-year periods. In addition to equipment replacement needs, the following specific deficiencies or concerns were noted during this review:

1. Grout on the bottom of the primary and final clarifiers is popping and spalling in areas.

2. Slide gate frames and concrete within the primary clarifier splitter box are in poor condition.

3. Concrete within the aeration distribution box is severely corroded.

4. The activated sludge process has inadequate capacity considering the projected future loads, current operating preferences, potential future ammonia limits, and potential slug loadings.

5. Existing aeration blowers are inefficient, and two blowers are inoperable.

6. The disinfection system is undersized for the current peak flows. Chemical handling presents operator safety issues.

7. Short biosolids application windows, along with changing farming practices and other pressured on the biosolids disposal program, have required dewatering and landfilling of a significant volume of sludge. The dewatered cake pumping system prevents the sludge from being dewatered to a desirable solids concentration, significantly increasing the volume and cost of landfilled biosolids.

8. The potential for a significant development immediately adjacent to the WPCF requires careful consideration of odor control measures at the WPCF.

Two alternatives were evaluated to address activated sludge deficiencies; two alternatives were evaluated to address the disinfection process deficiencies; three alternatives were evaluated to address odor control deficiencies; and three alternatives were evaluated to address the biosolids program deficiencies. Additionally, a number of other improvements common to the various alternatives evaluations were proposed to alleviate concerns listed previously and also to address equipment replacement needs.

ES.07 EVALUATION OF ALTERNATIVES

Alternative AS1–Expansion of Activated Sludge System with Current Anaerobic/Oxic (A/O) Configuration was the treatment alternative with the lowest capital cost and 20-year present worth costs, as well as the most favorable nonmonetary factors. Implementation of this alternative would involve:

1. Addition of two activated sludge trains adjacent to existing tanks, each with a volume of approximately 1.95 million gallons (MG) to match existing trains.

2. Addition of new submersible anaerobic mixers in new trains and replacement of existing anaerobic mixers in existing trains.

3. Addition of new fine bubble diffusers in all activated sludge trains.

4. Replacement of two existing blowers with three high speed turbo blowers, each with a capacity of approximately 10,000 standard cubic feet per minute (scfm).

5. Replacement of air distribution piping as necessary for installation of new blowers and construction of new activated sludge trains.

6. Addition of a new blower control system, including new instrumentation and wiring.

7. HVAC improvements in the Blower Building.

Alternative D2–Ultraviolet (UV) Disinfection is the selected disinfection alternative. This alternative had the most favorable non-monetary factors and also allows the existing chemical storage space to be repurposed for use for backup chemical phosphorus removal. Implementation of this alternative would involve:

1. Modification of channels and walls of the chlorine contact tank for the installation of a UV disinfection system and fixed weir tank. Provide channel covers to minimize the growth of algae.

2. Installation of fixed weir troughs for level control.

3. Installation of the UV disinfection system.

4. Installation of slide gates.

5. Replacement of grit pumps and associated piping.

6. Removal of existing chlorination equipment.

7. Installation of the metal roof over the UV disinfection system.

Alternative OC2–Biofilter is the selected odor control alternative because of its present worth costs being near the lowest cost alternative and its non-monetary benefits such as reduction of chemical use and handling. Implementation of this alternative would involve:

1. Replacement of existing chemical scrubber with biofilter, including new fans and controls.

2. Modification of odorous air ducts to connect to the new biofilter.

3. Addition of concrete pavement at the location of the new biofilter.

4. Modification of water piping to connect to the new biofilter.

Alternative B3–Drying is the selected biosolids management alternative. It is within 10 percent of the lowest biosolids management alternative while also offering significant non-monetary benefits. It also significantly reduces the risk of additional pressures from future regulatory constraints on biosolids disposal. Implementation of this alternative would involve:

1. Replacement of GBT with a dewatering centrifuge with capacity of approximately 1,200 pounds per hour (lbs/hour).

2. Addition of new centrifuge feed pumps to replace the existing GBT feed pump.

3. Addition of new drying equipment, including cake feed hopper, conveyors, heat exchanges, thermal fluid heater system, dryer, and off-gas handling equipment.

4. Addition to the Process Building to house drying equipment and a new truck loadout area (or other type of storage and loadout facility) east of the existing thickening and dewatering room, including new biosolids conveyors from the centrifuge and belt filter press (BFP) to dryer.

Other project elements were recommended to address additional deficiencies and equipment replacement needs at the WPCF. These elements are listed in Table ES.08-1.

ES.08 SELECTION OF RECOMMENDED ALTERNATIVES AND FISCAL IMPACT SUMMARY

Recommended plan elements are listed in Table ES.08-1 and major elements effecting the site are shown on Figure ES.08-1. The opinion of probable costs for the recommended 0-5 year improvements is $42,456,000 (second quarter 2020 cost basis). Projecting this amount to an anticipated 2022 bid date and applying an annual construction inflation rate of 3 percent annually results in an anticipated opinion of probable costs of $45,040,000. The WPCF improvements are anticipated to be funded as shown in Table ES.08-2. The remaining amount to be financed through the Clean Water Fund (CWF) loan program results in an annual debt service payment of approximately $1,840,000.

Source	Amount
Vehicle Replacement Fund	$1,500,000
Existing Fund Balance	$5,000,000
New and Future Surplus Revenue[1]	$6,160,000
CWF Principal Forgiveness	$750,000
EDA Grant (estimated)	$3,000,000
CWF Loan	$28,630,000
Total Project Cost	**$45,040,000**

[1]Based on anticipated rate increases of 3.0 percent in 2021 and 4.5 percent annually from 2023 to 2024.

Table ES.08-2 Sources of Funds for 0- to 5-Year WPCF Project

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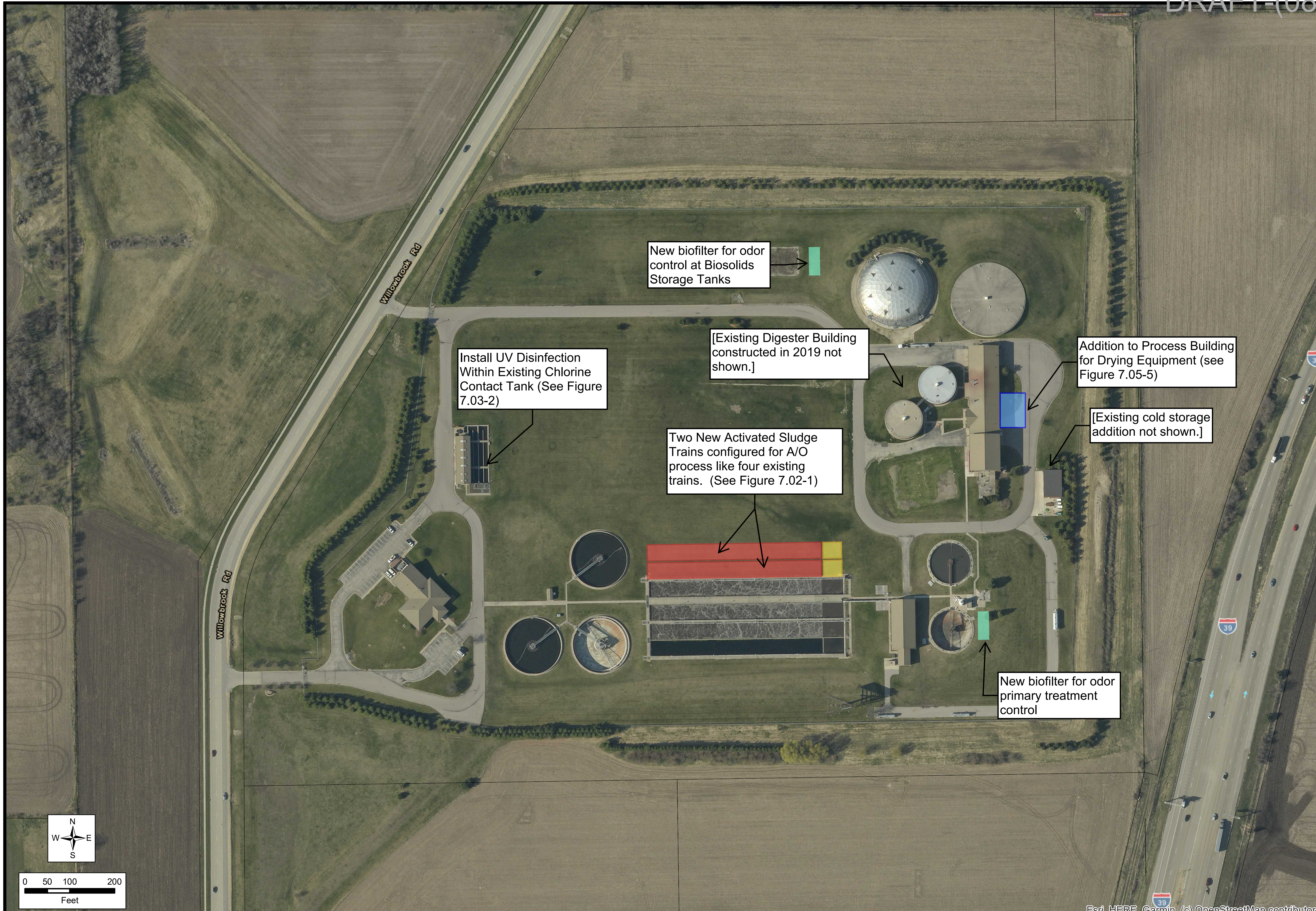

RECOMMENDED PLAN PRELIMINARY SITE LAYOUT

WPCF FACILITIES PLANNING
CITY OF BELOIT
ROCK COUNTY, WISCONSIN

STRAND ASSOCIATES®

FIGURE ES.08-1
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Table ES.08-1 Summary of Recommended Improvement Costs

	Item	Opinion of Capital Cost[1]		
		0 to 5 Years	6 to 10 Years	11 to 15 Years
Selected Alternatives	Install two high speed turbo blowers, replace existing diffusers (Alternative AS1).	$3,650,000		
	Construct two additional activated sludge trains, install a third high-speed turbo blower (Alternative AS1).[2]	$11,540,000		
	Construct the UV disinfection (Alternative D2).	$3,140,000		
	Construct the biosolids drying process (Alternative B3).	$13,770,000		
	Install a biofilter for primary treatment odor control (Alternative OC2).	$1,470,000		
Common Improvements	Replace the grit collector equipment.	$345,000		
	Replace the grit classifiers.	$441,000		
	Rehabilitate Primary Clarifier No. 1.	Included in current budget		
	Repair the primary clarifier splitter box and replace gates.	$509,000		
	Replace the scum concentrator.	$523,000		
	Repair the concrete in the aeration distribution box.	$486,000		
	Repair or replace the final clarifier equipment	Included in current budget		
	Install launder covers on the final clarifiers.	$847,000		
	Repair the grout on the primary and final clarifiers.	$215,000		
	Replace the digester spiral heat exchangers.	$301,000		
	Replace the davit cranes at Biosolids Storage Tank No. 2.	$35,000		
	Replace two GBTs used to thicken WAS.	$1,386,000		
	Replace the polymer system equipment.	$983,000		
	Replace the waste gas burner.	$591,000		
	Replace the plant air system compressors and dryers.	$821,000		
	Replace the plant drain system pumps.	$181,000		
	Replace the automatic transfer switches.	$303,000		
	Improve the Administration Building HVAC.	$811,000		
	Improve the gas compressor room and control room in accordance with NFPA 820.	$108,000		
	Replace the influent fine screens.		$1,399,000	
	Replace the grit slurry pumps.		$181,000	
	Replace the concentrated scum tank and concentrated scum pump.		$311,000	
	Replace two primary digester boilers.		$838,000	
	Replace the digester recirculation pumps.		$150,000	
	Replace the Biosolids Storage Tank No. 2 mixers.		$425,000	
	Replace the Biosolids Storage Tank No. 2 loadout pump.		$ 68,000	
	Construct the biofilter at the biosolids storage tanks.		$579,000	
	Replace the W3 system pumps.		$359,000	
	Replace the medium-voltage service entrance switchgear.		$607,000	
	Replace the medium-voltage disconnect switches and dry type transformers.		$1,078,000	
	Replace the low-voltage switchboards.		$1,232,000	
	Replace the diaphragm primary sludge pumps.			$182,000
	Replace the primary scum pumps.			$93,000
	Replace the RAS pumps.			$1,395,000
	Replace the WAS pumps.			$181,000
	Rehabilitate the digester covers.			$863,000
	Total	**$42,456,000**	**$7,222,000**	**$2,714,000**

Notes:
[1]All costs in second quarter, 2020 dollars.
[2]This component of the project was split from the alternative in even the City chooses to delay construction of these activated sludge trains and installation of the third blower.

Based on the projected debt service payment of $1,840,000, a preliminary analysis of the impact on sewer user charges was made. The first principal and interest payment would be due around substantial completion of the project (June 2024). Therefore, sewer rate increases could be phased in over the next four years. The current monthly average residential sewer bill for the City (assuming seven units of sewer usage per month) is $31.24. Based on the estimated increase in annual debt service required for the project, a total increase in revenue of approximately 17.5 percent is required. Applying this rate increase to the average residential user results in an average monthly sewer bill of $36.72, a total increase of $5.48 per month. This total increase could be phased in as a 3 percent rate increases in 2021, and 4.5 percent increases annually from 2022 to 2024. when the first debt service payment becomes due.

The schedule for the project is shown in Table ES.08-3.

Task	Schedule Date
Submit Preliminary Facilities Plan to WDNR	August 2020
Public Hearing on Facilities Plan	September 2020
Submit Final Facilities Plan (with Public Participation Summary) to WDNR	September 2020
Begin Design	October 2020
Submit CWF Program ITA and PERF Forms	October 31, 2020
Site Survey	November 2020
Soil Borings	November 2020
Pass Reimbursement Resolution	November 2020
Submit Drawings and Specifications to WDNR[1]	July 2021
Submit CWF Program Loan Application[1]	July 2021
WDNR Plan and Specification Approval	October 2021
Publish Advertisement to Bid	Early November 2021
Bid Opening	Early December 2021
Begin Construction	March 2022
Complete Construction	June 2024

[1]CWF Program Deadline for fiscal year 2022 Funding is September 30, 2021.
ITA=Intent to Apply, PERF=Priority Evaluation and Ranking Formula

Table ES.08-3 Project Implementation Schedule

ES.09 RESOURCE IMPACT SUMMARY

A resource impact summary was completed to aid WDNR in review of this facilities plan. There are no wetlands, water bodies, shorelands, or floodplains that will be impacted by the project. Minor impacts to groundwater (due to dewatering operations) and soil will be experienced during the construction. The project will be completed entirely on the existing site so there are no known biological, cultural, or other resource impacts.

ES.10 PUBLIC PARTICIPATION

To be completed following completion of public comment period and public hearing.

SECTION 1
INTRODUCTION

This section describes the purpose and scope of the facilities plan and the location of the study area. It also summarizes previous and related studies and reports. A list of definitions and abbreviations is provided as an aid to the reader.

1.01 PURPOSE AND SCOPE

The City of Beloit (City) owns wastewater conveyance and treatment facilities that provide service to the City's residents and businesses. Treatment facilities include an 11.0-million-gallon-per-day (MGD) (permitted average annual flow) Water Pollution Control Facility (WPCF), located at 555 Willowbrook Road. The City also operates 11 sanitary lift stations throughout the sewer service area (SSA). The WPCF discharges into the east bank of the Rock River immediately south of the Shirland Avenue bridge, approximately two miles southwest of the wastewater treatment plant (WWTP).

This facilities plan was prepared for the purpose of developing an overall plan for wastewater management at the WPCF through the year 2045 and beyond. Implementation of this plan will allow the City to comply with federal and state regulations related to water quality in the Rock River and help maintain the significant investment that the City has made in the WPCF.

The majority of current facilities at the WPCF were placed in operation in 1992 during the initial plant construction. This new WPCF replaced the City's previous WWTP located on the banks of the Rock River just north of the Illinois state line.

The WPCF consistently achieves compliance with all water quality requirements and produces an exceptional quality effluent. However, there are several emerging issues that provided the need to conduct a comprehensive review of the facility, including:

1. Age and Condition of Equipment and Facilities

   The City's staff has done an exceptional job maintaining the WPCF and associated equipment. However, much of the equipment at the WPCF has surpassed its expected useful life, which in many cases is 20 years.

2. Significant Industrial User Growth

   Past and planned future increases in wastewater discharges from Significant Industrial Users (SIUs) has also prompted the City to consider options for WPCF expansion.

3. Future Regulatory Requirements

   This plan will include a review of near future as well as longer term anticipated regulatory changes that will impact the WPCF operations.

Based on the age and capacity of the existing facilities, potential changes in flows discharged from SIUs, as well as the future anticipated regulatory changes governing discharges from the WPCF, there is a need to conduct a comprehensive review of the facilities.

This report reviews the condition and capacity of the existing WPCF facilities, compliance with the Wisconsin Administrative Code, and potential impacts of anticipated effluent limit changes. Facilities are evaluated for both 10-year (year 2030) and 25-year (year 2045) planning periods.

A specific plan for upgrades to the WPCF is recommended and supported by an evaluation of monetary costs, environmental impacts, and other nonmonetary considerations.

This plan also includes a review of the City's 11 wastewater pumping stations and a plan for improvements recommendation.

1.02 LOCATION OF STUDY

The service area for the WPCF includes the entire City of Beloit, located in southern Rock County along US Highway 90. The WPCF site is located immediately west of Interstate Highway 39/90 and approximately 1,000 feet north of the Illinois border on Willowbrook Road. Figure 1.02-1 shows the existing WPCF site, the location of the City's 11 wastewater pumping stations, the City's existing sewer area, and the potential future connections from the Town of Beloit.

1.03 RELATED STUDIES, REPORTS, AND DRAWINGS

1. *City of Beloit Water Pollution Control Facility Preliminary Phosphorus Alternatives Plan,* prepared by Donohue & Associates, Inc., July 2018.

2. *Iva Court Lift Station Study* DRAFT, prepared by Town & Country Engineering, Inc., May 2018.

3. *Fats, Oils, and Grease Study,* prepared by Strand Associates, Inc.®, May 2018.

4. *City of Beloit Water Pollution Control Facility Capacity Evaluation*, prepared by Donohue & Associates, Inc., March 2018.

5. *Biosolids Program Evaluation*, prepared by Clark Dietz, Inc., April 2017.

6. *Domestic Water Study & Allocations*, prepared by the City of Beloit Water Resources Division, 2016.

7. *Sanitary Sewer System CMOM Manual of Practice,* prepared by the City of Beloit, 2015.

8. *Industrial Interceptor chemical Addition Study*, prepared by Strand Associates, Inc.®, December 2014.

9. *Beloit WPCF Anaerobic Digester Study,* prepared by Clark Dietz, Inc., May 2013.

10. *Engineering Report for Pump Station Renovations*, prepared by Applied Technologies, Inc., March 2013.

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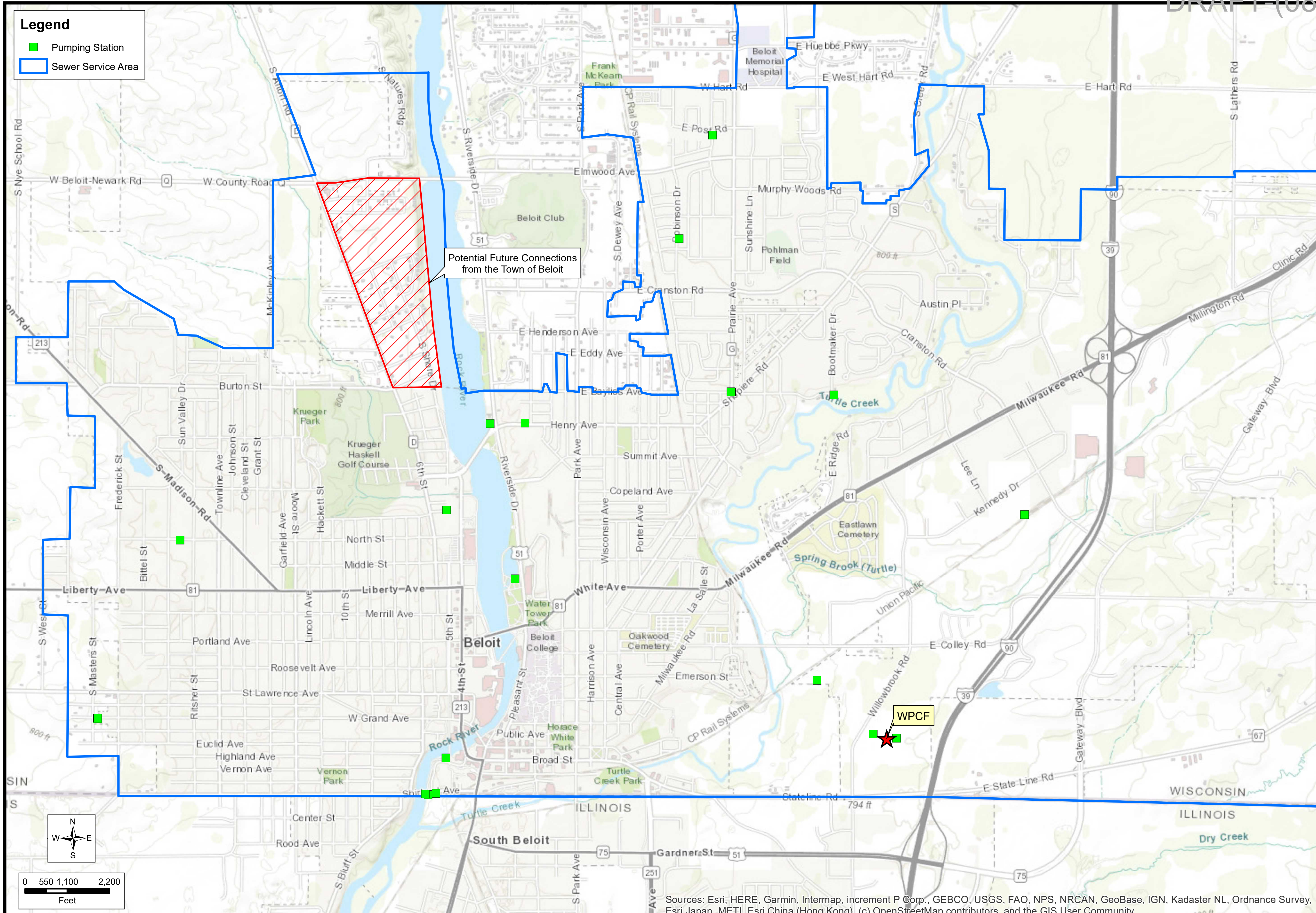


LOCATION OF STUDY

WATER POLLUTION CONTROL FACILITY FACILITIES PLAN
CITY OF BELOIT
ROCK COUNTY, WISCONSIN

STRAND ASSOCIATES®

FIGURE 1.02-1
1743.016

Path: S:\MAD\1700--1799\1743\016\Drawings\GIS\Figures\Fig 1.02-1 Location 11x17.mxd User: danc Date: 11/15/2019 Time: 7:30:28 AM

11. *Biosolids Dewatering, Odor Control, and Ancillary Equipment (Contract C10-23)*, drawing prepared by Symbiont, February 2010.

12. *Standby Power Generator and Aeration Blower VFD (Contract No. C09-23),* drawings prepared by Symbiont, June 2009.

13. *Biosolids Storage Expansion*, drawings prepared by Applied Technologies, February 1997.

14. *Wastewater System Improvements Contract No. 4 Wastewater Treatment Plant,* drawings by CHM Hill, July 1989.

1.04 ABBREVIATIONS AND DEFINITIONS

μg/L	micrograms per liter
A^2O	anaerobic/anoxic/oxic
A/O	anoxic/oxic
AGS	aerobic granular sludge
AHU	air handling unit
ATS	Automatic Transfer Switches
BAS	ballasted activated sludge
BFP	belt filter press
BMP	best management practices
BNR	biological nutrient removal
BOD_5	five-day biochemical oxygen demand
BPR	biological phosphorus removal
C	Celsius
$CBOD_5$	five-day carbonaceous biochemical oxygen demand
cf	cubic feet
cfd	cubic feet per day
cfm	cubic feet per minute
City	City of Beloit
CMAR	Compliance Maintenance Annual Report
CMOM	compliance, management, operations, and maintenance
COD	chemical oxygen demand
CPR	chemical phosphorus removal
CWF	Clean Water Fund
DAF	design average flow
DMF	design maximum flow
DO	dissolved oxygen
F:M	food-to-microorganism ratio
GAO	Glycol Accumulating Organisms
GBT	gravity belt thickener
GE	General Electric
GIS	geographical information system
GM	geometric mean

gpcd	gallons per capita per day
gpd	gallons per day
gpd/ft	gallons per day per foot
gpd/sq ft	gallons per day per square foot
gpm	gallons per minute
H_2S	hydrogen sulfide
hp	horsepower
HRT	hydraulic retention time
HSW	high strength waste
HUC	Hydraulic Unit Code
HVAC	heating, ventilation, and air conditioning
I/I	infiltration/inflow
I/O	input/output
IFAS	integrated fixed film activated sludge
lbs TS/hr	pounds total solids per hour
lbs/day	pounds per day
lbs/hour	pounds per hour
ITA	Intent to Apply
MABR	membrane aerated biofilm reactors
MAU	make-up air unit
MBR	membrane bioreactors
MDV	multidischarger variance
MG	million gallons
mg/L	milligrams per liter
MGD	million gallons per day
MHI	Mean Household Income
mi^2	square miles
ML	mixed liquor
MLSS	mixed liquor suspended solids
mm	millimeters
MPN	Most Probable Number
MS4s	municipal separate storm sewer systems
mV	millivolts
NACWA	National Association of Clean Water Agencies
NFPA	National Fire Protection Association
ng/L	nanograms per liter
NH_3-N	Ammonia nitrogen
NPDES	National Pollutant Discharge Elimination System
O&M	operation and maintenance
PAO	polyphosphate accumulating organisms
PEC	predicted environmental concentrations
PERF	Priority Evaluation and Ranking Formula
PFAS	per- and polyfluoroalkyl substances
PHF	peak hourly flow
PLC	programmable logic controller
PMP	pollutant minimization program

POTW	publicly owned treatment works
PRESTO	Pollutant Load Ratio Estimation Tool
PRS	primary sludge
psi	pounds per square inch
RAS	return activated sludge
RCI	residential, Commercial, and institutional
S2BPR	sidestream-enhanced BPR
SCADA	supervisory control and data acquisition
scfm	standard cubic feet per minute
sf	square feet
SIU	Significant Industrial User
SOP	Standard Operating Procedures
SSA	sewer service area
SSES	sanitary sewer evaluation studies
SSO	sanitary sewer overflow
STV	statistical threshold value
SWD	side water depth
TKN	total Kjeldahl nitrogen
TMDL	total maximum daily load
TN	total nitrogen
TP	total phosphorus
TPAD	temperature-phased anaerobic digestion
TS	total solids
TSS	total suspended solids
TWAS	thickened waste activated sludge
UCT	University of Cape Town
UPS	uninterruptible power supply
USEPA	Unites States Environmental Protection Agency
USGS	United States Geological Survey
UV	ultraviolet
VFA	volatile fatty acids
VFD	variable frequency drive
VS	volatile solids
WAC	Wisconsin Administrative Code
WAS	waste activated sludge
WDNR	Wisconsin Department of Natural Resources
WDOA	Wisconsin Department of Administration
WEF	Water Environment Federation
WERF	Water Environment Research Foundation
WET	whole effluent toxicity
WLA	wasteload allocations
WPCF	water pollution control facility
WPDES	Wisconsin Pollutant Discharge Elimination System
WQBEL	water quality-based effluents
WQT	water quality trading
WWTP	wastewater treatment plant

SECTION 2
SUMMARY OF WASTEWATER CONVEYANCE FACILITIES

2.01 BACKGROUND

The City presently operates and maintains collection and conveyance facilities that serve residential, commercial, and industrial users in the City. The focus of this facilities plan is the WPCF. However, this section of the facilities plan provides a brief overview of the wastewater collection and conveyance system.

2.02 DESCRIPTION OF EXISTING CONVEYANCE FACILITIES

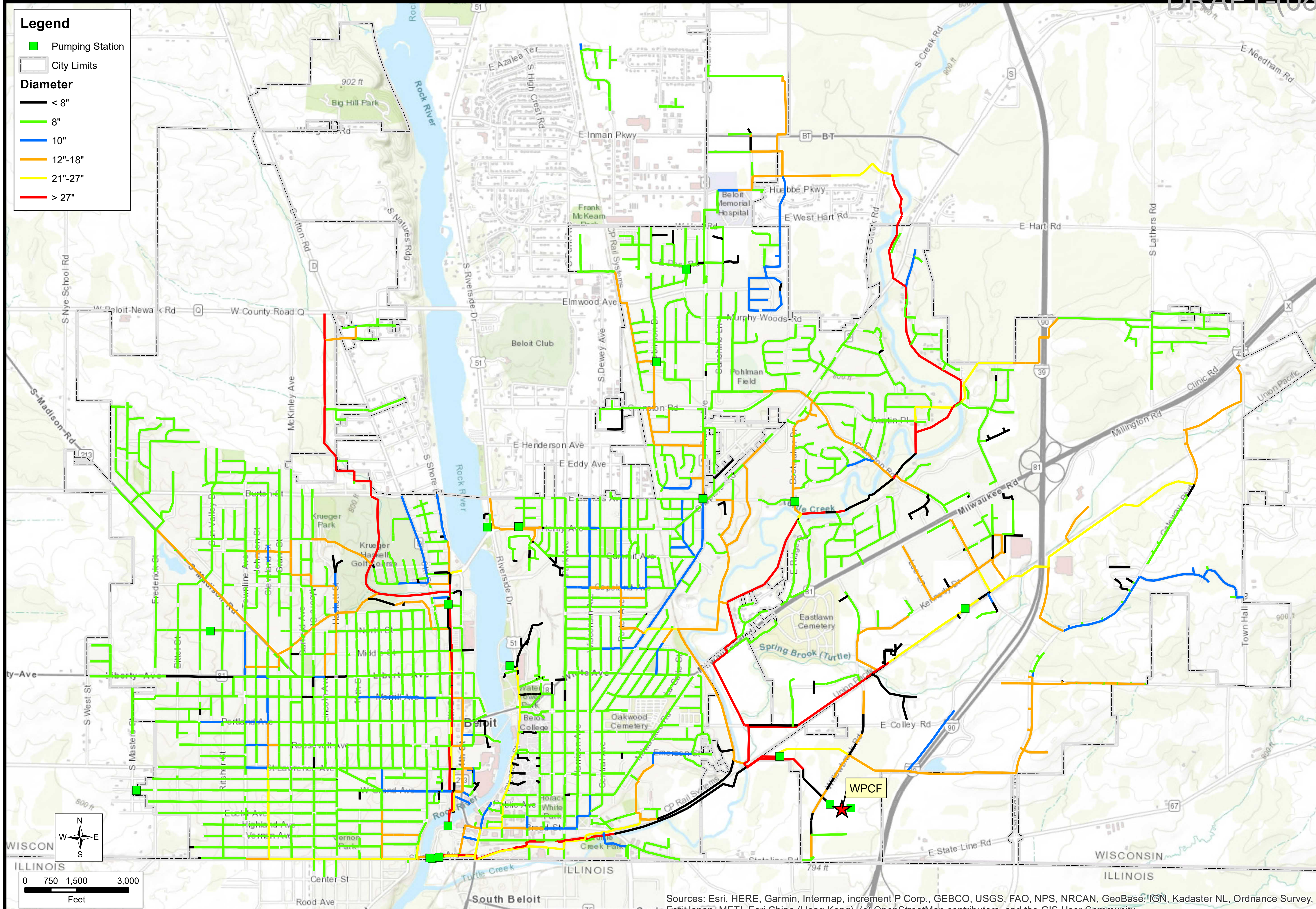
Conveyance facilities owned and operated by the City include 11 lift stations, more than 172 miles of sanitary sewer, approximately six miles of force main, and 3,500 manholes. The City's sanitary sewer collection system is mapped in a geographical information system (GIS). After treatment, the sewage is pumped through an effluent return pipe to the rock river where it is discharged. Figure 2.02-1 shows the City's sanitary sewer collection system and the location of the 11 sanitary sewer pumping stations.

2.03 INFILTRATION/INFLOW (I/I) EVALUATION

The City significantly reduced I/I in the late 1990s and early 2000s as the result of several collection system rehabilitation and I/I removal projects. I/I at the WPCF dropped significantly as a result of these efforts. However, an upward trend in flows, especially during periods of high-water levels in the Rock River, has been experienced in the last approximately two to three years. The City suspects that these increases in I/I induced by high river levels is the result of previously grouted sanitary sewer defects near the river that have begun to fail. The City is actively investigating these sources of I/I and continues to place a high priority on removing I/I from its collection system.

The City has also developed a sanitary sewer compliance, management, operations, and maintenance (CMOM) program.

Figure 2.03-1 shows the average daily flow in relation to rainfall and river level at the Afton, Wisconsin United States Geological Survey (USGS) river gage. The relationship between higher rainfall and river levels to influent flow is apparent.



COLLECTION SYSTEM

WATER POLLUTION CONTROL FACILITY FACILITIES PLAN
CITY OF BELOIT
ROCK COUNTY, WISCONSIN

STRAND ASSOCIATES®

FIGURE 2.02-1
1743.016

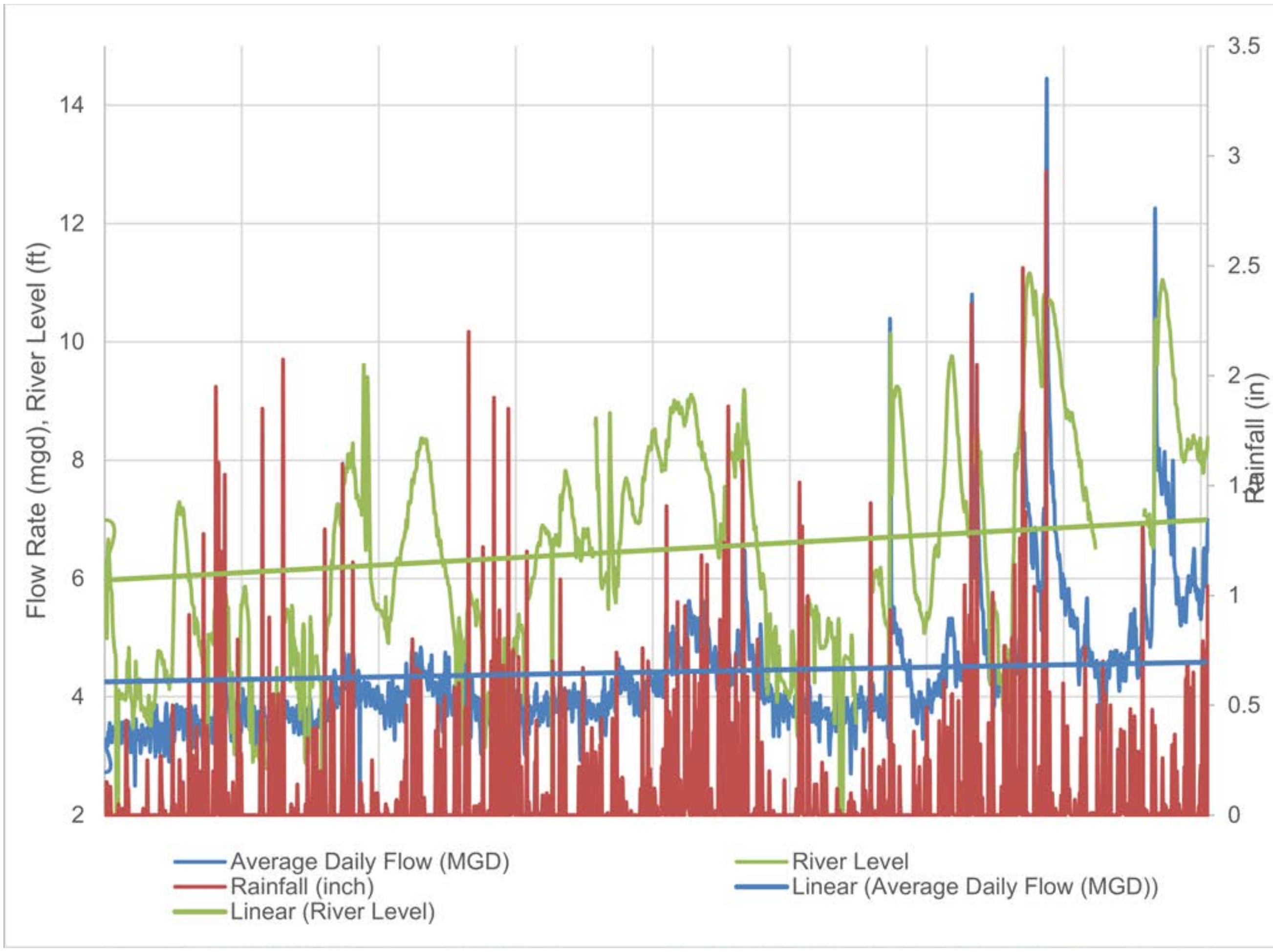


Figure 2.03-1 Influent Flow, Rainfall, and Rock River Level at Afton

Flow data from January 2015 through May 2019 was reviewed to determine whether I/I is excessive by United States Environmental Protection Agency (USEPA) standards. During this 53-month review period, the highest monthly average influent flow to the WPCF (excluding industrial sources) was 6.457 MGD, occurring from March 13, 2019 through April 11, 2019. This occurred during a period of high water levels in the Rock River. The City suspects that these abnormally high flows are the result of failure of grout in previously repaired sanitary sewer defects as mentioned above. Before 2018, the highest monthly average influent flow to the WPCF (excluding industrial sources) was 4.131 MGD, occurring from April 29, 2017 through May 28, 2017. At the 2018 estimated population of 36,683, this equates to a per capita flow rate of 113 gallons per capita per day (gpcd). The USEPA criteria for determining whether the per capita flows include excessive infiltration during periods of high ground water conditions is 120 gpcd [40 CFR 35.2120(c)(1)]. The per capita flow rate of 113 gpcd during the review period does not exceed this criteria.

The highest total daily (24-hour average) flow rate at the WPCF (excluding industrial sources) was approximately 13.107 MGD on October 7, 2018. This flow resulted from a combination of a significant rainfall event, and very high levels in the Rock River. The highest total daily (24-hour average) flow rate at the WPCF prior to 2018 (when flows at the WPCF were less affected by Rock River levels) was approximately 5.264 and occurred on July 23, 2017. At the 2018 estimated population of 36,683, this equates to a per capita flow rate of 144 gpcd. The USEPA criteria for determining whether per capita flows include excessive inflow during a rainfall event is 275 gpcd [40 CFR 35.2120(b)]. The per capita flow rate of 144 gpcd does not exceed this criteria.

Because per capita flows during periods of high groundwater as well as the total per capita flows during rainfall events are less than USEPA thresholds for excessive I/I, no additional I/I, or sanitary sewer evaluation studies (SSES) are included in this facilities plan.

SECTION 3
EXISTING WATER POLLUTION CONTROL FACILITY

3.01 BACKGROUND

The City's current WPCF was originally constructed in 1992 replacing the previous WPCF located on the west bank of the Rock River near the Illinois border. Wastewater is pumped directly to the WPCF from the Shirland Avenue and Turtle Creek Pumping Stations. The WPCF consists of influent raw wastewater screening, vortex grit removal, primary sedimentation, activated sludge treatment, secondary clarification, liquid sodium hypochlorite disinfection, dechlorination, thickening of primary and waste activated sludge (WAS) by means of a gravity belt thickener (GBT), anaerobic digestion of primary sludge and WAS, gravity belt thickening of digested sludge, storage of thickened digested sludge, and land application of thickened digested sludge. A portion of the thickened digested sludge is also dewatered using a belt filter press (BFP) and disposed of at the Janesville Landfill. Biogas generated during anaerobic digestion is used to fire boilers that provide heat to the digestion process and buildings and excess biogas is flared. Treated effluent is discharged to the Rock River.

In 1997, a second liquid biosolids storage tank was constructed. Additional odor control, serving the Process Building was constructed in 2010 in anticipation of a possible casino development adjacent to the WPCF site. A BFP was also constructed as part of the 2010 project. Construction is currently underway on a digester mixing system replacement project. This project includes the addition of a pumped mixing system to each digester and a new building to house the pumps and electrical gear and ancillary equipment related to the new mixing system.

Figure 3.01-1 shows a site plan of the WPCF. Figure 3.01-2 shows the process flow schematic for the WPCF.

Figure 3.01-1 Existing WPCF Site Plan

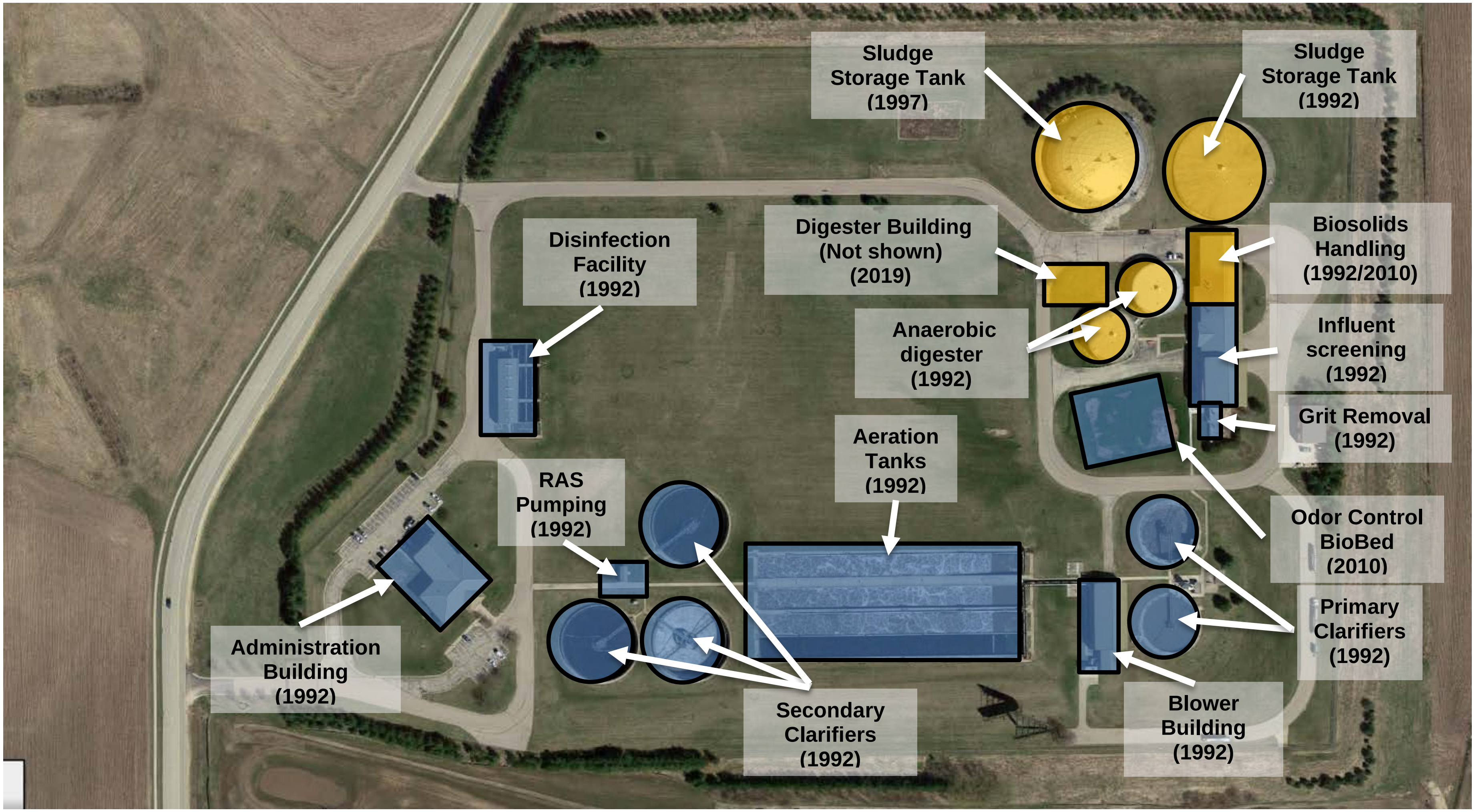
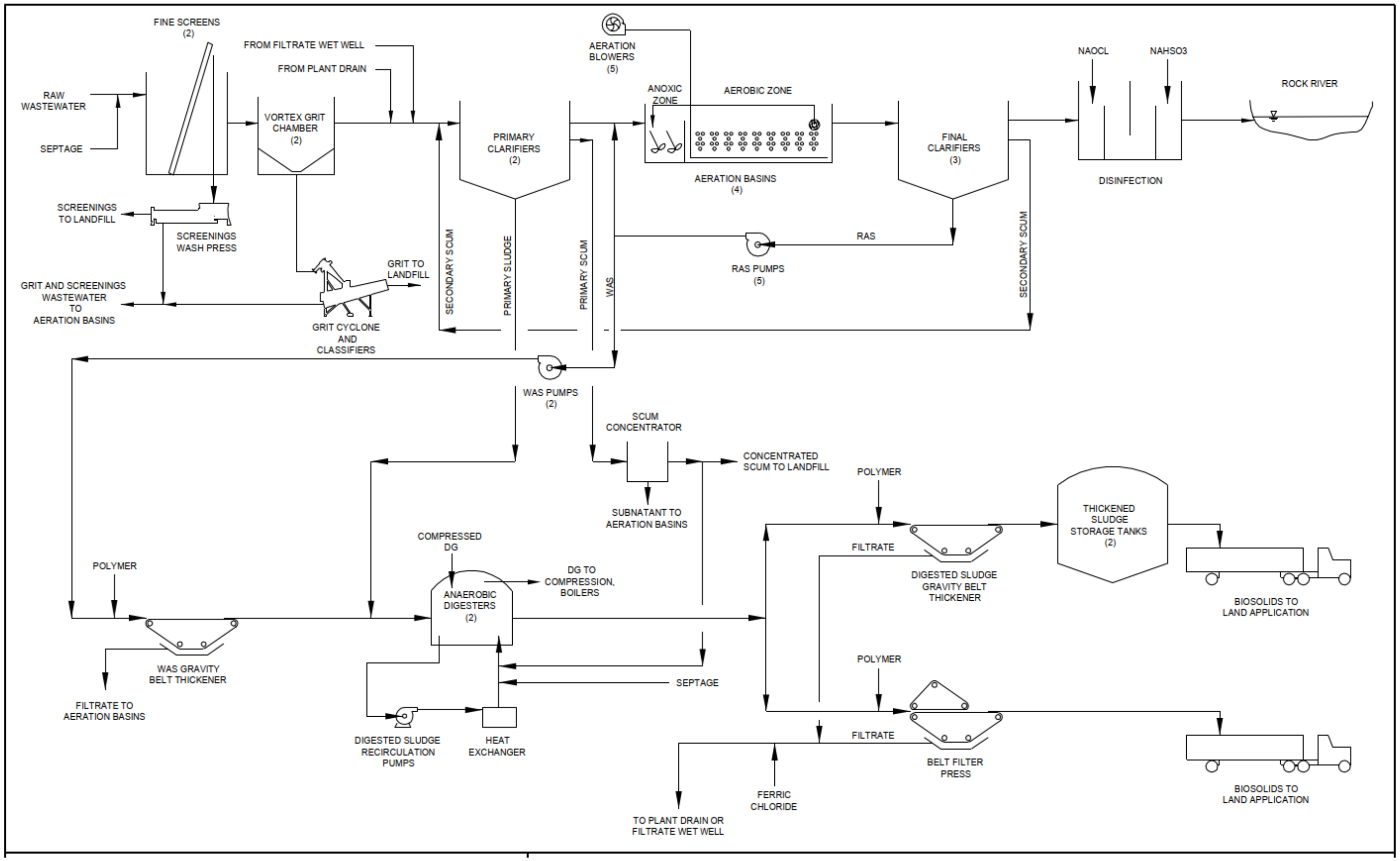


Figure 3.01-2 Process Flow Schematic



Source: Process Flow Diagram from 2018 Capacity Evaluation by Donohue and Associates, Inc.

3.02 UNIT PROCESS DESCRIPTIONS

A summary of the WPCF processes is presented in Table 3.02-1 and discussed below.

A. Influent Pumping and Flow Measurement

Raw wastewater is pumped to the WPCF from the Shirland Avenue and Turtle Creek Pumping Stations through two 30-inch force mains. Flow in each force main is measured via magnetic flow meters located at the WPCF.

B. Hauled Waste Receiving

The WPCF has two septage receiving pits, a septage holding tank, and two septage pumps that can pump to either the influent wastewater stream or directly to the digesters. However, minimal hauled waste is currently accepted at the WPCF.

C. Preliminary Treatment

Raw wastewater is discharged from the influent force mains into the screening channels in the screenings area of the Process Building. Influent wastewater flows through one of two 6-millimeter fine screens installed in 1992 as part of initial construction. A third screening channel contains a manually cleaned bar screen that is available for use if the mechanical screens are out of service. Screenings from the mechanical screen are conveyed to a screenings wash press that was installed in 2010 where they are washed, dewatered, and compacted before discharge to a dump truck for disposal at the Janesville Landfill.

Influent wastewater is sampled prior to screening. The sampler is located in the lower level of the Process Building and draws a sample directly from the influent force mains. The screened influent wastewater then flows to two parallel vortex grit basins located on the southernmost end of the Process Building. The grit slurry produced by the vortex grit removal basins is pumped by two grit pumps located in the lower level of the process building to one of two grit classifiers located in the upper level of the Process Building. The grit classifier separates the water and organics from the grit. Excess water and organic material drains back into the influent waste stream. An auger on the grit classifier conveys the dewatered grit to the same dump truck used for screenings where it awaits landfill disposal.

Table 3.02-1 WPCF Processes Summary

Current Rated WPCF Capacity	
Design Average Flow (DAF)[A]	11.0 MGD
Maximum Month Flow (MMF)[E]	13.2 MGD
Maximum Day Flow (DMF)[B]	22.4 MGD
Peak Hourly Flow (PHF)[D]	28.3 MGD
Maximum Month Five-Day Biochemical Oxygen Demand (BOD_5)[C]	60,400 lbs/day
Maximum Month Total Suspended Solids (TSS)[B]	37,310 lbs/day
Maximum Month Ammonia Nitrogen (NH_3-N)[B]	3,515 lbs/day

Notes:
[A]Information from Wisconsin Pollutant Discharge Elimination System (WPDES) permit.
[B]Information from July 1989 WPCF Record Drawings by CH2MHILL
[C]Information from May 31, 2018 WPCF re-rating acceptance letter from Wisconsin Department of Natural Resources (WDNR)
[D]Information from 1991 Operations and Maintenance Manual.
[E]Information from WDNR letter dated May 31, 2018.
MGD = million gallons per day
lbs/day = pounds per day

Description	Unit Specifications
Screening	
Number	Two
Type	Mechanically-cleaned bar screen
Opening	6 millimeters
Capacity	14.0 MGD
Screenings Wash Press	
Number	One
Grit Removal and Processing	
Number	Two
Type	Vortex
Capacity	14.0 MGD (each)
Grit Pumping	Centrifugal
Number of Grit Pumps	Two
Grit Processing	Classifier
Number of Grit Classifiers	Two
Influent Flow Measurement	
Number	Two (one on each influent force main)
Type	Magnetic Flow Meter
Size	30-inch
Primary Clarification	
Number	Two
Type	Circular
Size, each	100-foot-diameter
Side Water Depth	12 feet
Volume, Total	1,400,000 gallons
Surface Area, Total	15,700 square feet

Surface Overflow Rate	
@ DAF (11.0 MGD)	700 gpd/sq ft
@ PHF (28.3 MGD)	1,800 gpd/sq ft
Weir Length (Total)	582 feet
Weir Overflow Rate	
@ DAF (11.0 MGD)	17,500 gal/ft/day
Aeration Basins	
Number	Four
Size (Selectors)	50 feet x 38 feet x 15.9 feet SWD
Volume, total (Selectors)	904,000 gallons
Size (Aeration Basins)	385 feet x 38 feet x 15.9 feet SWD
Volume, total (Aeration Basins)	6,960,000 gallons
Volume, total (Selectors and Aeration Basins)	7,864,000 gallons
Detention Time (Total, Selectors and Aeration Basins)	
@ DAF (11.0 MGD)	17.2 hours
@ DMF (22.4 MGD)	8.4 hours
Aeration Blowers	
Number	5 centrifugal
Capacity, Each	Two at 6,700 scfm, three at 10,000 scfm
Capacity, Firm	33,400 scfm
Secondary Clarification	
Number	Three
Type	Circular, Center Feed
Diameter	125 feet
SWD	16.1 feet
Surface Area–Total	36,800 square feet
Volume, Total	4,432,000 gallons
Surface Overflow Rate	
@DAF (11 MGD)	300 gpd/sq ft
@ PHF (28.3 MGD)	770 gpd/sq ft
Weir Length, Total	1,105 feet
Weir Overflow Rate @ DAF (11.0 MGD)	9,955 gal/ft
Chlorine Contact Tank	
Number	Two
Volume (total)	496,000 gallons
Chlorination	Sodium Hypochlorite
Dechlorination	Sodium Bisulfite
Anaerobic Digestion Tanks	
Number	Two
Size, each	80-foot-diameter x 36-foot SWD
Volume, total	2,700,000 gallons

Digester Mixing	
Number	Three pumps, one mixing system per digester
Type	Pumped, Jet Mix
GBT	
Number	Three (two typically used for WAS thickening, one typically used for digested sludge thickening)
Size	2 meters
WAS Loading Rate, Each GBT	450 gpm, 1,800 lb TS/hr
Digested Sludge Thickening Loading Rate, Each GBT	250 gpm, 3,750 lb TS/hr
BFP	
Number	One
Size	2 meters
Loading Rate	Intermittent use only as needed
Biosolids Storage Tanks	
Number	Two
Diameter, Tank 1	160 feet
SWD, Tank 1	25 feet
Volume, tank 1	3,900,000 gallons
Diameter, Tank 2	160 feet
SWD, Tank 2	28 feet
Volume, Tank 2	4,200,000 gallons
Volume, Total	8,100,000 gallons

Notes:
gpd/sq ft = gallons per day per square foot
gal/ft/day = gallons per foot per day
SWD = side water depth
scfm = standard cubic feet per minute
gpm = gallons per minute
lb TS/hr = pounds total solids per hour

D. Primary Clarification

Following preliminary treatment, wastewater flows by gravity to the primary splitter box, where primary influent is split between two circular, 100-foot-diameter primary clarification tanks. Each tank has a side-water depth of 12 feet. The tanks were constructed in 1992. The north primary clarifier was rehabilitated with new paint and replacement of various components in 2018. The north primary clarifier is shown in Figure 3.02-1.

Under normal operations, primary sludge is pumped continuously from the primary clarifiers to the anaerobic digesters using two diaphragm pumps. Scum flows by gravity to a scum collection box. It is then pumped through a grinder to the scum concentrator located on the upper level of the Process Building. After the concentrator, the concentrated scum is pumped to either trucks for landfill disposal or the anaerobic digesters by a positive displacement pump.

Figure 3.02-1 Primary Clarifier No. 2

E. Activated Sludge Treatment

Activated sludge treatment was constructed as part of the 1992 WPCF construction. Biological treatment occurs in four parallel activated sludge tanks. The aeration tanks were originally designed with nitrate recycle pumps and up-front anoxic selector zones with high Food:Mass (F:M) ratios to help with filament control. However, to meet phosphorus limits, the WPCF does not run the nitrate recycle pumps in order to achieve anaerobic conditions in the selector zones which has been successful for enhanced Biological Phosphorus Removal (BPR). Each tank has a selector volume of 226,000 gallons, followed by an aerated zone volume of 1,740,000 gallons. Total activated sludge tank volume is 7,864,000 gallons. Before entering the activated sludge process, primary effluent is mixed with return activated sludge (RAS) to form mixed liquor (ML). The ML flows out of the aeration tanks and into the final clarifiers. The WPCF has historically achieved low effluent phosphorus concentrations as a result of BPR occurring in the activated sludge process.

Air is supplied using five multistage centrifugal blowers located in the Blower Building. All five blowers are Lamson centrifugal blowers. Two 400-hp Lamson and three 600-hp Lamson blowers were installed during the initial WPCF construction in 1992. Air is distributed in the aeration tanks via fine bubble membrane diffusers. Diffusers in Basin 5 were replaced in 2018. Diffusers in Basin 2 were replaced approximately ten years ago. Diffusers in Basins 3 and 4 were replaced approximately five years ago. Figure 3.02-2 shows Aeration Basin 5.

Figure 3.02-2 Aeration Basin 5

F. Secondary Clarifiers

ML from the aeration tanks flows to the three circular final clarifiers. Each clarifier is 125 feet in diameter, with a SWD of 16.1 feet. The clarifiers have a total surface area of 36,800 square feet. The secondary clarifiers were constructed during the 1992 WPCF construction.

RAS is pumped with five centrifugal pumps with variable speed drives located in the RAS Pumping Station. WAS is drawn off the RAS line downstream of the RAS pumps via two centrifugal pumps and pumped to the GBTs for thickening before anaerobic digesters. Scum from the secondary clarifiers is either combined with the WAS or is pumped to the primary influent channel downstream of the grit collectors through a progressive cavity pump. Following secondary clarification, secondary effluent flows to the chlorine contact basin.

G. Disinfection

Disinfection of the WPCF effluent is achieved using sodium hypochlorite addition for chlorination followed by sodium bisulfite addition for dichlorination. Disinfection is required seasonally from

May 1 through September 30. Disinfection facilities were constructed in 1992. The chlorine contact tank has a total volume of 496,000 gallons.

H. Biosolids Thickening

WAS from the secondary clarifiers is typically thickened using two of the three 2-meter GBTs. Two GBTs were installed in 1992 as part of the WPCF construction. The third GBT was initially moved from the previous WWTP location, rebuilt, and reinstalled at the new WPCF in 1992. Polymer is added to the sludge to improve sludge thickening.

Typically, two of the GBTs are used to thicken WAS or a combination of WAS and primary sludge. Thickened waste activated sludge (TWAS) (or WAS and primary sludge) is held in the thickened sludge wet well until is it pumped by a progressing cavity pump to the anaerobic digester. The two GBTs used for WAS thickening are typically run about nine hours per day, seven days per week at a rate of 450 gpm and 1,800 lb TS/hr to each GBT.

The third GBT is typically used for thickening anaerobically digested sludge. Thickened digested sludge is held in one cell of the thickened sludge wet well before being pumped to the biosolids storage tanks. The GBT used for thickening digested sludge is typically run approximately nine hours per day, seven days a week at a rate of 250 gpm and 3,750 lb TS/hr. Filtrate and wash water from the GBTs drains by gravity to the WPCF drain system.

Occasionally, when the diaphragm primary sludge pumps do not keep up with primary sludge production (for example, they cannot pump at a high enough rate to keep the primary sludge blanket at a desired depth), redundant centrifugal primary sludge pumps will be run. These pumps can pump sludge to the one quadrant of the thickened sludge wet well, where it is comingled with WAS and thickened on one of the GBTs. Alternatively, they can pump primary sludge directly to the anaerobic digesters.

J. Biosolids Dewatering

A two-meter BFP was installed in the GBT area of the Process Building in 2010. This BFP was installed to allow for dewatered biosolids to be disposed of at the landfill, effectively providing additional biosolids processing and disposal capacity. Digested sludge is dewatered at the BFP, producing a cake. The cake sludge is then pumped by a progressing cavity pump to the cake loadout bin, also located in the Process Building. From the loadout bin, the cake drops into a truck for disposal at the Janesville Landfill.

I. Anaerobic Digestion

Anaerobic digestion of primary sludge and thickened waste activated sludge occurs in two mesophilic, completely mixed anaerobic digestion tanks with volumes of 1,350,000 gallons each (80-foot-diameter with 36-foot SWD). The tanks were constructed in 1992 during initial construction. The digesters are mixed with a pumped mixing system that was constructed in 2019. The pumps are located in the digester pumping station, also constructed in 2019. The pumped mixing system replaced a compressed gas mixing system.

Both digesters are heated with spiral type heat exchangers. Heat is supplied to the heat exchangers by two boilers that can burn either natural gas or biogas from the digester. These boilers were installed in 1992. There are also three smaller natural gas boilers that back up the two primary boilers. These were installed in 2009.

J. Liquid Biosolids Storage and Disposal

Two liquid biosolid sludge storage tanks are used to store thickened biosolids from the digester. Biosolids Storage Tank No. 1 has a capacity of 3,900,000 gallons and was constructed in 1992. Biosolids Storage Tank No. 2 has a capacity of 4,200,000 gallons and was constructed in 1997. Biosolids Storage Tank No. 2 is shown in Figure 3.02-3. The combined capacity of both tanks is 8,100,000 gallons. Tank No. 1 is mixed by a compressed gas mixing system. Tank No. 2 is mixed by four submersible mixers. Two centrifugal pumps are used to pump sludge from tank one into trucks for disposal. These pumps can also be used for recirculation. One centrifugal pump is used to pump sludge from Tank No. 2 into trucks for disposal.

Figure 3.02-3 Biosolids Storage Tank No. 2

Thickened sludge is applied to nearby agricultural land by City staff.

L. Odor Control

A mist scrubber odor control system using sodium hydroxide and sodium hypochlorite is located near the primary clarifiers and was installed with the original WPCF construction in 1992. This odor control system receives odorous air from the grit removal area, primary influent splitter, primary clarifier launders, and the aeration distribution box. Figure 3.02-4 shows this system.

An inground soil biofiltration bed was constructed as part of the 1997 biosolids storage tank project and received odorous air from Sludge Storage Tank No. 2. This system is no longer in service and has been abandoned.

A second in ground soil biofiltration bed located near the Process Building was constructed in 2010. This system serves the preliminary treatment and sludge thickening/dewatering areas of the Process Building.

Figure 3.03-4 Mist Scrubber Odor Control System

3.03 INFLUENT FLOWS AND LOADS

Influent flow is measured via two magnetic flow meters, one located on each of the raw sewage force mains in the process building. Influent flow data for January 2015 through May 2019 are summarized in Table 3.03-1. Figure 3.03-1 graphically depicts daily influent flows for the same time period. The existing DAF is 11.0 MGD. The existing peak hourly design flow is 28.3 MGD.

	2015	2016	2017	2018	2019
January	3.37	3.99	4.14	3.95	4.51
February	3.33	3.86	4.02	4.65	5.13
March	3.44	4.11	4.28	4.46	7.13
April	3.58	4.38	4.78	3.93	6.14
May	3.54	3.93	5.21	4.67	5.99
June	3.89	3.92	4.47	5.67	
July	3.75	3.76	4.96	4.67	
August	3.62	3.85	4.32	4.16	
September	3.68	3.78	3.80	6.62	
October	3.63	3.82	3.90	7.58	
November	3.68	3.87	3.65	5.52	
December	4.31	3.81	3.68	4.54	
Average	3.65	3.92	4.27	5.00	5.78
Maximum	4.31	4.38	5.21	7.58	7.13
Minimum	3.33	3.76	3.65	3.93	4.51

Table 3.03-1 Influent Flow Summary

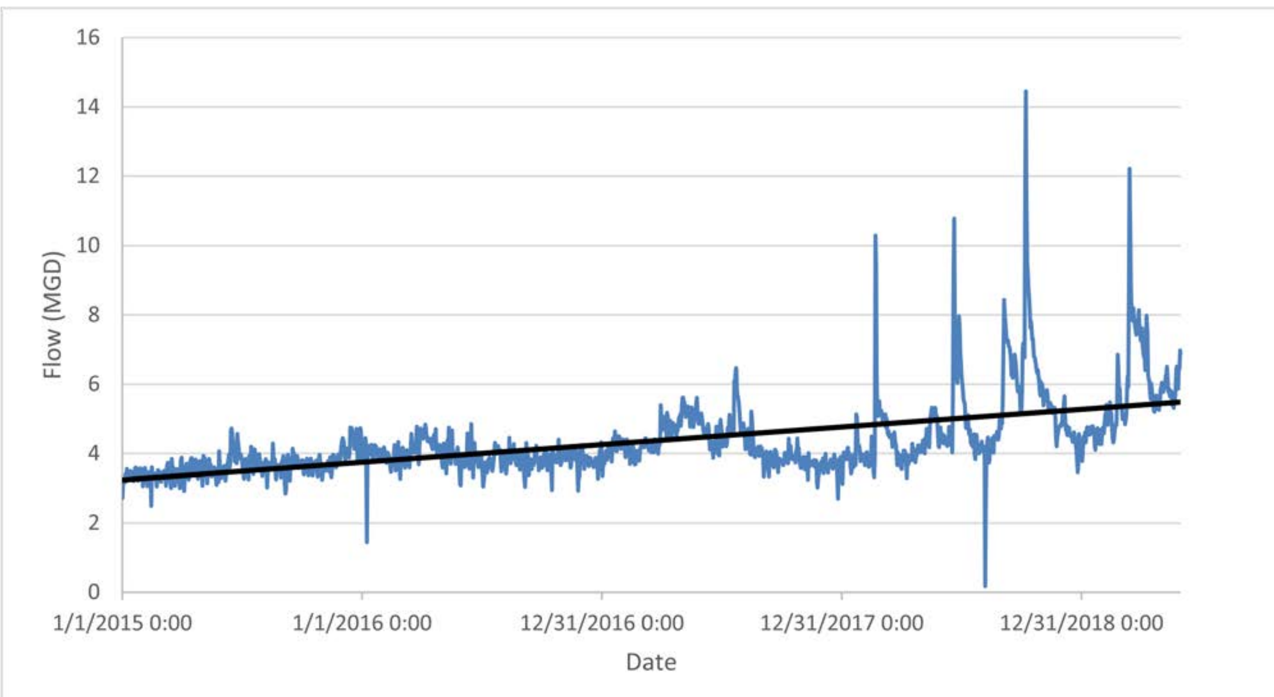


Figure 3.03-1 Daily (24-Hour Average) Influent Flows

Summaries of the influent wastewater concentrations and loadings for five-day biochemical oxygen demand (BOD_5), TSS, total phosphorus (TP), and ammonia (NH_3-N) are shown in Table 3.03-2 through Table 3.03-5. The WPCF does not routinely test for influent total Kjeldahl nitrogen (TKN). Influent samples are taken from the influent channel prior to screening via the automatic sampler. Influent sampling does not capture any return flows. Appendix A presents influent concentrations and loads graphically for the period of January 2015 through May 2019.

	2015		2016		2017		2018		2019	
	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day
January	606	17,214	515	17,623	619	21,260	569	18,611	589	22,213
February	649	18,203	569	18,463	660	22,100	472	17,928	459	19,978
March	621	17,858	538	18,575	684	24,366	524	19,370	297	16,978
April	706	21,183	450	16,489	428	17,243	686	22,448	387	20,082
May	703	20,663	575	19,003	492	21,549	503	19,486	407	20,051
June	485	15,682	628	20,847	672	24,598	442	19,878		
July	517	16,250	549	17,382	531	21,204	549	20,466		
August	559	16,829	678	21,606	644	23,119	621	21,238		
September	451	13,829	518	16,374	708	22,447	319	17,752		
October	556	16,805	572	18,496	681	22,228	326	19,915		
November	618	18,937	548	17,846	601	18,318	476	20,703		
December	496	18,141	561	17,867	631	19,321	532	20,336		
Average	581	17,633	559	18,381	613	21,480	502	19,844	428	19,860
Maximum	706	21,183	678	21,606	708	24,598	686	22,448	589	22,213
Minimum	451	13,829	450	16,374	428	17,243	319	17,752	297	16,978

Table 3.03-2 Influent BOD_5 Concentration and Load

	2015		2016		2017		2018		2019	
	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day
January	401	11,296	297	9,903	410	14,218	315	10,322	342	12,909
February	333	9,285	311	10,085	398	13,350	267	10,446	263	11,181
March	326	9,460	351	12,033	407	14,544	293	10,744	191	11,043
April	370	11,138	365	13,322	318	12,701	333	10,903	239	12,269
May	405	11,988	398	13,189	317	13,803	253	9,820	229	11,409
June	360	11,774	393	12,810	386	14,232	230	10,416		
July	382	12,037	398	12,552	292	11,913	266	10,171		
August	380	11,509	485	15,640	323	11,513	328	11,603		
September	296	9,093	353	11,179	347	10,994	198	10,583		
October	310	9,409	411	13,163	361	11,736	182	10,997		
November	337	10,305	367	11,901	276	8,383	243	10,640		
December	368	13,441	348	11,125	321	9,893	290	11,091		
Average	356	10,895	373	12,242	346	12,273	266	10,645	253	11,762
Maximum	405	13,441	485	15,640	410	14,544	333	11,603	342	12,909
Minimum	296	9,093	297	9,903	276	8,383	182	9,820	191	11,043

Table 3.03-3 Influent TSS Concentration and Load

	2015		2016		2017		2018		2019	
	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day
January	30.51	859	28.70	971	28.18	949	32.01	1,042	28.23	1,055
February	39.10	1,082	31.86	1,019	30.52	1,034	27.05	993	22.98	993
March	35.30	1,012	31.68	1,079	30.99	1,111	26.89	996	16.81	966
April	35.18	1,041	28.33	1,031	22.58	903	33.22	1,091	19.16	980
May	37.44	1,095	35.44	1,162	20.71	908	28.62	1,106		
June	31.77	1,025	34.75	1,142	31.44	1,160	27.78	1,129		
July	34.18	1,057	35.47	1,101	27.01	1,085	25.51	986		
August	33.23	987	37.08	1,175	29.22	1,068	30.33	1,067		
September	31.92	975	32.79	1,026	33.11	1,048	16.42	909		
October	37.18	1,109	31.08	986	34.93	1,130	16.05	1,001		
November	34.94	1,059	31.68	1,014	35.02	1,052	25.29	1,082		
December	26.81	958	35.41	1,116	34.46	1,052	27.68	1,041		
Average	33.96	1,021	32.85	1,069	29.85	1,042	26.41	1,037	21.79	998
Maximum	39.10	1,109	37.08	1,175	35.02	1,160	33.22	1,129	28.23	1,055
Minimum	26.81	859	28.33	971	20.71	903	16.05	909	16.81	966

Table 3.03-4 Influent NH_3-N Concentration and Load

	2015		2016		2017		2018		2019	
	mg/L	**lbs/day**	**mg/L**	**lbs/day**	**mg/L**	**lbs/day**	**mg/L**	**lbs/day**	**mg/L**	**lbs/day**
January	10.38	293	9.03	302	10.51	365	9.03	295	8.48	319
February	10.51	292	10.04	325	12.74	426	9.53	390	7.21	305
March	9.67	279	9.86	337	12.97	462	8.49	312	4.93	278
April	9.55	284	8.33	305	8.75	350	11.29	370	5.86	299
May	10.71	316	10.92	359	10.00	435	8.53	330		
June	9.08	294	10.94	356	10.91	408	7.27	289		
July	9.24	289	10.22	321	6.41	247	6.66	255		
August	9.43	286	11.70	377	9.43	336	9.13	321		
September	8.45	261	9.39	296	10.38	329	3.69	195		
October	9.56	289	11.14	355	10.86	352	5.38	307		
November	9.79	300	9.55	309	10.69	326	6.78	281		
December	8.21	295	9.56	295	10.82	334	8.36	315		
Average	9.55	290	10.06	328	10.37	364	7.85	305	6.62	300
Maximum	10.71	316	11.70	377	12.97	462	11.29	390	8.48	319
Minimum	8.21	261	8.33	295	6.41	247	3.69	195	4.93	278

Table 3.03-5 Influent TP Concentration and Load

3.04 WPDES PERMIT REQUIREMENTS

The monitoring requirements and effluent limitations required by the current WPDES permit are presented in Table 3.04-1.

The facility is operating under a WPDES permit number WI-0023370-09-0 that was issued on July 1, 2015, and expires June 30, 2020. A copy of this permit is included in Appendix B.

Table 3.04-1 City's Current WPDES Monitoring Requirement and Effluent Limitations

Parameters	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Flow Rate		MGD	Continuous	Continuous	
$CBOD_5$, Total	Monthly Average	25 mg/L	Five per week	24-Hr Flow Prop Comp	
$CBOD_5$, Total	Weekly Average	40 mg/L	Five per week	24-Hr Flow Prop Comp	
TSS	Monthly Average	30 mg/L	Daily	24-Hr Flow Prop Comp	
TSS	Weekly Average	45 mg/L	Daily	24-Hr Flow Prop Comp	
TSS	Monthly Average	1,778 lbs/day	Daily	Calculated	Limit effective January annually.
TSS	Monthly Average	2,196 lbs/day	Daily	Calculated	Limit effective February annually.
TSS	Monthly Average	2,465 lbs/day	Daily	Calculated	Limit effective March annually.
TSS	Monthly Average	2,323 lbs/day	Daily	Calculated	Limit effective April annually.
TSS	Monthly Average	2,141 lbs/day	Daily	Calculated	Limit effective May annually.
TSS	Monthly Average	2,015 lbs/day	Daily	Calculated	Limit effective June annually.
TSS	Monthly Average	1,596 lbs/day	Daily	Calculated	Limit effective July annually.
TSS	Monthly Average	1,248 lbs/day	Daily	Calculated	Limit effective August annually.
TSS	Monthly Average	845 lbs/day	Daily	Calculated	Limit effective September annually.
TSS	Monthly Average	1,367 lbs/day	Daily	Calculated	Limit effective October annually.
TSS	Monthly Average	2,094 lbs/day	Daily	Calculated	Limit effective November annually.
TSS	Monthly Average	1,746 lbs/day	Daily	Calculated	Limit effective December annually.
TSS	Weekly Average	2,276 lbs/day	Daily	Calculated	Limit effective January annually.
TSS	Weekly Average	2,811 lbs/day	Daily	Calculated	Limit effective February annually.
TSS	Weekly Average	3,155 lbs/day	Daily	Calculated	Limit effective March annually.
TSS	Weekly Average	2,973 lbs/day	Daily	Calculated	Limit effective April annually.
TSS	Weekly Average	2,740 lbs/day	Daily	Calculated	Limit effective May annually.
TSS	Weekly Average	2,579 lbs/day	Daily	Calculated	Limit effective June annually.
TSS	Weekly Average	2,043 lbs/day	Daily	Calculated	Limit effective July annually.
TSS	Weekly Average	1,597 lbs/day	Daily	Calculated	Limit effective August annually.

TSS	Weekly Average	1,082 lbs/day	Daily	Calculated	Limit effective September annually.
TSS	Weekly Average	1,750 lbs/day	Daily	Calculated	Limit effective October annually.
TSS	Weekly Average	2,680 lbs/day	Daily	Calculated	Limit effective November annually.
TSS	Weekly Average	2,235 lbs/day	Daily	Calculated	Limit effective December annually.
NH_3-N Total	Daily Maximum	17 mg/L	Three per week	24-Hr Flow Prop Comp	
Chlorine, Total Residual	Daily Maximum	38 µg/L	Daily	Grab	Limit effective May 1 through September 30 annually.
Chlorine, Total Residual	Weekly Average	31 µg/L	Daily	Grab	Limit effective May 1 through September 30 annually.
Fecal Coliform	Geometric Mean	400 #/100 mL	Two per week	Grab	Limit effective May 1 through September 30 annually.
Dissolved Oxygen	Daily Minimum	6.0 mg/L	Three per week	Grab	
pH Field	Daily Maximum	9.0 su	Daily	Grab	
pH Field	Daily Minimum	6.0 su	Daily	Grab	
Mercury, Total Recoverable	Daily Maximum	3.3 µg/L	Quarterly	Grab	This is an alternative Mercury Effluent Limit.
TP	Monthly Average	2.0 mg/L	Daily	24-Hr Flow Prop Comp	This is an interim limit.
Chloride		mg/L	Monthly	24-Hr Flow Prop Comp	Monitor Only–January 1, 2019 to December 31, 2019
Acute WET		TU_a	See listed Quarter(s)	24-Hr Flow Prop Comp	
Chronic WET		rTU_c	See listed Quarter(s)	24-Hr Flow Prop Comp	
Cadmium, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	Monitor Only
Chromium, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	Monitor Only
Copper, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	Monitor Only
Lead, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	Monitor Only
Nickel, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	Monitor Only
Zinc, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	Monitor Only
Temperature Maximum		deg f	3/Week	Continuous	Monitor Only–January 1, 2019 to December 31, 2019.
Nitrogen, Total Kjeldahl		mg/L	Quarterly	24-Hr Flow Prop Comp	Monitor Only
Nitrogen, Nitrite + Nitrate Total		mg/L	Quarterly	24-Hr Flow Prop Comp	Monitor Only
Nitrogen, Total		mg/L	Quarterly	Calculated	Monitor Only

Notes:
Mg/L = milligrams per liter

3.05 WASTEWATER TREATMENT PERFORMANCE

The WPCF has consistently met the effluent limits in the National Pollutant Discharge Elimination System (NPDES) permit producing an exceptional quality effluent for discharge to the Rock River.

Tables 3.05-1 through 3.05-4 summarize the WPCF's average monthly effluent five-day carbonaceous biochemical oxygen demand ($CBOD_5$), TSS, NH_3-N, and TP concentrations and loads, respectively, from January 2015 to May 2019.

	2015		2016		2017		2018		2019	
	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day
January	4.19	116	2.76	92.1	4.30	145	5.27	168	3.17	117
February	5.68	156	3.43	108	3.55	116	3.80	159	3.72	160
March	6.30	176	3.10	105	2.91	102	3.62	135	3.43	202
April	6.45	191	4.65	166	3.80	148	4.63	143	3.90	186
May	5.33	154	5.17	162	4.39	189	3.87	150	4.15	203
June	3.27	103	4.27	137	4.00	139	3.66	159		
July	4.77	148	3.40	103	3.38	134	3.55	139		
August	4.05	119	4.32	134	3.09	108	3.07	116		
September	3.32	97	3.33	106	4.20	139	3.52	200		
October	4.55	136	2.77	87.9	3.16	99.0	4.72	299		
November	8.59	258	2.26	71.5	3.45	104	3.92	170		
December	7.87	278	2.90	89.9	4.00	120	2.86	105		
Average	5.4	161	3.5	114	3.7	129	3.9	163	3.7	174
Maximum	8.6	278	5.2	166	4.4	189	5.3	299	4.1	203
Minimum	3.3	97	2.3	72	2.9	99	2.9	105	3.2	117

Table 3.05-1 Effluent $CBOD_5$ Concentration and Load

	2015		2016		2017		2018		2019	
	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day
January	6.45	178	3.42	114	6.22	212	9.74	312	3.94	146
February	10.07	274	3.38	106	6.12	199	5.83	240	5.29	227
March	9.90	278	4.03	137	6.23	218	5.91	218	4.75	272
April	14.40	423	8.69	309	5.28	206	7.43	236	6.50	304
May	6.67	194	8.35	261	4.84	209	4.13	160	6.26	308
June	4.00	127	5.80	182	4.54	160	4.58	199		
July	6.00	185	3.41	102	3.96	161	4.47	178		
August	4.90	144	5.18	163	3.32	115	2.34	88		
September	3.50	102	3.40	108	5.08	165	5.89	328		
October	5.03	150	4.31	135	3.91	123	8.30	539		
November	11.70	354	2.07	65	3.76	114	5.07	222		
December	9.40	328	3.72	115	5.58	169	2.93	106		
Average	7.67	228	4.65	150	4.90	171	5.55	236	5.35	251
Maximum	14.40	423	8.69	309	6.23	218	9.74	539	6.50	308
Minimum	3.50	102	2.07	65	3.32	114	2.34	88	3.94	146

Table 3.05-2 Effluent TSS Concentration and Load

	2015			2016		
	Total Nitrogen, Nitrite + Nitrate (mg/L)	Total Nitrogen (mg/L)	Kjeldahl Nitrogen (mg/L)	Total Nitrogen, Nitrite + Nitrate (mg/L)	Total Nitrogen (mg/L)	Kjeldahl Nitrogen (mg/L)
Q1				17.0	19.0	2.0
Q2				60.0	63.0	2.5
Q3	19	20.6	1.6	19.0	20.4	1.4
Q4				9.7	11.8	2.1
	2017			2018		
	Total Nitrogen, Nitrite + Nitrate (mg/L)	Total Nitrogen (mg/L)	Kjeldahl Nitrogen (mg/L)	Total Nitrogen, Nitrite + Nitrate (mg/L)	Total Nitrogen (mg/L)	Kjeldahl Nitrogen (mg/L)
Q1	17.0	19.2	2.2	12.0	15.0	3.0
Q2	17.0	18.6	1.6	18.0	19.9	1.9
Q3	8.7	10.9	2.2	17.0	18.5	1.5
Q4	17.0	18.9	1.9	15.0	16.5	1.5

Table 3.05-3 Quarterly Effluent Ammonia and Nitrogen Monitoring Results

	2015		2016		2017		2018		2019	
	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day
January	0.33	9.13	0.24	8.12	0.28	9.64	0.42	13.55	0.15	5.55
February	0.40	10.86	0.19	5.84	0.28	9.24	0.28	10.94	0.19	7.99
March	0.41	11.41	0.19	6.45	0.34	11.82	0.28	10.27	0.17	9.84
April	0.53	15.36	1.03	36.88	0.30	11.63	0.32	9.92	0.24	11.19
May	0.32	9.37	0.41	12.70	0.29	12.47	0.26	9.92	0.24	12.02
June	0.77	25.46	0.36	11.32	0.27	9.67	0.29	12.79		
July	1.84	57.30	0.59	18.02	0.26	10.36	0.36	14.27		
August	1.35	39.44	0.66	20.87	0.15	5.28	0.20	7.62		
September	0.42	12.25	0.88	27.43	0.28	8.98	0.61	33.85		
October	0.74	22.03	0.42	13.20	0.25	7.70	0.72	44.82		
November	1.01	30.30	0.22	6.97	0.24	7.19	0.48	21.35		
December	1.04	36.80	0.22	6.81	0.30	9.00	0.19	6.99		
Average	0.76	23.31	0.45	14.55	0.27	9.41	0.37	16.36	0.20	9.32
Maximum	1.84	57.30	1.03	36.88	0.34	12.47	0.72	44.82	0.24	12.02
Minimum	0.32	9.13	0.19	5.84	0.15	5.28	0.19	6.99	0.15	5.55

Table 3.05-4 Effluent TP Concentration and Load

SECTION 4
WASTELOAD AND FLOW FORECASTS

Information on population trends and projections for future flows and waste loads are presented in this section. Current and projected flows and loadings are developed to evaluate alternatives for improvements to the WPCF and to develop preliminary design criteria. Projections of flows and loadings were made for 10-year and 25-year planning periods. For purposes of this plan, years 2030 and 2045 will be considered the 10-year and 25-year planning periods, respectively.

4.01 URBAN SERVICE AREA

Populations served by the wastewater treatment facilities are delineated by sewer service area, shown in Figure 1.02-1.

4.02 POPULATIONS PROJECTIONS

Population projections developed by the Wisconsin Department of Administration (WDOA) were used for projecting future flows and waste loads. The projected 2030 population (10-year planning period), is 39,670. The projected 2040 population is 39,590. This is slightly lower than the projected year 2035 population of 39,860. WDOA does not currently have population projections available past year 2040. Therefore, a year 2045 City population of 39,860 will be used for the 25-year planning period.

In addition to the City's population, sewer has been extended to an area within the Town of Beloit. Although no homes are currently connected to this sewer, it is likely that approximately 180 homes will be connected by year 2030. At an average rate of 2.31 people per home, the average number of people per dwelling unit, this adds 416 people to the 10-year and 25-year planning projections.

The total population used for the 10-year and 25-year planning periods is 40,086 and 40,276, respectively. Table 4.02-1 and Figure 4.02-1 show census data as well as population projections in tabular and graphical format, respectively. The WDOA estimate for January 1, 2018 is the most current estimate of the City's population.

Year	Census	WDOA Estimate	WDOA Projections	Total Service Population[1]
1980	35,207			
1990	35,573			
2000	35,775			
2010	36,966			
2015			37,180	
2018		36,683		
2020			38,250	
2025			39,020	
2030			39,670	40,086
2035			39,860	40,276
2040			39,590	40,006

[1] Includes the added population within the Town of Beloit (416 people).

Table 4.02-1 Census Data (1980 to 2010) and Projected Populations

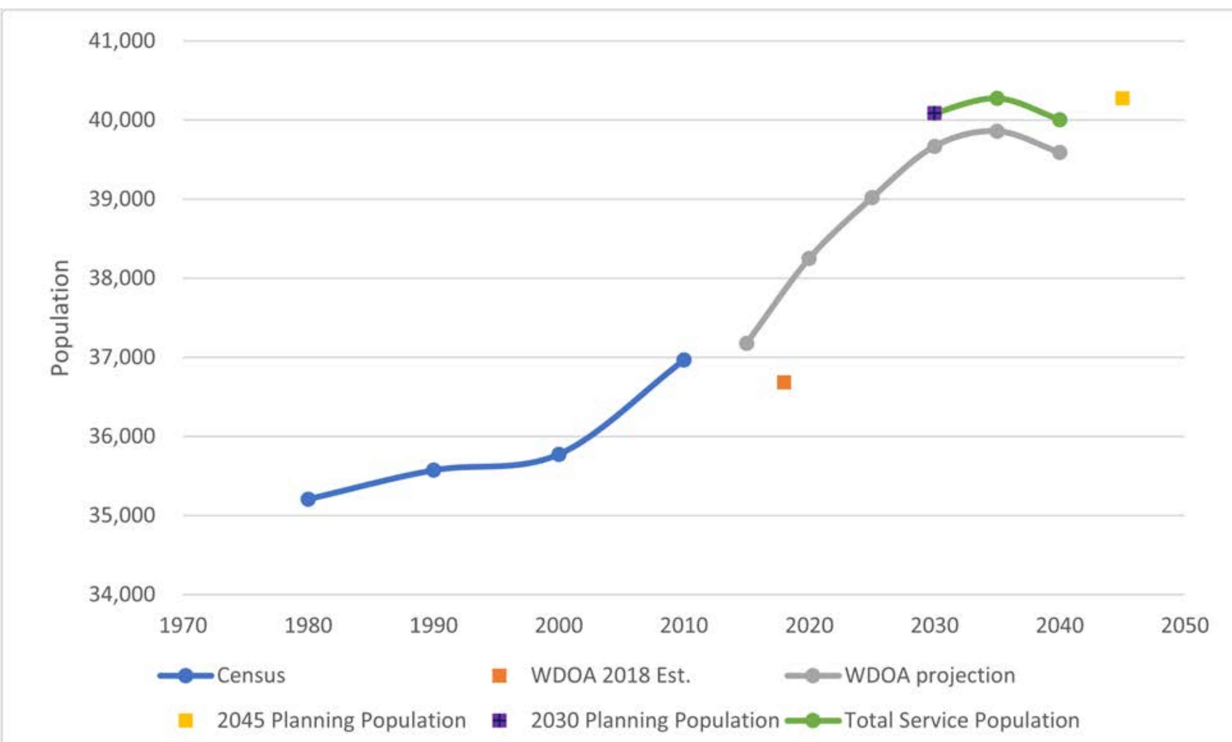


Figure 4.02-1 Census Data (1980 to 2010) and Projected Populations

4.03 SIU AND COMMERCIAL FLOW AND LOADING PROJECTIONS

The City's SIUs and commercial entities are a significant source of flow and loadings to the WPCF. Changes to discharges from SIU and commercial sources can significantly impact the overall volume and nature of the influent wastewater to the WPCF. For this reason, an extensive effort was made during development of this plan to understand the likelihood and magnitude of potential changes at SIUs (and the more significant commercial sources) to understand the resultant potential impact to future flow and loading projections.

A. Potential Casino Development

Ho-Chunk Nation has proposed a significant development within the City on land immediately north of the WPCF site. This proposed development may include a large casino, convention center, hotel, and possibly a water park and could generate a significant wastewater flow and load. As such, the projected flows and loads from this potential casino development are included in the 10-and 25-year flow and loading projections. In a letter sent from the City to Ho-Chunk Nation dated September 25, 2012, the City anticipated the following flow and loads would result from the casino development (shown in Table 4.03-1). The letter is included as Appendix C. Updated flow and load projections for this development were requested from Ho-Chunk Nation but were not provided before the writing of this report.

Flow	107,000 gpd
BOD Discharge	494 lbs/day
COD Discharge[1]	988 lbs/day
TSS Discharge	253 lbs/day

[1]Chemical oxygen demand (COD) load is calculated based on a BOD_5:COD ratio of 0.50:1.00

Table 4.03-1 Casino Development Flow and Load Projections

B. SIU Flow and Loading Projections

The City currently permits nine industries, one hospital, and the Krueger Municipal pool as SIUs. Each of the ten permitted private SIUs will hereafter be referenced to as SIU A through J to respect the confidentiality of the private organizations. Table 4.03-2 lists the SIUs and their current monthly average limits for flow, COD, TSS, and phosphorus. COD is the total measurement of oxygen demand associated with all chemicals in the waste stream, not just the organic components (as is the case with the BOD_5 test). This provides a better measurement of the total oxygen demand of wastewater being received from industries, as the industrial sources may have more significant non-organic fractions within the waste stream. SIUs that do not have significant COD, TSS, or TP loads do not currently have a limit for the respective pollutants.

SIU	Flow (gpd)	COD (lbs/day)	TSS (lbs/day)	TP (lbs/day)
SIU A	100,000			
SIU B	700,000	9,000	3,000	75
SIU C	100,000	500	500	25
SIU D	200,000	1,000	500	25
SIU E	100,000	2,500	500	50
SIU F	600,000	15,000	1,800	300
SIU G	750,000	4,100	1,000	75
SIU H	100,000			
SIU I	60,000			
SIU J	100,000			
Krueger Municipal Pool	100,000			
Total	**2,910,000**	**32,100**	**7,300**	**550**

Table 4.03-2 SIU Limits

An in-person meeting was held with each SIU (with the exception of the hospital) during June 2019. The hospital was previously reported to not be planning any significant changes that would impact the wastewater flow or load received at the WPCF. The purpose of these meetings was to discuss the magnitude and likelihood of changes that would result in changes to wastewater flows or loadings discharged from the City's facility. Near-term (less than 5 years), 10-year, and 25-year changes were discussed. Summaries of flows and loads discharged from each facility from a period of January 2015 through May 2019 were presented. Based on these discussions, and because of the uncertainty associated with projecting future industrial flows and loads, low and high range flow and loading projections were made for each SIU. Summaries of past flow and loading data are included in Appendix D.

The SIU flow and loading projections were reviewed with City staff on August 16, 2019. The City has historically promoted industrial growth by providing sufficient WPCF reserve capacity for continued industrial growth. In addition, due to pre-treatment process upsets from time to time and sudden changes in production, variable loadings have needed to be accommodated by the WPCF over certain periods. Therefore, a conservative approach to projecting future SIU flows and loadings was agreed to during this meeting. High-end growth projections are used for projecting future flows and loads from SIUs.

1. Average Day SIU Flow and Loading Projections

Tables 4.03-3, 4.03-4, 4.03-5, 4.03-6, and 4.03-7 show the average flow and loading for each SIU from January 2018 through May 2019, the high end growth projections, and the projected average day flow and loading projections for each SIU for the 10-year and 25-year planning periods.

		Projected Growth (gallons)			Projected Average Flow (gallons)		
SIU	Average Flow (gallons) (January 2018 to May 2019)	Near-Term	10-Year	25-year	Near-Term	10-Year	25-year
SIU A	34,000	0%	0%	0%	34,000	34,000	34,000
SIU B	471,000	0%	40%	100%	471,000	659,000	942,000
SIU C	25,000	0%	10%	25%	25,000	28,000	31,000
SIU D	80,000	0%	100%	100%	80,000	160,000	160,000
SIU E[1]	29,000 (See Note 1)	0%	100%	100%	100,000	200,000	200,000
SIU F	316,000	30%	57%	110%	411,000	496,000	663,000
SIU G	345,000	15%	15%	15%	397,000	397,000	397,000
SIU H	18,000	-100%	-100%	-100%	-	-	-
Ho-Chunk Casino[2]		0%	0%	0%	107,000	107,000	107,000
Total	1,318,000				1,625,000	2,081,000	2,534,000

[1] Ownership and Operations at SIU E have changed significantly in 2019. Future loads are assumed to be equal to currently permitted allocations.
[2] Assumed future flow.

Table 4.03-3 Projected Average SIU Flows

		Projected Growth			Projected Average Load (lbs/day)		
SIU	Average Load (lbs/day) (January 2018 to May 2019)	Near-Term	10-Year	25-Year	Near-Term	10-Year	25-Year
SIU A	160	0%	0%	0%	160	160	160
SIU B	7,420	0%	40%	100%	7,420	10,390	14,840
SIU C	180	0%	10%	25%	180	200	230
SIU D	640	0%	100%	100%	640	1,280	1,280
SIU E[1]	620 (See Note 1)	0%	100%	100%	2,500	5,000	5,000
SIU F	9,020	30%	57%	110%	11,730	14,160	18,940
SIU G	3,080	15%	15%	15%	3,540	3,540	3,540
SIU H	60	-100%	-100%	-100%	-	-	-
Ho-Chunk Casino[2]		0%	0%	0%	770	770	770
Total	21,180				26,940	35,500	44,760

[1] Ownership and Operations at SIU E have changed significantly in 2019. Future loads are assumed to be equal to currently permitted allocations.
[2] Assumed future load.

Table 4.03-4 Projected Average SIU COD Loads

		Projected Growth			Projected Average Load (lbs/day)		
SIU	Average Load (lbs/day) (January 2018 to May 2019)	Near-Term	10-Year	25-Year	Near-Term	10-Year	25-Year
SIU A	50	0%	0%	0%	50	50	50
SIU B	1,030	0%	40%	100%	1,030	1,440	2,060
SIU C	30	0%	10%	25%	30	30	40
SIU D	160	0%	100%	100%	160	320	320
SIU E[1]	20 (See Note 1)	0%	100%	100%	500	1,000	1,000
SIU F	810	30%	57%	110%	1,050	1,270	1,700
SIU G	500	15%	15%	15%	580	580	580
SIU H	20	-100%	-100%	-100%	-	-	-
Ho-Chunk Casino[2]		0%	0%	0%	250	250	250
Total	2,620				3,650	4,940	6,000

[1] Ownership and Operations at SIU E have changed significantly in 2019. Future loads are assumed to be equal to currently permitted allocations.
[2] Assumed future load.

Table 4.03-5 Projected Average SIU TSS Loads

		Projected Growth			Projected Average Load (lbs/day)		
SIU	Average Load (lbs/day) (January 2018 to May 2019)	Near-Term	10-Year	25-Year	Near-Term	10-Year	25-Year
SIU A	5.27	0%	0%	0%	5.27	5.27	5.27
SIU B	35	0%	40%	100%	35	49	70
SIU C	0.29	0%	10%	25%	0.29	0.31	0.36
SIU D	6.3	0%	100%	100%	6.3	12.6	12.6
SIU E[1]	0 (See Note 1)	0%	100%	100%	0.00	0.00	0.00
SIU F	277	30%	57%	110%	360	435	582
SIU G	48	15%	15%	15%	55	55	55
SIU H	0.38	-100%	-100%	-100%	0.00	0.00	0.00
Ho-Chunk Casino[2]	5.3	0%	0%	0%	5.3	5.3	5.3
Total	378				467	562	731

[1] Ownership and Operations at SIU E have changed significantly in 2019. Future loads are assumed to be equal to currently permitted allocations.
[2] Assumed future load.

Table 4.03-6 Projected Average SIU NH_3-N Loads

		Projected Growth			Projected Average Load (lbs/day)		
SIU	**Average Flow (gallons) (January 2018 to May 2019)**	**Near-Term**	**10-Year**	**25-Year**	**Near-Term**	**10-Year**	**25-Year**
SIU A	1.2	0%	0%	0%	1.2	1.2	1.2
SIU B	24	0%	40%	100%	24	34	48
SIU C	1.1	0%	10%	25%	1.1	1.2	1.4
SIU D	0.88	0%	100%	100%	0.88	1.8	1.8
SIU E	1.1 (See Note 1)	0%	100%	100%	50	100	100
SIU F	110	30%	57%	110%	143	173	231
SIU G	47	15%	15%	15%	54	54	54
SIU H	6.4	-100%	-100%	-100%	0.00	0.00	0.00
Ho-Chunk Casino[2]	1.2	0%	0%	0%	1.2	1.2	1.2
Total	193				276	367	439

[1] Ownership and Operations at SIU E have changed significantly in 2019. Future loads are assumed to be equal to currently permitted allocations.
[2] Projected future load.

Table 4.03-7 Projected Average SIU TP Loads

2. Maximum Month SIU Flow and Loading Projections

Flow and load allocations to SIUs are made based on the maximum month design capacity of the WPCF (i.e., the total maximum month design capacity of the WPCF is allocated to residential, commercial, and institutional [RCI], and SIU sources). In accordance with USEPA's Local Limits Guidance documents, the City considers any WPCF capacity allocated to a particular source (either SIU, RCI) unavailable to be allocated to other sources (for example, if capacity is allocated to an individual source, it must remain available to that source at all times). Therefore, it was agreed that the existing baseline maximum month flows/loadings would be developed by adding up the higher of the existing allocated flow and load or the maximum month flow/load that was actually discharged from January 2015 through May 2019. Tables 4.03-8, 4.03-9, 4.03-10, 4.03-11, and 4.03-12 show the baseline maximum month flows, COD load, TSS load, NH3 load, and TP load that will be used for projecting maximum month flows and loads for each SIU, respectively.

The projected growth for each SIU for the near term, 10-year, and 25-year timeframes, and corresponding maximum month flow and loading projections for each SIU are also shown in the following tables. Table 4.03-13 presents the total maximum month flow, COD, TSS, phosphorus, and NH3 projections for the near-term, 10-year, and 25-year planning periods. The near-term SIU flow and loading projections are shown in this table for informational purposes only. Subsequent sections of this report will include flow and loading projections for the 10-year and 25-year planning periods only.

Table 4.03-8 Projected Maximum Month SIU Flows

				Projected Growth			Projected Maximum Month Flow (gallons)		
SIU	Existing Allocation (gallons)	Existing Maximum Month Flow (gallons)	Baseline Maximum Month Flow (gallons)	Near-Term	10-Year	25-Year	Near-Term	10-Year	25-year
SIU A	100,000	66,000	100,000	0%	0%	0%	100,000	100,000	100,000
SIU B	700,000	604,000	700,000	0%	40%	100%	700,000	980,000	1,400,000
SIU C	100,000	39,000	100,000	0%	10%	25%	100,000	110,000	125,000
SIU D	200,000	206,000	206,000	0%	100%	100%	206,000	412,000	412,000
SIU E	100,000	84,000	100,000	0%	100%	100%	100,000	200,000	200,000
SIU F	600,000	382,000	600,000	30%	57%	110%	780,000	942,000	1,260,000
SIU G	750,000	453,000	750,000	15%	15%	15%	863,000	863,000	863,000
SIU H	100,000	68,000	100,000	-100%	-100%	-100%	-	-	-
SIU I	60,000	-	60,000	0%	0%	0%	60,000	60,000	60,000
SIU J	100,000	-	100,000	0%	0%	0%	100,000	100,000	100,000
Krueger Municipal Pool	100,000	-	100,000	0%	0%	0%	100,000	100,000	100,000
Ho-Chunk Casino	-	-	-	0%	0%	0%	107,000	107,000	107,000
Total	2,910,000	1,902,000	2,916,000				3,216,000	3,974,000	4,727,000

Table 4.03-9 Projected Maximum Month SIU COD Load

				Projected Growth			Projected Maximum Month Load (lbs/day)		
SIU	Existing Allocation (lbs/day)	Existing Maximum Month Load (lbs/day)	Baseline Maximum Month Load (lbs/day)	Near-Term	10-Year	25-year	Near-Term	10-Year	25-year
SIU A	-	480	480	0%	0%	0%	480	480	480
SIU B	9,000	11,590	11,590	0%	40%	100%	11,590	16,230	23,180
SIU C	500	540	540	0%	10%	25%	540	590	680
SIU D	1,000	2,480	2,480	0%	100%	100%	2,480	4,960	4,960
SIU E	2,500	620	2,500	0%	100%	100%	2,500	5,000	5,000
SIU F	15,000	15,980	15,980	30%	57%	110%	20,770	25,090	33,560
SIU G	4,100	5,530	5,530	15%	15%	15%	6,360	6,360	6,360
SIU H	-	290	290	-100%	-100%	-100%	-	-	-
Ho-Chunk Casino	-	-	-	0%	0%	0%	770	770	770
Total	32,100	37,510	39,390				45,490	59,480	74,990

Note: SIU I, Krueger Municipal Pool, and SIU J are not shown as they contribute negligible loads.

Table 4.03-10 Projected Maximum Month SIU TSS Load

				Projected Growth			Projected Maximum Month Load (lbs/day)		
SIU	Existing Allocation (lbs/day)	Existing Maximum Month Load (lbs/day)	Baseline Maximum Month Load (lbs/day)	Near-Term	10-Year	SIU	Existing Allocation (lbs/day)	Existing Maximum Month Load (lbs/day)	Baseline Maximum Month Load (lbs/day)
SIU A	-	200	200	0%	0%	0%	200	200	200
SIU B	3,000	3,970	3,970	0%	40%	100%	3,970	5,560	7,940
SIU C	500	100	500	0%	10%	25%	500	550	630
SIU D	500	1,270	1,270	0%	100%	100%	1,270	2,540	2,540
SIU E	500	180	500	0%	100%	100%	500	1,000	1,000
SIU F	1,800	1,440	1,800	30%	57%	110%	2,340	2,830	3,780
SIU G	1,000	1,620	1,620	15%	15%	15%	1,860	1,860	1,860
SIU H	-	90	90	-100%	-100%	-100%	-	-	-
Ho-Chunk Casino	-	-	-	0%	0%	0%	250	250	250
Total	7,300	8,870	9,950				10,890	14,790	18,200

Note: SIU I, Krueger Municipal Pool, and SIU J are not shown as they contribute negligible loads.

Table 4.03-11 Projected Maximum Month SIU NH_3-N Load

				Projected Growth			Projected Max Month Load (lbs/day)		
SIU	**Existing Allocation (lbs/day)[1]**	**Existing Maximum Month Load (lbs/day)**	**Baseline Maximum Month Load (lbs/day)**	**Near-Term**	**10-Year**	**25-year**	**Near-Term**	**10-Year**	**25-year**
SIU A	-	13	13	0%	0%	0%	13	13	13
SIU B	-	96	96	0%	40%	100%	100	130	190
SIU C	-	1.3	1.3	0%	10%	25%	1.3	1.4	1.6
SIU D	-	33	33	0%	100%	100%	30	70	70
SIU E	-	1.8	1.8	0%	100%	100%	1.8	3.6	3.6
SIU F	-	533	533	30%	57%	110%	690	840	1,120
SIU G	-	79	79	15%	15%	15%	91	91	91
SIU H	-	1.3	1.3	-100%	-100%	-100%	0	0	0
Ho-Chunk Casino	-			0%	0%	0%			
Total	-	758	758				927	1,149	1,489

Note: SIU I, Krueger Municipal Pool, and SIU J are not shown as they contribute negligible loads.
[1] The City does not currently allocate NH_3-N loads.

Table 4.03-12 Projected Maximum Month SIU Phosphorus Load

				Projected Growth			Projected Max Month Load (lbs/day)		
SIU	**Existing Allocation (lbs/day)**	**Existing Maximum Month Load (lbs/day)**	**Baseline Maximum Month Load (lbs/day)**	**Near-Term**	**10-Year**	**25-year**	**Near-Term**	**10-Year**	**25-year**
SIU A	-	2.8	2.8	0%	0%	0%	2.8	2.8	2.8
SIU B	75	102	102	0%	40%	100%	102	143	204
SIU C	25	6	25	0%	10%	25%	25	28	31
SIU D	25	5	25	0%	100%	100%	25	50	50
SIU E	50	4.4	50	0%	100%	100%	50	100	100
SIU F	300	309	309	30%	57%	110%	402	485	649
SIU G	75	75	75	15%	15%	15%	86	86	86
SIU H	-	5.2	5.2	-100%	-100%	-100%	0	0	0
Ho-Chunk Casino	-	-	-	0%	0%	0%	-	-	-
Total	550	509	594				693	895	1,123

Note: SIU I, Krueger Municipal Pool, and SIU J are not shown as they contribute negligible loads.

Planning Period	Flow	COD	TSS	NH_3	TP
Near-Term (2020)	3,216,000	45,500	10,890	927	693
10-Year (2030)	3,974,000	59,480	14,790	1,149	895
25-Year (2045)	4,727,000	75,000	18,200	1,488	1,122

Table 4.03-13 Projected Maximum Month SIU Flows and Loads

3. Maximum Week and Day SIU Flow and Loading Projections

Maximum week and day flow and loading projections for SIUs are discussed below.

C. Commercial and Institutional Flow and Loading Projections

The City has several hundred licensed commercial and institutional entities in the City. Calls to 12 of these entities (those with the highest volume of water usage) were made in June and July 2019 for purposes of discussed changes that may affect wastewater flows and loads discharged from the City's facility. None of the commercial entities anticipated changes that would have a significant effect on the City's wastewater discharge. Therefore, it was assumed that commercial and institutional flows and loads would remain proportionate to the City's population.

D. Hauled Waste Summary

The WPCF does not currently accept significant volumes of hauled waste. It is assumed that the volume and nature of any future hauled waste received at the facility will have a negligible impact to flow and loading projections.

4.04 WPCF PROJECTED FLOWS

Projecting future wastewater flow requires identification of RCI, and industrial wastewater flow, base flows, peaking factors, and anticipated growth of RCI and industrial sources within the City's WPCF tributary area. The data used in these evaluations includes daily flow measurements from the WPCF's influent flow meter from January 2015 through May 2019.

A. Dry Weather Base Flows and Per Capita Flows

Since 2015, average annual flows have increased from 3.65 MGD in 2015 to a high of 5.79 MGD in 2019 (January through May). As discussed in Section 2, influent flows to the WPCF have increased significantly in the recent past as a result of more rainfall and higher water levels in the Rock River. It is also suspected that I/I reduction work from the early 2000s may be compromised in areas allowing increased I/I. For purposes of projecting future flows, the average of annual flows from January through December 2018 and January through May 2019 (5.23 MGD) will be used as a baseline for projecting future flows and calculating maximum (day, week, month) to average flow ratios.

Influent flow to the WPCF is from RCI and industrial sources in addition to I/I. A dry weather per capita flow from RCI sources was determined by identifying a 30-day period of low influent flow to the WPCF (resulting from dry weather and low river levels). The 30 days from February 6, 2015 to March 3, 2015 resulted in an average influent flow of 3.32 MGD. The combined flow from SIUs during the period was 0.89 MGD, resulting in a dry weather flow of 2.43 MGD from RCI sources. This flow also includes dry weather infiltration. Based on the 2018 population estimate of 36,683, the average per capita RCI flow is 66 gpcd. Average annual I/I can then be calculated by subtracting annual SIU flows and the dry weather RCI from the annual average flow for each year. Annual average I/I has ranged from 0.17 MGD in 2015 to 2.02 MGD for January through May 2019. Average annual influent flows, SIU flow, and I/I are presented in Table 4.04-1.

Table 4.04-1 Existing Daily, Weekly, and Monthly Flow Summary

	2015	2016	2017	2018	2019 (through May)	Average 2018 and 2019	Maximum	Average to Maximum Flow Ratio
Overall Average Flow (MGD)	3.65	3.92	4.27	5.00	5.79	5.23	5.8	
SIU Flow (MGD)	1.05	1.15	1.24	1.31	1.35	1.32	1.31	
Average Dry Weather Flow (MGD)	2.43	2.43	2.43	2.43	2.43	2.43	2.43	
Per Capita Dry Weather RCI Flow (gpcd)	66	66	66	66	66	66		
Average Annual I/I (MGD)	0.17	0.34	0.61	1.26	2.01	1.49	2.02	
Average RCI Flow, including I/I (MGD)	2.60	2.77	3.04	3.69	4.44	3.92	4.44	
Per Capita RCI Flow, Including I/I (gpcd)	71	76	83	101	121	106	121	
Maximum Month Flow (MGD)[2]	4.306	4.425	5.216	7.702	7.894		7.894	1.51
30-Day Period	12/2/15 to 12/30/15	3/28/16 to 4/25/16	4/27/17 to 5/25/17	10/2/18 to 10/30/18	3/12/19 to 4/11/19		3/12/19 to 4/11/19	
Maximum Week Flow (MGD)	4.526	4.605	6.019	10.532	9.241		10.532	2.01
Week	12/14/15 to 12/20/15	4/2/16 to 4/8/16	7/20/17 to 7/26/17	10/6/18 to 10/12/18	3/13/19 to 3/19/19		10/6/18 to 10/12/18	
Maximum Day Flow (MGD)	4.753	4.85	6.466	14.446	12.21		14.446	2.76
Day	12/14/2015	6/15/2016	7/23/2017	10/7/2018	3/14/2019		10/7/2018	
Total Precipitation	36.73	32.42	39.96	47.9	17.71	40.45	47.9	

Notes:
[1]Based on a 2018 population estimate of 36,683.
[2]Maximum month flow refers to the maximum average flow for a consecutive 30-day period, not the calendar months. For this reason, values shown in this row will conflict with values shown in Table 3.03-1.

B. Average and Maximum Day, Maximum Week, Maximum Month Flows, and Per Capita Flows

Table 4.04-1 also presents maximum daily flows, maximum week, and maximum month flows from 2015 through May 2019. Graphs of daily flows to the WPCF from 2015 through May 2019 are included in Appendix E.

From 2015 through May 2019, the maximum month flow (30 consecutive days and not calendar month as shown in Table 3.03-1) was 7.894 MGD and occurred during the 30-day period from March 12 to April 11, 2019. When comparing to the January 2018 through May 2019 average flow of 5.23 MGD, this results in a peak month to average day ratio of 1.51. The maximum week flow was 10.532 MGD and occurred the week of October 6 through October 12, 2018. This results in a peak week to average day ratio of 2.01. The peak day flow was 14.446 MGD and occurred on October 7, 2018. This results in a peak day to average day flow ratio of 2.76. Peak month, week, and day flows and peak flow ratios are shown in Table 4.04-2. Peaking ratios for COD, TSS, NH_3, and TP are also shown and will be referenced in later sections.

	Flow	COD	TSS	NH_3	TP
Maximum Month	1.51	1.26	1.53	1.18	1.52
Maximum Week	2.01	1.70	2.08	1.31	2.42
Maximum Day	2.76	2.46	4.82	1.68	5.62

Table 4.04-2 Flow and Loading Peaking Ratios

The 2030 annual average design flow can be projected by multiplying the 2018 to May 2019 average per capita RCI flow rate (including annual average I/I) of 106 gpcd by the projected 2030 population of 40,086, yielding a flow rate of 4.24 MGD. Section NR110 of the Wisconsin Administrative Code allows for an additional 25 percent of projected SIU flows to be included in flow and loading projections to account for future unforeseen industrial growth within the service area for facilities that serve a population equivalent of at least 10,000 people. The projected 2030 SIU flow of 2.08 MGD multiplied by an additional 25 percent yields a total year 2030 projected SIU flow of 2.60 MGD. Adding this to the RCI flow rate yields a total year 2030 projected average annual flow of 6.84 MGD.

The maximum month flow for year 2030 was calculated by multiplying the year 2030 average annual RCI flow 4.24 MGD by the average annual to maximum month peaking factor of 1.51 yielding a flow rate of 6.40 MGD. This was added to the year 2030 maximum month SIU flow of 3.97 MGD calculated above (with a 25 percent unforeseen growth factor) to yield a total maximum month projected flow of 11.36 MGD.

The projected year 2030 maximum week and day flows were calculated by multiplying the projected year 2030 average annual flow rate of 6.84 MGD by the maximum week and maximum day to annual average peaking factors of 2.01 and 2.76, respectively. This yields a projected maximum week and maximum day flows of 13.75 MGD and 18.88 MGD, respectively.

The projected 2045 annual average, maximum month, maximum week, and maximum day flows were calculated in a similar manner. Table 4.04-3 presents a summary of the projected year 2030 and year 2045 annual average, maximum month, maximum week, and maximum day flows.

	2030	2045
Annual Average (MGD)	6.84	7.44
Maximum Month (MGD)	11.36	12.35
Maximum Week (MGD)	13.75	14.95
Maximum Day (MGD)	18.88	20.53

Table 4.04-3 Maximum Flows

C. Peak Hourly Flows

Influent flows at the WPCF are measured via two magnetic flow meters located at each pumping station upstream of the WPCF. The flows are stored in the WPCF's supervisory control and data acquisition (SCADA) system; however, this stored data is only available back to approximately January 2014. Peak hourly flows were recorded in the SCADA system for the time period analyzed and show a peak hourly flow of 22.23 MGD on November 8, 2018 at 4 A.M. This corresponds with a large rainfall event of 2.93 inches the day before. The existing peak hourly design capacity of the WPCF is 28.3 MGD and will be used for planning purposes for both the year 2030 and year 2045 planning projections.

4.05 PROJECTED FACILITY LOADINGS

Future design loadings for the WPCF were developed using an analysis similar to that employed for flow projections. Existing per capita loadings for BOD_5, TSS, NH_3-N, and TP were determined using existing WPCF data. Projections of future loadings were developed using populations projected by the WDOA and the current per capita loadings. SIU loading projections were previously described in section 4.03.

A. BOD to COD Ratio

The City's SIUs permits require monitoring effluent COD near the point the SIUs discharge enters the City's collection system. The City currently measures influent BOD_5 and influent COD. Based on this sampling, an overall average BOD_5 to COD ratio of 0.50:1:00 has been established and will be used for projecting loadings to the WPCF.

B. Per Capita Loads, Maximum Month, Maximum Week, Maximum Day Loads

The existing monthly average influent concentrations and loadings for BOD_5, TSS, NH_3-N, and TP from 2015 through May 2019 are shown in Tables 3.03-2 and 3.03-3.

Existing maximum month, maximum week, and maximum day loads for influent BOD_5, TSS, NH_3, and TP and the corresponding maximum to average day load ratios are shown in Table 4.05-1.

		Load	Peaking Factor
BOD_5 (lbs/day)	Average[1]	19,875	
	Maximum Month[2]	25,023	1.26
	Maximum Week[3]	33,741	1.70
	Maximum Day[4]	48,896	2.46
TSS	Average[1]	10,851	
	Maximum Month[2]	16,600	1.53
	Maximum Week[3]	22,577	2.08
	Maximum Day[4]	52,275	4.82
NH_3-N	Average[1]	1,025	
	Maximum Month[2]	1,208	1.18
	Maximum Week[3]	1,339	1.31
	Maximum Day[4]	1,723	1.68
TP	Average[1]	305	
	Maximum Month[2]	464	1.52
	Maximum Week[3]	738	2.42
	Maximum Day[4]	1,715	5.62

[1] Average of January 2018 through May 2019 loads
[2] Maximum 30-day average load January 2015 through May 2019
[3] Maximum 7-day average load January 2015 through May 2019
[4] Maximum day load January 2015 through May 2019

Table 4.05-1 Current Peak Flows and Loads

Similar to the previously presented flow projections, the average loadings from January 2018 through May 2019 were used for purposes of projecting future loads. The average load from all SIUs was subtracted from the total average load to yield the total load from RCI sources. Dividing by the 2018 population estimate of 36,683 people allows for the existing per capita RCI loads to be calculated. These existing per capita RCI loads are presented in Table 4.05-2. The existing average per capita COD, TSS, NH_3-N, and TP loadings (2018 and 2019) are shown in Table 4.05-2. These values are within typical ranges for domestic wastewater.

	Annual Average WPCF Influent Load (January 2018 to May 2019)	Total Average SIU Load (January 2018 to May 2019)	Average RCI Load (January 2018 to May 2019)	2018 Population Estimate	Per Capita RCI Load
COD (lbs/day)	39,750	21,180	18,570	36,683	0.51
TSS (lbs/day)	10,851	2,620	8,231	36,683	0.22
NH_3-N (lbs/day)	1,025	378	647	36,683	0.0176
TP (lbs/day)	305	193	112	36,683	0.0031

Table 4.05-2 Existing Average and Per Capita Loadings

B. Future Load Projections–Average Day

Future average day loads to the WPCF were projected by multiplying the 2030 and 2045 populations presented in Section 4.02 by the per capita loading values shown in Table 4.05-2 and then adding them to the projected SIU load. Similar to the methodology used for projecting future average flow rates, an additional 25 percent is added to the projected SIU load to account for future unforeseen industrial growth. Tables 4.04-3 and 4.04-4 present the projected future average loads for COD, TSS, NH_{3-}N, and TP for year 2030 and 2045, respectively.

	Projected 2030 Average RCI Load[1]	Projected SIU Load	Unforeseen Industrial Growth (25%)	Total 2030 Projected Average Load
COD (lbs/day)	20,440	35,500	8880	64,820
TSS (lbs/day)	8,820	4,940	1240	15,000
NH_3-N (lbs/day)	706	562	141	1,409
TP (lbs/day)	124	367	92	583

[1] Based on a projected year 2030 population of 40,086.

Table 4.05-3 Year 2030 Average Design Load Projections

	Projected 2045 Average RCI Load[1]	Projected SIU Load	Unforeseen Industrial Growth (25%)	Total 2045 Projected Average Load
COD (lbs/day)	20,540	44,760	11,190	76,490
TSS (lbs/day)	8,860	6,000	1,500	16,360
NH_3-N (lbs/day)	709	731	183	1,623
TP (lbs/day)	125	439	110	674

[1] Based on a projected year 2045 population of 40,276.

Table 4.05-4 Year 2045 Average Design Load Projections

C. Future Load Projections–Maximum Month

The projected average annual RCI load was multiplied by the maximum month to average annual load peaking factor to determine the maximum month RCI load. The maximum month SIU load was then added to this (in addition to a 25 percent unforeseen industrial growth factor) to calculate the total projected maximum month load. Table 4.05-5 presents the maximum month loads for BOD_5, TSS, NH_3-N, and TP.

	COD		TSS		NH_3-N		TP	
	2030	2045	2030	2045	2030	2045	2030	2045
Average Annual RCI Load (lbs/day)	20,440	20,540	8,820	8,860	706	709	124	125
Average Annual Load to Maximum Month Peaking Factor	1.26	1.26	1.53	1.53	1.18	1.18	1.52	1.52
RCI Peak Month (lbs/day)	25,750	25,880	13,490	13,560	833	837	188	190
SIU Maximum Month Load (lbs/day)	59,480	74,990	14,790	18,200	1,149	1,489	895	1,123
Unforeseen Industrial Growth (25%) (lbs/day)	14,870	18,750	3,700	4,550	287	372	224	281
Total Load (lbs/day)	100,110	119,620	31,980	36,310	2,269	2,698	1,307	1,593

Table 4.05-5 Maximum Month Loads

D. Future Load Projections–Maximum Week and Maximum Day

The existing peak to average load ratios for the maximum week, and maximum days were multiplied by the average day load projections to calculate the maximum week and maximum day loads at the WPCF. Table 4.05-6 presents the peaking factors and projected maximum month, week, and day loads for BOD_5, TSS, NH_3-N, and TP for the two planning periods. As a result of the conservative method that was used to project maximum month loadings, which aligns with the City's methods of allocating the maximum month WPCF capacity (see Section 4.03 and Table 4.03-8 through 4.03-12), the maximum month TSS and NH_3-N loads were projected to be greater than the projected maximum week TSS and NH_3-N loads. Statistically, this is not possible. Therefore, the maximum week TSS and NH_3-N loads were set to be equal to the maximum month TSS and NH_3-N loads.

	Peaking Factor	Projected (Year 2030)	Projected (Year 2045)
Average Day COD Loading (lbs/day)	--	64,820	76,490
Maximum Month COD Loading (lbs/day)	See Note 1	100,110	119,620
Maximum Week COD Loading (lbs/day)	1.70	110,190	130,030
Maximum Day COD Loading (lbs/day)	2.46	159,460	188,170
Average Day TSS Loading (lbs/day)	--	15,000	16,360
Maximum Month TSS Loading (lbs/day)	See Note 1	31,980	36,310
Maximum Week TSS Loading (lbs/day)	2.08	31,980[2]	36,310[2]
Maximum Day TSS Loading (lbs/day)	4.82	72,300	78,860
Average Day NH_3-N Loading (lbs/day)	--	1,409	1,623
Maximum Month NH_3-N Loading (lbs/day)	See Note 1	2,269	2,698
Maximum Week NH_3-N Loading (lbs/day)	1.31	2,269[2]	2,698[2]
Maximum Day NH_3-N Loading (lbs/day)	1.68	2,366	2,726
Average Day TP Loading (lbs/day)	--	583	674
Maximum Month TP Loading (lbs/day)	See Note 1	1,307	1,593
Maximum Week TP Loading (lbs/day)	2.42	1,410	1,630
Maximum Day TP Loading (lbs/day)	5.62	3,275	3,786

[1] See Tables 4.05-4 and 4.05-5 for calculations on maximum month loads

[2] See Section 4.03 for methodology used for projecting average day and maximum month loads for SIUs. The conservative method used to project maximum month loads resulted in the projected maximum month load being slightly higher than the projected maximum week load. Because this is not statistically possible, the maximum week load was adjusted to be equal to the maximum month load.

Table 4.05-6 Years 2030 and 2045 Peak Design Load Projections

4.06 SUMMARY OF DESIGN FLOWS AND LOADS

Table 4.06-1 and 4.06-2 summarize the design flows and loads for both the 10- and 25-year planning periods that will be used as the basis for the process and equipment evaluations in the remainder of this facilities plan.

	Average Day	Maximum Month	Maximum Week	Maximum Day	Peak Hourly
Flow (MGD)	6.84[2]	11.36[4]	13.75[5]	18.88[3]	28.30
COD Load (lbs/day)	64,820	100,110	110,190	159,460	
BOD Load (lbs/day)[1]	32,410	50,060[6]	55,100	79,730	
TSS Load (lbs/day)	15,000	31,980	31,980	72,300	
NH_3-N Load (lbs/day)	1,409	2,269	2,269	2,366	
TP Load (lbs/day)	583	1,307	1,410	3,275	

[1]BOD load converted from COD using ratio of 0.50 lb BOD to 1 lb COD
[2]Existing WPCF is rated for a daily average flow of 11.0 MGD, which will remain as the rated daily average capacity and design flow.
[3]Existing WPCF is rated for a maximum day flow of 22.4 MGD, which will remain as the rated maximum day capacity and design flow.
[4]Existing WPCF is rated for a maximum month flow of 13.2 MGD, which will remain as the rated maximum month capacity and design flow
[5]Existing WPCF is rated for a maximum week flow of 19.2 MGD, which will remain as the rated maximum week capacity and design flow.
[6]Current rated maximum month WPCF BOD capacity is 60,400 lb/day, which will remain as the rated maximum month BOD capacity and design load.

Table 4.06-1 Design Flow and Load Summary (Year 2030)

	Average Day	Maximum Month	Maximum Week	Maximum Day	Peak Hourly
Flow (MGD)	7.44[2]	12.35[4]	14.95[5]	20.53[3]	28.30
COD Load (lbs/day)	76,490	119,620	130,030	188,170	
BOD Load (lbs/day)[1]	38,250	59,810[6]	65,020	94,090	
TSS Load (lbs/day)	16,360	36,310	36,310	78,860	
NH_3-N Load (lbs/day)	1,623	2,698	2,698	2,726	
TP Load (lbs/day)	674	1,593	1,630	3,786	

[1]BOD load converted from COD using ratio of 0.50 lb BOD to 1 lb COD
[2]Existing WPCF is rated for a daily average flow of 11.0 MGD, which will remain as the rated capacity and design flow.
[3]Existing WPCF is rated for a maximum day flow of 22.4 MGD, which will remain as the rated maximum day capacity and design flow.
[4]Existing WPCF is rated for a maximum month flow of 13.2 MGD, which will remain as the rated maximum month capacity and design flow
[5]Existing WPCF is rated for a maximum week flow of 19.2 MGD, which will remain as the rated maximum week capacity and design flow.
[6]Current rated maximum month WPCF BOD capacity is 60,400 lb/day, which will remain as the rated maximum month BOD capacity and design load.

Table 4.06-2 Design Flow and Load Summary (Year 2045)

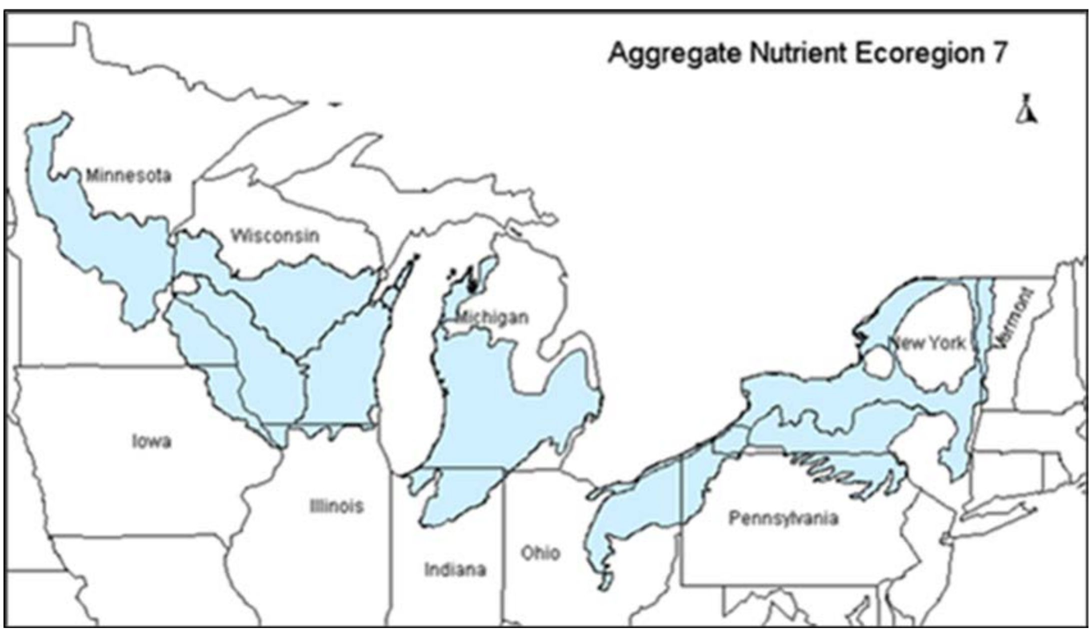
SECTION 5–WATER QUALITY STANDARDS AND DISCHARGE PERMIT REQUIREMENTS

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. This section discusses current and anticipated future national and state regulatory strategies and how these might apply to the WPCF. It also recommends provisions that should be included in any proposed WPCF modifications to address these future regulatory concerns.

5.01 NATIONAL NUTRIENT STRATEGY

In December 2000, the USEPA published recommended regional water quality criteria with the goal of reducing the impact of excess nutrients to waterbodies. The USEPA is now working with states to adopt appropriate water quality criteria for nutrients. States were expected to adopt the recommended water quality criteria or develop their own by 2004, but this schedule was revised to allow states more time to develop rules.

The City WPCF discharges to the Rock River on the south end of the City. This discharge location is in Rivers and Streams Ecoregion VII as shown in Figure 5.01-1. The USEPA's recommended aggregate criteria for rivers and streams in this ecoregion are presented in Table 5.01-1. Permit limits will sometimes be higher than a criterion because consideration can be given to dilution of the effluent with the receiving water. In the case where the receiving water's background concentrations of a pollutant are higher than the criterion, or the receiving water's dilutional flow is low, the permit limit may be set at the criterion.



Source: USEPA *Ambient Water Quality Criteria Recommendations: Information Supporting the Development of State and Tribal Nutrient Criteria for Rivers and Streams in Ecoregion VII*, Washington, D.C.: GPO, 2000) 7.

Figure 5.01-1 Aggregate Nutrient Region for Region VII Rivers and Streams

Parameter	Nutrient Criteria
TP	33 μg/L
Total Nitrogen (TN)	0.54 mg/L
Chlorophyll a	3.50 μg/L
Turbidity	1.7 NTU

Table 5.01-1 USEPA Recommended Nutrient Criteria for Rivers

In 2007, an environmental advocacy group, the Natural Resources Defense Council (NRDC), petitioned the USEPA to revise its secondary treatment regulations to include numeric effluent limitations for discharges of nitrogen and phosphorus. The petition proposed an effluent limit of 0.3 mg/L for TP and 3 to 8 mg/L for TN. The petition was rejected; however, it is possible these or similar effluent limitations could someday be adopted instead of, or in addition to, water quality-based criteria.

Concern over hypoxia in the Gulf of Mexico could impact nutrient limits, particularly nitrogen. Hypoxia refers to a condition where dissolved oxygen (DO) concentrations in the water drop to a level that does not adequately support fish and other desirable aquatic species. The USEPA and other agencies have been working on a strategy to reduce the size of the hypoxic zone off the coast of Louisiana. The hypoxic zone was approximately 7,000 square miles (mi^2) in 2019, the eight largest size mapped since 1985. Nutrients from the Mississippi River Basin, which includes the Rock River in the Rock River Basin, are identified as one of the causes of hypoxia. To decrease the size of the hypoxic zone, the 2008 Gulf Hypoxia Action Plan and its 2013 reassessment recommends incentives and voluntary-based approaches to reduce agricultural runoff and restore wetlands. Additionally, permitting authorities within the Mississippi River Basin may require publicly owned treatment works (POTWs) to remove nutrients to reduce loadings (*Mississippi River/Gulf of Mexico Watershed Nutrient Task Force 2008 Action Plan for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico*, Washington, D.C.).

5.02 WISCONSIN NUTRIENT STRATEGY

According to the WDNR, nutrients, particularly phosphorus, will remain a primary focus of regulatory concern. Phosphorus is considered the limiting nutrient in Wisconsin surface waters, meaning its availability controls the amount of nuisance plant and algal growth.

A. Phosphorus Regulations

Phosphorus rule revisions were passed by the Wisconsin State Legislature and became effective on December 1, 2010. These regulations established numeric water quality criteria for phosphorus. The criterion for Rock River at the City is 0.1 mg/L. If dilution is not available in the receiving stream because of high upstream phosphorus concentrations or low stream flow, the WPCF water quality-based effluent limit (WQBEL) may be set at the criterion as described in Wisconsin Administrative Code (WAC) Chapter NR 217 at s. 217.13. The Rock River is routinely monitored for phosphorus concentrations at Afton, Wisconsin, upstream of the City. Recent data indicate the phosphorus concentration is well above the criterion at Afton, averaging 0.2 mg/L. The NR 217 rolling median concentration is currently 0.21 mg/L according to the WDNR's *Surface Water Data Viewer* tool (https://dnrmaps.wi.gov/H5/?Viewer=SWDV). Therefore, if the WDNR was to impose an NR 217.13-based WQBEL in the City's WPDES permit, it would be set at 0.1 mg/L. This would be expressed as a six-month average limit, and there would also be a 0.3 mg/L monthly average WQBEL for phosphorus.

The WDNR has been reissuing WPDES permits with the new, more stringent phosphorus limits. A nine-year schedule is typical for stringent phosphorus WQBELs (below around 0.3 mg/L as a six-month average) in Wisconsin. These permits require an initial phosphorus Operational Evaluation Report including an optimization study in the first year after permit reissuance, feasibility studies in the next three years, and drawings and specifications, if required for new or enhanced phosphorus removal facilities, in the following two years. This is followed by construction, start-up, and compliance. Chapter NR 217 includes several options for compliance with the stringent phosphorus limits, and some of these are shown in Figure 5.02-1 and described in the next subsections. Permittees are encouraged to explore these options during the feasibility study phase to determine the best, most cost-effective alternative for their particular situation.

B. Rock River Total Maximum Daily Load (TMDL)-Based Limits

Several options are available in NR 217 for compliance with the state phosphorus criteria. One of these (NR 217.16) is a TMDL-based phosphorus limit, where available. The USEPA and WDNR completed a phosphorus and TSS TMDL for the Rock River Basin that was approved by the USEPA in September 2011. The TMDL includes load allocations for agricultural and other nonpoint sources, and wasteload allocations (WLAs) for point sources like WPCFs and municipal separate storm sewer systems (MS4s).

The City's WPCF permit was reissued on July 1, 2015 and includes TMDL-based WQBELs in lieu of NR 217.13 WQBELs for phosphorus. The TMDL-based WQBELS were determined from the associated WLAs and are less stringent than a NR 217.13-based 0.1 mg/L limit. The permit requires compliance with these limits by July 1, 2024. These mass-based limits vary by month and are expressed as monthly averages for phosphorus. The most stringent phosphorus limit occurs in September and is 18.5 lbs/day. Refer to the WPDES permit in Appendix B.

Because the WLAs are mass-based and were determined assuming a WPCF DAF of 11 MGD, the associated maximum discharge concentrations are currently not as stringent as they will be in the future. For example, the September limit is equivalent to an effluent concentration of 0.17 mg/L at a flow of 13.2 MGD, but is equivalent to 0.37 mg/L at a flow of 6 MGD. The limits will become more stringent as the service area continues to develop and flows to the WPCF increase. It should also be noted that TMDL-based limits are meant to be temporary (two, five-year permit terms or possibly longer) according to NR 217.16. The WDNR should be consulted to assure that the TMDL limits are likely to apply for the full 20- to 25-year planning period assumed in this report.

The City's MS4 also has WLAs for phosphorus and TSS in the Rock River Basin TMDL. The compliance schedule for MS4s is longer; it is essentially 15 to 20 years.

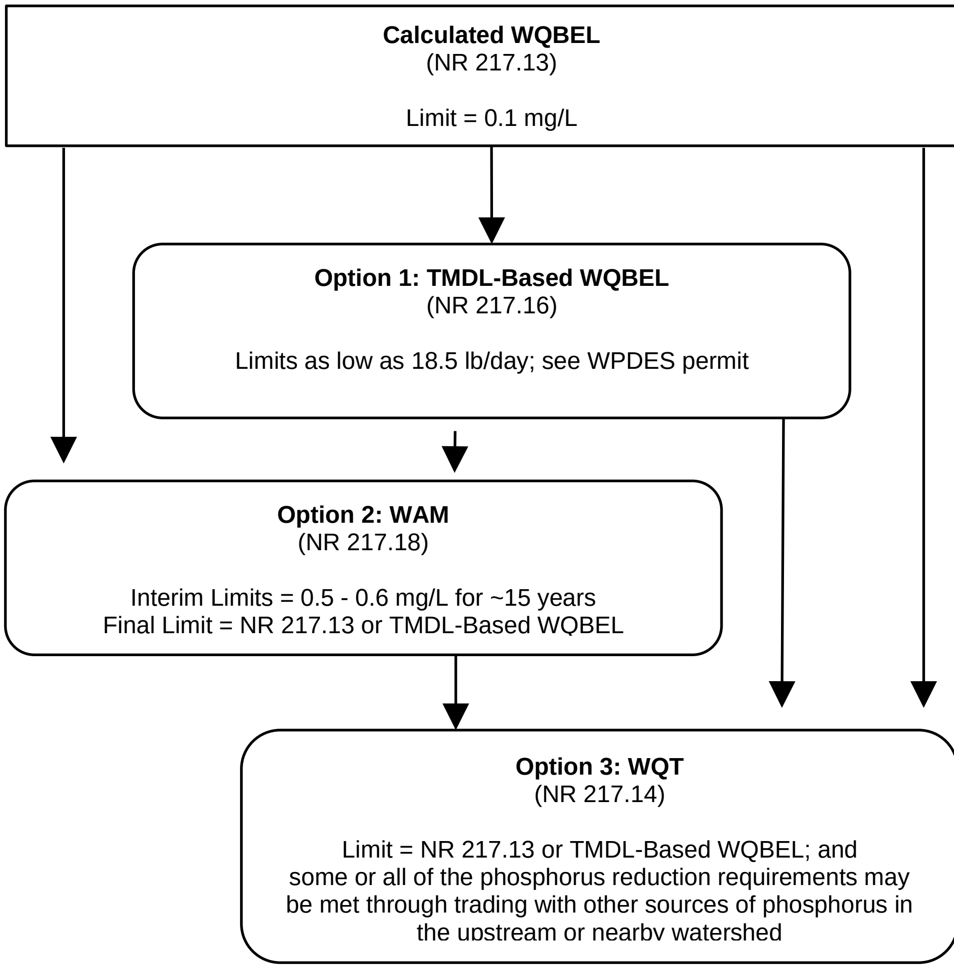
C. Available Phosphorus Compliance Options

Several phosphorus compliance options are available in NR 217 and listed in the WPDES permit that could reduce compliance cost and provide ancillary benefits. These include watershed adaptive management, water quality trading (WQT), the state-wide variance, or other variances. A brief overview of these is provided in this section. These options to mitigate the phosphorus limit are discussed in more detail in the Phosphorus Final Compliance Alternatives Plan submitted June 30, 2019.

1. Watershed Adaptive Management

A watershed adaptive management option is available to WPCFs when at least 50 percent of the phosphorus load to the receiving stream comes from nonpoint sources and permitted MS4s, when the WPCF's phosphorus effluent limit is stringent, and when the phosphorus criterion is exceeded in the receiving stream. WPCFs must apply to the WDNR for this option. If accepted, it will allow three extra permit terms before a WQBEL goes into effect. There are interim phosphorus limits of 0.6 mg/L for the first permit term and 0.5 mg/L for the second and likely the third permit term. Act 378 passed by the state legislature in April 2014 extended the adaptive management allowable time by five years and expanded it to include TSS in addition to phosphorus. The fourth permit term would include the (possibly recalculated) NR 217.13 or TMDL-based WQBEL, and a five-year compliance schedule may be granted to meet the WQBEL. During the interim time period, WPCFs are expected to optimize the WPCF process, work with other dischargers in the watershed to reduce point and nonpoint sources of phosphorus, and monitor phosphorus in the surface water and report results to WDNR. MS4s can also use this option, if the effort is led by a WPCF.

According to the WDNR's Pollutant Load Ratio Estimation Tool (PRESTO) model, 82 percent of the phosphorus loading in the Rock River at the WPCF outfall comes from nonpoint sources. It was previously noted that the receiving stream exceeds the water quality criterion for phosphorus. Therefore, the City would be eligible for this option. The Preliminary Compliance Alternatives Plan indicated this option was impractical for the WPCF and eliminated it from further consideration; however, this option could be reconsidered if it appears beneficial to use it as a compliance option for the City's MS4 and WPCF, or potentially for a regional group including other MS4s and WPCFs.



Notes:
Other options include variances or site-specific standards, although these are less likely.
WQBEL = water quality-based effluent limit.
NR 217 = Wisconsin Administrative Code chapter NR 217.

Figure 5.02-1 Chapter NR 217 Compliance Options

2. WQT

Once an NR 217.13 or TMDL-based WQBEL is included in a WPDES permit, WQT may be an option. In this alternative, the City would pay for land or modified agricultural or urban practices that would reduce the amount of phosphorus reaching the Rock River upstream of or in the same subwatershed as the WPCF discharge. A trade ratio of about 2 to 1 typically applies, whereby nonpoint sources would need to remove twice the phosphorus load that the WPCF would have had to remove. This is because of uncertainties associated with nonpoint source phosphorus reduction modeling, lack of required in-stream monitoring, need to demonstrate a water quality improvement, and other factors. In a TMDL watershed, credit thresholds also apply that generally make trades more costly, because nonpoint sources need to comply with their load allocations before long term (as opposed to interim five-year) credits can be generated. WQT may be used to meet some or all the required phosphorus reduction and could be implemented after TMDL-based WQBELs expire or after a watershed adaptive management has run its course. The state legislature is currently considering new legislation related to WQT state clearinghouse (essentially a one-stop-shop) that may make trading less onerous for permittees. The WDNR is also in the process of updating its WQT guidance to make it more flexible, as recommended by the USEPA. The Final Phosphorus Compliance Alternatives Plan identified trading with nonpoint sources as a cost-effective option for the City's WPCF. The City is uniquely situated such that it could trade with almost any credit generator in the Rock River Basin. The City will continue to track this concept and if best management practices (BMPs) or biosolids practices are conducted that generate credits, it may be possible to register these practices and obtain credit for them, assuming it reduces the total cost of compliance at the WPCF. TMDL-based WQT credit thresholds should be reviewed to determine whether trades will be interim (one five-year permit term only) or long term, as this will have a significant impact on costs. In Strand's experience, the WDNR will likely expect the City to have trades in place and generating credits by around mid-2022, or two years sooner than the current tertiary-treatment based compliance schedule.

3. Statewide Multidischarger Variance (MDV) and Other Variances

This option has been approved by USEPA through 2027 and may be reauthorized. It includes up to a 20-year variance that would require the City to pay $50 per pound (inflated annually) for the amount of phosphorus that is discharged over 0.2 mg/L, or over the TMDL-based limits in this case. The revenue generated would be used by the counties in the Hydraulic Unit Code (HUC) 8 watershed to implement BMPs. The variance also includes interim effluent limits of 0.8 mg/L, 0.6 mg/L, and 0.5 mg/L for each of the next three (five-year) permit terms, respectively. This option could be more cost-effective than treatment to below approximately 0.2 mg/L. The statewide MDV requires several socioeconomic factors to be met for the community to be eligible. Rock County has five of these factors, indicating that the City would be eligible for the MDV if projected residential wastewater rates with tertiary treatment were expected to exceed 1 percent of the median household income (MHI) (i.e., residential rates greater than around $30 per month). The Final Compliance Alternatives Plan indicated that the City did not appear eligible for the MDV. This could be revisited after compliance costs are determined with more certainty, and the City could apply for the MDV with its January 4, 2020 permit application, if deemed favorable.

C. TN, Chlorophyll a, Harmful Algal Blooms, and Turbidity

TN includes all forms of nitrogen: organic, ammonia, and inorganic forms like nitrite and nitrate. It is the sum of the measured total Kjeldahl nitrogen (TKN) plus nitrate and nitrite nitrogen. The USEPA is expecting states to develop water quality standards for TN and other nutrient-related parameters in addition to phosphorus. The WDNR's surface water quality studies have not shown good correlations between TN concentrations and algae or other biological impairments. Phosphorus is generally understood to be the limiting nutrient for algal growth and, therefore, the nutrient that requires control in Wisconsin surface waters. In the past, the WDNR has stated that it may use a different approach to TN control than it has for phosphorus such as requiring a certain percent reduction for Mississippi River Basin dischargers. This would include facilities in the Rock River Basin. The required reductions would be based on regional goals for the Gulf of Mexico hypoxia control. This approach may not be acceptable to the USEPA, however. While the WDNR's approach and schedule are currently uncertain, new TN effluent limits appear likely within approximately the next 10 to 20 years for the City. For 25-year planning purposes, limits in the treatment technology-based range of 8 mg/L can be assumed. It appears likely the WDNR will allow watershed-based solutions such as watershed adaptive management or WQT to be used for TN effluent limit compliance.

Because of the more frequent incidence and greater concerns associated with harmful algal blooms, the USEPA has developed recreational standards for cyanotoxins from cyanobacteria, also known as blue-green algae. The specific compounds are Microcystins and Cylindrospermopsin. The criteria were made available for public review and comment in 2016, with final recommendations published in 2019.

In a similar vein, the WDNR proposed rule revisions for biocriteria and a hearing was held in September 2019. The rule package addresses several areas related to the state's assessments of its streams, rivers, lakes, and other waterbodies. It focuses largely on assessments related to the biological quality of a waterbody. Notable additions or revisions include:

1. Establishment of narrative biocriteria (i.e., fish and insect/macroinvertebrate communities) for surface waters.

2. Revisions to dissolved oxygen criteria for aquatic life. The proposed minimum DO limits for the following water bodies are as follows:

    a. Limited forage fish streams: 3 mg/L

    b. Limited aquatic life streams or wetlands: 1 mg/L

    c. Trout Class I or II waters: 6.0 mg/L (or 7.0 mg/L during spawning season)

    d. Trout Class III waters: 6 mg/L

    e. All Others: 5 mg/L

3. Algae Criteria for Recreation and Aquatic Life (expressed as chlorophyll *a*)

    a. Aquatic Life–Mean concentrations shall not the following concentrations:
        (1) 10 μg/L for two-story fishery lakes
        (2) 27 μg/L for all others

    b. Recreational Use–Mean concentrations shall not exceed the following concentration:
        (1) 20 μg/L

4. Phosphorus assessment procedures using biological metrics.

5. Revisions to NR 217 related to the calculation of upstream background phosphorus concentrations.

a. Aligns the phosphorus calculation methods used to determine background phosphorus concentrations for effluent limit calculations with those delineated in proposed s. NR 102.07 (1) (a) 2.

b. Calculations will be based on six monthly samples taken from May through October in a single year.

c. Deleted language about using data from past five years.

d. Deleted language saying samples collected in the same month are averaged.

The WDNR will be responding to public comments and appears likely to propose final rules for adoption to the WDNR Board soon. The WDNR has stated that these rules are not expected to result in even more stringent WPCF effluent limits for phosphorus or TN; however, these new developments should continue be tracked.

5.03 AMMONIA REGULATIONS

Ammonia surface water quality standards were previously revised by the WDNR to agree with promulgated USEPA criteria. The 2015 WPDES permit the City is currently operating under (see Appendix B) only includes a daily maximum ammonia-nitrogen limit of 17 mg/L.

The current state and federal water quality standards for ammonia are based primarily on toxicity to fish. The USEPA developed more stringent ammonia criteria for surface waters that have the ability to support mussels and snails that are more sensitive to ammonia. This would include the Rock River. The USEPA released its draft mussel and snail-based ammonia criteria in 2009 and public comments have been received. The USEPA has adopted these criteria, but the schedule for subsequent state implementation is unknown at this time. It appears this initiative could result in more stringent effluent ammonia-nitrogen limits for the City's WPCF within approximately the next five to ten years.

Ammonia control is also important for biological TN removal through nitrification-denitrification. Therefore, if a TN limit is imposed, effluent ammonia should be controlled according to how stringent the limit is. The City WPCF currently nitrifies; however, additional nitrification or deammonification improvements such as sidestream equalization, sidestream deammonification, and/or expansion of the aeration tanks should be considered if more stringent ammonia limits or new TN limits are imposed.

5.04 CHLORIDE REGULATIONS

The State of Wisconsin's chloride water quality regulations are contained in WAC Chapters NR 102 and NR 106. They are based on toxicity to fish and aquatic life and most commonly affect dischargers to smaller streams and rivers in the southern part of the state. The WDNR calculates the potential to exceed water quality criteria each time it reissues WPDES permits. In the most recent calculation (2014), the WDNR determined that the City's WPCF had a low potential and that chloride limits were not needed. The WPCF typically passes its whole effluent toxicity (WET) tests, further indicating that chlorides and other toxics are not a concern. If upstream Rock River concentrations or effluent concentrations of chloride increase to the point where a limit is proposed, the City could seek a variance and receive an interim limit. The variance requires source reduction activities to reduce the chloride loading to the WPCF.

5.05 MERCURY REGULATIONS

The WPCF has a mercury variance with an associated Alternative Mercury Effluent Limit of 3.3 nanograms per liter (ng/L). This effluent limit is based on wildlife criteria. Without the variance, the limit would likely be set equal to the criterion (1.3 ng/L) in accordance with NR 106.06(6) because the background concentration in Wisconsin surface waters exceeds the wildlife criterion. A compliance program is included in the WPDES permit and the City already has a mercury pollutant minimization program (PMP) in place as required.

5.06 THERMAL STANDARDS

The State of Wisconsin has adopted thermal standard rule revisions in Chapters NR 102 and NR 106 of the WAC. The rules have an effective date of October 1, 2010. Chapter NR 102 was revised to create water quality standards for heat in surface waters. Chapter NR 106 was revised to include procedures to implement the thermal standards in WPDES permits issued to point sources discharging to surface waters of the state. The WDNR has stated that it does not expect the thermal standards to have an impact on existing POTWs except in unusual situations or where there is a high temperature industrial discharge to the POTW. The WDNR reviewed effluent temperatures compared to the water quality standards in 2014 and determined that the WPCF did not require effluent limits. Additional temperature monitoring is required by the permit throughout 2019.

5.07 EFFLUENT PATHOGEN REGULATIONS

The USEPA released final recommendations on November 26, 2012, for recreational water quality criteria. The 2012 recommended criteria are based on the use of two bacterial indicators of fecal contamination, *E. coli* and enterococci. The new criteria are designed to protect primary contact recreation, including swimming and other activities where a high degree of bodily contact with the water, immersion, and ingestion are likely. The recommended criteria are shown in Table 5.07-1

CRITERIA ELEMENTS	Recommendation 1 Estimated Illness Rate 36/1,000		Recommendation 2 Estimated Illness Rate 32/1,000	
Indicator	GM (cfu/100 mL)	STV (cfu/100 mL)	GM (cfu/100 mL)	STV (cfu/100 mL)
Enterococci (marine & fresh)	35	130	30	110
E. coli (fresh)	126	410	100	320

GM=geometric mean; STV=statistical threshold value

Table 5.07-1 USEPA 2012 Recommended Water Quality Criteria

GM and STV are recommended for the bacteria samples. The STV approximates the 90th percentile of the water quality distribution and is intended to be a value that should not be exceeded by more than 10 percent of the samples taken. The GM and STV are recommended to be determined over a 30-day interval. These recommendations are not regulations but are intended to be used by states to set water quality standards.

WAC Chapter NR 210 currently includes a categorical effluent limit for pathogens of 400 cfu per 100 mL fecal coliform as a geometric mean. This limit is included in the WPCF permit and applies during the recreation season from May 1 through September 30 each year. The WDNR has drafted water quality standards based on the USEPA recommendations and conducted two public review processes that concluded in 2019. The WDNR based the rule revisions on *E. coli* and Recommendation 1 shown in Table 5.07-1, with the GM and STV expressed on a calendar month basis. The proposed rule revisions were adopted at the October 2019 WDNR Board meeting and will proceed to legislative and USEPA review. The new limits will likely be included in the City's next reissued WPDES permit.

It appears most ultraviolet (UV) and chlorine disinfection facilities will be able to meet the revised limits with existing disinfection systems; however, higher dosages or contact times may be required in some cases. The WPCF is only required to sample the effluent twice a week for effluent pathogen indicators currently, and one compliance approach would be to sample the effluent more frequently, particularly if the first sample of the week has a high result for *E. coli.*

The USEPA is also reportedly working to develop recreational water quality criteria based on bacteriophage (coliphage) as an indicator for the presence of viruses. National Association of Clean Water Agencies (NACWA) has encouraged the USEPA to first work closely with the Water Environment Research Foundation (WERF) to conduct studies of how bacteriophages behave in wastewater treatment plants, how they are affected by current disinfection practices, and how their levels compare to those of current indicator organisms like *E. coli*. NACWA, WERF, and the Water Environment Federation (WEF) are coordinating efforts on this issue and have identified areas in need of additional research. NACWA has also indicated that viruses are generally harder to disinfect than bacteria; however, with little available data, it is difficult to predict the extent of any changes that might be required to existing disinfection practices to meet the proposed criteria.

The latest meeting on coliphage criteria took place in 2016, so the likelihood or timing of the potential criteria is unclear. If the WDNR and the City believe significant disinfection system modifications are required for compliance with any new effluent limits for viruses, a compliance schedule will very likely be included in any reissued WPDES permit.

5.08 ANTIDEGRADATION ANALYSIS

Within the USEPA's framework of water quality criteria, the nation's waterbodies are to be protected through compliance with water quality standards. 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 use.

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

The WDNR intends to update its antidegradation rules in the near future, possibly within the next three years. It appears unlikely this activity will have a significant impact on the WPCF during the planning period since the permitted design flow for the WPCF is considerably higher than the current flows.

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

According to the WEF Government Affairs Committee, the main issues emerging at the national level are sustainability, financing, nutrients, and microconstituents. Nutrient regulations are probably the most imminent issue affecting the City WPCF and were discussed earlier 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. The WDNR currently has the ability to regulate microconstituents in WPCF effluent only if a specific problem such as a directly linked adverse impact on aquatic life is demonstrated. Eventually, advanced oxidation processes or membrane treatment may be required to treat some of these microconstituents. Some communities have taken a pollution prevention approach and have implemented drug take-back programs to help reduce the concentrations of pharmaceuticals in wastewater. Successful drug take-back programs have been implemented in many Wisconsin communities. The City Police Department has a drop box for pharmaceuticals has also partnered with Walgreens to dispose of unwanted medications.

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. The WDNR has 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. In Wisconsin, there is a proposed groundwater standard for two PFAS compounds. Additional Wisconsin information may be found here: https://dnr.wi.gov/topic/Contaminants/PFASGroup.html . At this time, it is too soon to predict whether PFAS regulations will have a major impact the WPCF during the planning periods considered in this report, 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, similar to how the City is currently addressing mercury. Local limits for PFAS compounds could be incorporated into the City's existing pretreatment program, and associated surcharges potentially imposed, if warranted.

WEF is supporting sustainability measures, particularly with respect to stormwater management or "green infrastructure" measures and energy conservation measures. In Wisconsin, funding is available for certain stormwater management projects through programs including the state revolving fund. Funding is available from Focus on Energy, Wisconsin Public Power Institute Energy, and some power and gas companies for studying and implementing energy conservation measures.

The State of Wisconsin has made Clean Water Fund (CWF) principal forgiveness more available to communities that have financial hardships and phosphorus control, regionalization, or other specific initiatives.

5.10 BIOSOLIDS HANDLING AND BENEFICIAL REUSE

Biosolids handling at the City's WPCF follows the requirements of Chapter NR 204, Domestic Sewage Sludge Management. Biosolids are land-applied and a portion is landfilled. The City generates Class B biosolids, which by definition have a higher level of pathogenic bacteria than Class A. The digested biosolids fecal coliform count at the City's WPCF is consistently below 2,000,000 Most Probable Number (MPN) required by NR 204 for Class B biosolids. Additionally, biosolids are incorporated into the soil as required. Local farmers have accepted the Class B biosolids on agricultural land. The majority of POTWs in Wisconsin produce Class B biosolids. The WDNR has not indicated it would require WPCFs to produce a Class A biosolids in the foreseeable future. Therefore, the decision to produce a Class A biosolids is a local one based on local conditions.

Class A biosolids must have a fecal coliform concentration of less than 1,000 MPN. They also must meet high quality criteria for metals, if they are to be labeled "exceptional quality." Biosolids that are considered "exceptional quality" or Class A do not need to meet the lifetime cumulative metal loadings to be land-applied according to NR 204. Land application site evaluation reports would not be required. No bulk biosolids land application reports would need to be filed with the WDNR, and the WPCF would not need to receive approval from the WDNR before applying biosolids. More sites or other markets would potentially be available for the biosolids. Because Class A biosolids have lower levels of pathogens, there is a lower threat to human health and, therefore, fewer measures are required to minimize human contact with the sludge.

To be considered Class A, the sludge must undergo certain processes to further reduce pathogens. The processes might include temperature-phased anaerobic digestion (TPAD), lime stabilization with heat, composting, heat drying, thermophilic aerobic digestion, heat treatment, pasteurization, or an equivalent process. Any of these processes would be costly to implement at the City. Therefore, the City intends to continue its successful Class B biosolids program for the foreseeable future.

The USEPA periodically conducts surveys and investigations of biosolids content including metals, organics, inorganic ions, and other targeted pollutants. Data from these surveys help determine exposure to target pollutants in biosolids and whether target pollutants may need to be regulated pursuant to 40 CFR 503. New standards for molybdenum or other compounds may result. The USEPA is also assessing the potential use of various microbial risk assessment models such as salmonella via the ingestion pathway. This assessment is ongoing and may eventually affect the way the City monitors pathogens and manages biosolids.

The WDNR and other states have also been considering requiring agronomic phosphorus application rates, which could make phosphorus the limiting nutrient for land application of biosolids instead of nitrogen. There has been some discussion of restricting sludge application to the amount of phosphorus required for plant growth, and some farms are now required to, or choose 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. The increasing concern over nutrients in surface water and groundwater may result in lower sludge application rates in the future (meaning more land and longer hauling distances will be required), more careful selection of land application sites, and possibly installation of BMPs at biosolids application sites to reduce soil erosion and runoff. These requirements will likely result in higher future costs for biosolids disposal.

Concerns over PFAS in biosolids could also impact the way the City manages its biosolids in the future. Landfilling of dewatered biosolids may not be the long-term solution, since PFAS can migrate through the landfill and into the leachate, which may then be trucked to a WPCF for treatment. It appears likely the WDNR will have new PFAS standards for biosolids within the planning period of this report.

Changing weather patterns and farming practices could also impact the City's biosolids land application program. Many agricultural producers have relatively small windows of time in the spring and fall when they will accept biosolids, because of concerns about soil compaction or coordination with planting and harvesting. Extreme weather events have made these windows even smaller for several Wisconsin communities in recent years.

5.11 SANITARY SEWER OVERFLOW (SSO) RULES

On August 1, 2013, new regulations pertaining to sewage collection systems became effective. These rules, typically referred to as the "SSO Rules," are intended to focus attention on the proper operation of collection systems. The new rules include the following key components:

1. The City was required to develop a CMOM program by August 31, 2016. The goal of a CMOM program is to make sure that the collection system is properly managed, operated, and maintained and that the system has adequate capacity to convey peak flows, even during wet weather. All feasible steps are to be taken to reduce I/I, eliminate SSOs, and mitigate the effects of SSOs.

2. When SSOs or chronic basement backups occur, the rules require the following:

    a. Notification of the WDNR within 24 hours of the occurrence, with a written follow-up report within five days. A new "fillable" PDF form is available on the WDNR Web site.

    b. Public notification of SSO events is required.

    c. If drinking water systems will be impacted, notification of the impacted parties is also required.

3. CMOM compliance and SSO events will continue to be documented on the Compliance Maintenance Annual Report (CMAR) that the Village is required to submit each year. A plan to address such events will be required and must be documented in the CMAR.

For many entities, the impact of the new regulations has been administrative. The new rules place an emphasis on documentation of SSO events and CMOM program elements. Many communities that have good operation and maintenance (O&M) programs in place do not necessarily have them well-documented. Standard Operating Procedures (SOPs) will need to be developed for the major O&M activities and records maintained regarding maintenance activities. For some entities, ordinances may need to be reviewed and updated, especially the ordinances that address I/I sources and their removal. The City has been proactive in developing its CMOM program and associated language is already incorporated into its WPDES permit.

5.12 CURRENT WPDES PERMIT STATUS

The WPCF is currently operating under a WPDES permit that was issued on July 1, 2015 and expires on June 30, 2020. Effluent limitations required by this permit are presented in Section 3. A permit reissuance application will need to be submitted to WDNR at least 180 days before expiration of the current permit, or by January 2, 2020.

5.13 CONCLUSIONS

This review has identified the following major areas that may be affected by changes in the regulatory climate in the foreseeable future:

1. The Final Compliance Alternatives Plan for phosphorus identified WQT with nonpoint sources as a cost-effective compliance method. The ongoing state initiatives including the proposed clearinghouse and the updates to WQT guidance documents should continue to be tracked, and credits should be sought from upstream nonpoint source dischargers. Upstream point source dischargers may also be considered. It appears likely that the City will need to have BMPs in place and generating credits by around mid-2022.

2. New ammonia-nitrogen and TN limits appear likely within the next decade or so. TN can be removed using biological nitrification-denitrification processes. WPCF improvements such as sidestream equalization could be considered to improve nitrification initially. Other improvements that could be considered include expanded aeration tankage, integrated fixed film biological treatment, or deammonification of sidestreams, potentially supplemented by WQT.

3. The WPCF will likely have *E. coli*, instead of fecal coliform, effluent limits in its next reissued permit. Disinfection chemical dosages and/or sampling frequency may need to be increased for reliable compliance.

4. PFAS and other compounds of emerging concern are likely to affect the City's pretreatment program scope in the short-term and may require tertiary treatment in the long-term.

5. Programs and regulations related to phosphorus and PFAS in surface waters and groundwater may reduce the allowable biosolids application rate or may make land application site criteria more restrictive. This will likely result in the need for more land and/or longer hauling distances over the next several years and associated higher biosolids disposal costs. Changing weather patterns and farming practices may also adversely impact the biosolids land application program. The WPCF may need to further

diversity its biosolids management program and set itself up for eventual biosolids drying or other significant upgrades.

6. To the extent practical, any tertiary treatment technologies that are considered for one pollutant such as PFAS should also consider removal of other pollutants like nutrients and pathogens, to improve the benefit-to-cost ratio.

SECTION 6–EVALUATION OF EXISTING FACILITIES AND SCREENING OF POTENTIAL ALTERNATIVES

This section evaluates the ability of the existing WWTP facilities to treat the projected future flows and loadings developed in Section 4 while meeting the anticipated future NPDES permit requirements. This section also presents a compliance evaluation of the current facilities with the current WAC NR 110 design standards and other applicable design criteria. The review focuses on the rated capacity, age, reliability, and other factors related to O&M of the existing facilities. In Section 7.02, potential alternatives are identified and screened for further review in Section 7. Treatment alternatives identified for detailed evaluation and consideration are discussed further in Section 7.

Site visits to the WPCF by Strand process, electrical, and heating, ventilation, and air conditioning (HVAC) engineers were made in summer 2019 to review the condition of process, electrical, and HVAC equipment. These site visits, in combination with in-depth conversations with WPCF staff provided an understanding of the age and condition of major process, electrical, and HVAC equipment. Specific deficiencies were discussed. The condition of each piece of equipment was scored on a 1 to 5 scale, with a score of 1 representing equipment that is in like new condition and a score of 5 representing equipment that is in immediate need or replacement. An importance score of 1 to 5 was also placed on the equipment by WPCF staff. The importance score is intended to consider redundancy, impacts to treatment quality if the particular piece of equipment is not available, run time, and ease of operations. Appendix F includes the equipment evaluations, including condition and importance scores. A narrative summary of major equipment deficiencies that impact facilities planning are documented in this section, including recommendations for improvements.

6.01 EVALUATION OF EXISTING FACILITIES

Table 6.01-1 provides a summary of the future flows and loadings (year 2030 and year 2045) used to evaluate the existing facilities. Further information relevant to the evaluation of a specific unit process appears in the subsection for that unit process.

Parameter	2030	2045
Design Flows (MGD)		
Annual Average Day	11.0	11.0
Maximum Monthly	18.6	18.6
Maximum Weekly	19.2	19.2
Maximum Day	22.4	22.4
Peak Hourly	28.3	28.3
Design Loadings (lbs/day)		
Average Day		
BOD_5	32,410	38,250
TSS	15,000	16,360
NH_3-N	1,409	1,623
TP	583	674
Maximum Month		
BOD_5	50,060	59,810
TSS	31,980	36,310
NH_3-N	2,269	2,698
TP	1,307	1,593
Maximum Day		
BOD_5	79,730	94,090
TSS	72,300	78,860
NH_3-N	2,366	2,726
TP	3,275	3,786

Table 6.01-1 Design Flows and Loadings

A. Influent Screening

Screening is accomplished using two 6-millimeter (mm) Parkson Aqua Guard® mechanically cleaned fine screens. The WCPF O&M Manual indicates that each screen has a rated capacity of 14.15 MGD. A bypass channel with a manually cleaned bar screen is available if the screens are out of service. Screenings are carried by screw conveyors from the bar screens to a screenings wash press, which discharges to a dumpster in the grit and screening loadout area. The existing influent screens have adequate capacity for the 2045 design flows.

The screens have performed well and have not had any major issues since installation with original plant construction in 1992. Both screens were rebuilt approximately two years ago, significantly extending their useful life and the City has spare parts on hand. However, considering the overall age of this equipment, the City should plan for replacement with similar screens approximately six to ten years.

The screenings conveyance equipment and washer/compactor were installed in 2011 and are in good condition. Staff noted the solenoid valves on the washer/compactor often cause water hammer. These solenoid valves could be replaced with slower closing ball valves with automatic actuators.

B. Grit Removal

Grit removal is provided by two 16-foot diameter vortex-type grit chambers. The WCPF O&M Manual indicates that each grit chamber has a hydraulic capacity of 28.3 MGD, but that performance is reduced at flows above 18 MGD each. Therefore, the existing grit removal system has adequate capacity for the 2045 design peak hourly flow of 28.3 MGD. The grit collectors were installed in 1992 during original WPCF construction and are in poor condition. Corrosion has resulted in WPCF staff replacing several components. Grit collector mechanisms and motors should be replaced within the next five years.

Grit is pumped from the grit chambers to two grit washers/classifiers using two recessed impeller centrifugal pumps. The grit pumps and classifiers were installed in 1992 during original WPCF construction. The grit pumps have recently been rebuilt, but replacement should be planned in the six- to ten-year time frame. The grit classifiers are in poor condition as a result of their age and corrosion and should be replaced within the next five years. Grit washers could also be considered to produce a cleaner end product.

C. Primary Clarification

The two existing 100-foot diameter primary clarifiers have a total surface area of 15,700 square feet (sf) and a total weir length of 574 feet. WAS is not cothickened in the primary clarifiers. WAC NR 110 provides design parameters for primary clarifiers based on surface settling rate as well as weir overflow rate. A summary of the rated average and peak hourly flow capacities of the existing primary clarifiers based on NR 110 requirements are presented in Table 6.01-2. Based on NR 110.18, the existing primary clarifiers have a DAF capacity of 15.7 MGD and a peak hourly flow (PHF) capacity of 23.6 MGD based on surface settling rate and 8.6 MGD DAF capacity based on weir overflow rate. At the DAF of 11.0 MGD, the surface settling rate is 700 gpd/sf. The design PHF of 28.3 MGD results in a surface settling rate of approximately 1,800 gpd/sf. At the projected flow rates, the existing clarifiers would not meet the requirements of WAC NR 110.18 for PHF or weir overflow rate at DAF.

Design Flow Basis	NR 110 Maximum Design Parameter	Rated Capacity (MGD)
Average Day		
	Surface Settling Rate: 1,000 gpd/sf	15.7
	Weir Overflow Rate: 15,000 gpd/ft*	8.6
Maximum Hour		
	Surface Settling Rate: 1,500 gpd/sf	23.6

*Rate for WPCFs above 1 MGD DAF

Table 6.01-2 Primary Clarifier Capacity Evaluation Summary

Based on average influent and primary effluent data from July 1, 2018 through November 20, 2019, the existing primary clarifiers provide approximately 57 percent TSS removal and 21 percent COD removal. Because return flows from thickening and dewatering processes return to the mainstream liquid process upstream of the primary clarifiers, these percent removals are understated relative to influent loadings.

Because side stream flows and concentrations are not regularly measured at the WPCF, these percentages are applied to influent loadings in the evaluation of downstream processes to account for both primary clarifier performance and side stream TSS and COD contributions. The City does not regularly analyze primary effluent for BOD_5. During this period, the average influent flow to the WPCF was approximately 5.77 MGD and the City operated one clarifier for the majority of the period, for an average surface settling rate of approximately 735 gpd/sf and a weir loading rate of 20,000 gpd/ft. There were several instances during this period in which daily influent flows were greater than 10 MGD and one primary clarifier was in service. During these events, TSS removal averaged approximately 40 percent and COD removal averaged approximately 17 percent. Based on this data, it is assumed that the existing primary clarifiers would provide similar performance at the design PHF of 28.3 MGD with both clarifiers in service for the evaluation of downstream processes and no additional primary clarifiers are recommended at this time. The aeration tank sizing and loadings will take into account slightly reduced performance from typical (60 percent TSS and 30 percent BOD removal) values. This is also likely attributable to higher than typical soluble BOD and COD industrial loadings.

Primary Clarifier No. 2 equipment was rehabilitated and repainted in 2018 and is in good condition. Primary Clarifier No. 1 consists of mostly original equipment from the 1992 WPCF construction. This clarifier equipment was repainted approximately 10 years ago but is again significantly corroded. The steel weirs are also significantly corroded. The City is currently planning to rehabilitate this clarifier in 2020 with local funds outside of this planning effort.

Grout in the bottom of the primary clarifiers has delaminated and spalled off in areas. This grout should be repaired within the five-year time frame.

Flow to the primary clarifiers is split in the upstream primary clarifier splitter box. Flow to each primary clarifier is isolated by use of the two slide gates located in this splitter box. The frames on these slide gates are in very poor condition as a result of corrosion. Concrete in this structure is also corroded in areas above the normal water line. The gates in this structure should be replaced and concrete repaired within the next five years to prevent more significant and costly damage. Protective coatings to prevent future corrosion should be applied to the concrete surfaces. Replacement of gates and repair of this structure will require bypass pumping around the structure.

Pumping of primary sludge is typically completed by air-operated diaphragm pumps (one associated with each primary clarifier). Occasionally during periods when the air-operated diaphragm pumps cannot keep the primary sludge blanket at an acceptable depth, the City will run parallel centrifugal sludge pumps (again, one associated with each clarifier). This typically occurs during periods of poor primary sludge settling. During operation of the centrifugal pumps primary sludge, which tends to be less concentrated, will be pumped to the gravity belt thickeners where it is co-mingled with WAS and thickened before digestion. This is discussed in more detail later in this section. The diaphragm pumps were installed in 1992 with original WPCF construction and remain in good condition with occasional diaphragm replacement. Replacement of these pumps should be planned within the 11- to 15-year time frame. The centrifugal primary sludge pumps were installed in 2010 and are in good condition.

Primary scum is collected in a scum hopper at each clarifier. It passes through an in-line grinder and is then pumped by one of two progressing cavity pumps to the scum concentrator located on the upper level of the Process Building. Scum can also be pumped directly to the digesters. Concentrated scum is then held in a concentrated scum storage tank until it is pumped by the concentrated scum pump (another progressing cavity pump) to either the digesters (typical operations) or the truck loading station where it is disposed of at the landfill. Primary scum grinder one is original (1992) and grinder two has been replaced more recently. The City currently owns a replacement unit to also replace grinder one. The primary scum pumps have been rebuilt since original WPCF construction in 1992 and are in reasonable condition. Replacement of these scum pumps will likely be required within the 11- to 15-year time frame. The scum concentrator is corroded in areas, especially near the chains, flights, and baffles. The scum concentrator should be replaced within the next five years. The concentrated scum pump was installed in 1992, but due to minimum run time (about one time every few days), it is in acceptable condition. The concentrated scum storage tank is stainless steel and is in good condition according to WPCF staff. For planning purposes, replacement of the concentrated scum tank and concentrated scum pump should be planned for the six- to ten- year time frame.

D. Activated Sludge Treatment

Flow from the primary clarifiers enters the aeration distribution boxes where it is combined with the RAS and split to each of the four aeration basins. Slide gates in this structure also allow for each aeration basin to be isolated and taken out of service. This structure exhibits extensive corrosion on the concrete above the waterline–up to 3 or 4 inches deep in areas. The concrete in this structure should be repaired within the next five years and corrosion resistant coatings applied to prevent continued corrosion.

As described in Section 3, the activated sludge system at the WPCF consists of four parallel trains that are currently operated as an extended aeration process with an anaerobic selector. Each of the four trains has an anaerobic selector zone of approximately 226,000 gallons followed by an aerated zone of approximately 1,740,000 gallons. This corresponds with a total activated sludge volume of approximately 7,864,000 gallons, or 1,051,000 cubic feet (cf). Nitrate recycle pumps were installed to promote TN removal and alkalinity recovery, but they are not currently operated. Therefore, the WPCF currently operates in an anoxic/oxic (A/O) mode and has successfully achieved average effluent TP concentrations in the 0.3 to 0.4 mg/L range without chemical addition to the mainstream liquid process (ferric sulfate is currently added to the thickening/dewatering filtrate as discussed later in this section).

While not originally designed as an extended aeration process (with a design activated sludge hydraulic retention time (HRT) of 17.2 hours), the City currently operates three of the four trains under normal conditions for an HRT of approximately 27 hours (two to three hours in the anaerobic zone) at the current average flow of 5.2 MGD. At the design PHF of 28.3 MGD, the existing aeration basins would provide an HRT of approximately 6.7 hours.

Mixed liquor suspended solids (MLSS) concentrations have typically ranged from approximately 2,500 to 5,000 mg/L with an overall average of approximately 4,400 mg/L. The 2045 design average loading to the activated sludge system of 30,220 pounds five-day biochemical oxygen demand per day (lbs BOD_5/day) would result in a food-to-microorganism (F:M) ratio of approximately 0.13 lbs BOD_5/lbs MLVSS-day, assuming a MLSS concentration of 4,400 mg/L, MLVSS concentration of 3,600 mg/L, a total activated sludge volume of 7,864,000 gallons, and 21 percent BOD_5 removal in the primary clarifiers (assumed to be equal to measured COD removal). Using the same assumptions, the F:M ratio would be 0.20 lbs BOD_5/lbs MLVSS-day at the projected 2045 maximum month condition (47,250 lbs BOD_5/day to the activated sludge system). This projected maximum month condition exceeds both the NR 110.21

guidelines for an extended aeration facility (0.05 to 0.15) as well as the Ten States Standards recommended value for single-stage nitrification (0.10).

NR 110 also includes maximum permissible volumetric loading rates to activated sludge systems for various treatment processes. The NR 110 maximum permissible volumetric loading rate for conventional activated sludge processes (carbon oxidation) is 40 lbs BOD_5/1,000cf/d. NR 110 does not identify a loading rate for single-stage nitrification processes. However, Ten States Standards recommends a maximum volumetric loading rate of 15 lbs BOD_5/1,000 cf/d for single stage nitrification, which is the same value identified in NR 110 for extended aeration processes.

Based on 21 percent BOD_5 removal in the primary clarifiers, the volumetric loading rate to the existing activated sludge system would be approximately 28.8 lbs/1,000cf/d at the projected 2045 average influent BOD_5 loading of 38,250 lbs BOD_5/day and 48.9 lbs/1,000cf/d at the projected 2045 maximum month influent BOD_5 loading of 65,020 lbs BOD_5/day. To comply with a maximum volumetric loading rate of 15 lbs/1,000 cf/d under year 2045 average loading conditions, additional aeration volume of 964,000 cf (approximately 7,210,000 gallons) would be needed. This would essentially be doubling the existing activated sludge volume. However, the WPCF has historically operated two trains at a higher volumetric loading rate (approximately 30 to 40 lbs/1,000 cf/d) for the majority of the year and a third train in winter, which has reduced the average volumetric loading rate to approximately 20 to 25 lbs/1,000 cf/d. At these loading rates, the WPCF has achieved average effluent NH_3-N and BOD_5 concentrations of approximately 0.1 and 3.4 mg/L, respectively. Historically, the WPCF has experienced an increase in effluent ammonia concentrations (of approximately 2 to 3 mg/L) during early winter before bringing a third activated sludge train online, after which the effluent ammonia has returned to an average of approximately 0.1 mg/L. This suggests that a volumetric loading rate in the range of 20 to 25 lbs/1,000 cf/d is necessary for the existing system to maintain effluent ammonia below 1 mg/L during cold temperatures. Operating at these volumetric loading rates has also provided the WPCF the flexibility to account for variable and slug loadings from industries during periods of higher production or during industrial pretreatment upsets.

Maintaining a volumetric loading rate of 20 lbs/1,000 cf/d at the 2045 average loading condition would require an additional 460,000 cf (approximately 3,440,000 gallons). Assuming that any new activated sludge trains are of equal size to the existing trains, this volume would be achieved with the addition of two trains (3,932,000 gallons). With six trains, for a total volume of approximately 1,577,000 cf, the volumetric loading rate at the 2045 average day and maximum month conditions would be 19.2 lbs/1,000 cf/d and 32.6 lbs/1,000 cf/d, respectively.

In addition to an evaluation of historical WPCF operation, a BioWin model was used to predict treatment performance of the existing activated sludge system under the projected 2045 maximum month conditions. At a MLSS concentration of approximately 4,000 mg/L and temperature of 10 degrees Celsius (°C), the BioWin model predicts effluent ammonia and TP concentrations of approximately 3 mg/L and 0.3 mg/L, respectively. The predicted effluent ammonia concentration increases further (above 6 mg/L) when maximum day loadings are included in dynamic simulations. These results appear to confirm the WPCF experience regarding the nitrification performance of the existing system at higher loading rates, particularly during cold temperatures. This also highlights the impact of slug loadings on the activated sludge system that are not captured when evaluating volumetric loading rates at average or maximum month conditions.

Air for the activated sludge system is provided by five multistage centrifugal blowers: two 400-hp blowers and three 600-hp blowers. The WPCF O&M Manual indicates that each 400-hp blower has a capacity of 6,700 scfm and each 600 hp blower has a capacity of 10,000 scfm, but does not indicate a firm capacity of the blower system. In addition, not all the air is delivered to the aeration basins, with channel aeration piping connected to the aeration header upstream of airflow measurement. WPCF staff indicates that the small blowers currently provide approximately 5,500 to 6,000 sfcm to the aeration basins when operating at full speed and the 600-hp blowers provide approximately 9,000 scfm to the basins when operating at full speed. The WPCF currently operates a maximum of two blowers at a time, with approximately 15,000 scfm provided with one 400-hp blower and one 600-hp blower in operation. Current average air demand for the activated sludge system is approximately 6,500 scfm. WPCF staff indicates that they have not experienced instances in recent years in which two blowers could not provide enough air to maintain the activated sludge dissolved oxygen setpoint of 2.0 mg/L. According to WPCF staff, two of the 600-hp blowers (blowers 2 and 3) have not been operated in over ten years and have had parts removed to repair the operating 600 hp blower (blower 4).

Diffused aeration is provided by fine bubble diffusers installed in four zones in each basin. DO probes installed in the aeration basin control the speed of the blowers based on a DO setpoint. Fine bubble diffusers in the aeration basins have been replaced in the past ten years: diffusers in Basin No. 2 approximately ten years ago, diffusers in Basin Nos. 3 and 4 were replaced approximately five years ago, and diffusers in Basin No. 5 were replaced approximately 2 years ago. It is anticipated that the diffusers and piping will be replaced as part of overall aeration system improvements. However, some of the newer diffusers may be able to be reused depending on type, condition, and configuration. This will be included as part of the activated sludge alternatives evaluated in Section 7.

Aeration system sizing for nitrifying activated sludge systems must account for the oxygen demand associated with the oxidation of BOD (at 1.1 pounds oxygen per pound biochemical oxygen demand ([lbs O_2/lb BOD]) as well as TKN (at 4.6 pounds oxygen per total Kjeldahl nitrogen [lbs O_2/TKN]). While the City does not regularly measure influent TKN, limited historical sampling suggests an average TKN:NH_3-N ratio of approximately 2.5. Using this ratio along with the 2045 loading projections presented in Table 6.01-1, and assuming 100 percent BOD_5 oxidation, 15 percent removal of TKN in the primary clarifiers, 21 percent BOD_5 removal in the primary clarifiers (17 percent removal at peak day as presented earlier), and an additional recycle TKN loading of 20 percent of the influent load (BOD recycle load accounted for in removal efficiency); the projected 2045 average oxygen demand is approximately 52,300 lbs O_2/day and the peak day oxygen demand is approximately 117,900 lbs O_2/day. Assuming an oxygen transfer efficiency of 12 percent, oxygen content in air of 23 percent, and an air density of 0.075 pounds per cubic feet (lbs/cf), approximately 17,500 cubic feet per minute (cfm) is required at average loading and approximately 39,500 cfm is required at peak loading. Therefore, the existing aeration system is not sufficient for the projected 2045 peak oxygen supply requirements.

Staff have reported electrical issues with blower 4 in the recent past and have noted parts for all the blowers are becoming hard to obtain. In the near term, it is recommended that the two non-functioning 600-hp blowers be replaced with high speed turbo blowers and a third high speed turbo blower be installed in place of the existing VFD cabinet. These blowers will increase aeration capacity as well as energy efficiency. Based on manufacturer literature, a 500-hp high speed turbo blower can provide approximately 10,000 scfm at a discharge pressure of 8.5 pounds per square inch (psi). This would provide redundancy for the current airflow use with new blowers. The existing functioning blowers could be maintained, providing an overall aeration capacity to meet the future peak loading air requirements and serving as backups if the new blowers are out of service. Modifications to the aeration piping are also recommended as necessary to reduce headloss and increase the firm aeration capacity. Additional blower replacements could then occur as necessary as influent loadings increase to provide future peak aeration requirements using new blowers only.

Aeration tank mixing using diffused aeration requires a minimum 20 cfm per 1,000 cf of aeration volume. The combined volume of the existing aeration tanks is approximately 931,000 cf, which would require 18,620 scfm to meet mixing requirements if all tanks are in service. Because the future aerated volumes of the activated sludge system may differ from the existing process configuration, mixing requirements will be considered individually for each activated sludge alternative evaluated in Section 7. However, it is anticipated that the peak aeration requirements related to oxygen demand will exceed the mixing requirements and would control the evaluation.

As described above, an increase in the capacity of the activated sludge system is required to provide adequate treatment for the projected future loadings. While the existing activated sludge system provides near complete nitrification as well as successful BPR, there are several other biological nutrient removal (BNR) configurations that could be considered for implementation at the WPCF, particularly if TN limits are imposed in the future. In addition, provisions for chemical phosphorus removal (CPR) could be considered for all alternatives to provide a backup to the BPR system for future phosphorus compliance requirements.

Two BNR processes that are commonly used to achieve TP and TN removal are the anaerobic/anoxic/oxic (A^2O) process and the University of Cape Town (UCT) process. In the A^2O process, anaerobic and anoxic zones are provided upstream of the aerobic (oxic) zones. See Figure 6.01-1 for a schematic of the A^2O process. Anaerobic zones provide an environment that selects for polyphosphate accumulating organisms (PAOs) responsible for BPR, while anoxic zones (which are created by recycling nitrified ML from the end of the aerated zone) allow for denitrification and alkalinity recovery. In the A^2O process, RAS is combined with primary effluent upstream of the anaerobic zone.

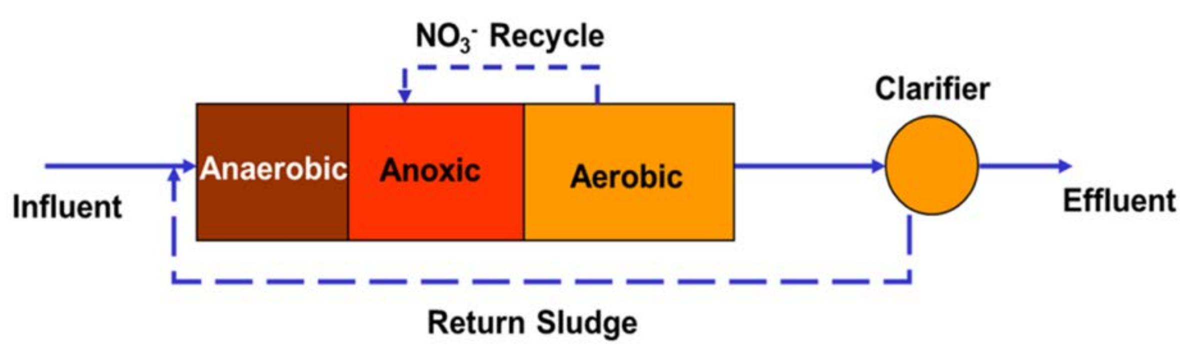


Figure 6.01-1 A^2O Process Schematic

The UCT process also consists of anaerobic and anoxic zones upstream of aerated zones, but in this configuration the RAS bypasses the anaerobic zones and is discharged to the anoxic zone. A second recycle is provided from the end of the anoxic zone to the anaerobic zone. (See Figure 6.01-2 for a schematic of the UCT process.) This process is well suited for primary effluents or RAS that have nitrates that could jeopardize the integrity of the anaerobic zone or weaker wastewaters with limited influent volatile fatty acids necessary for BPR.

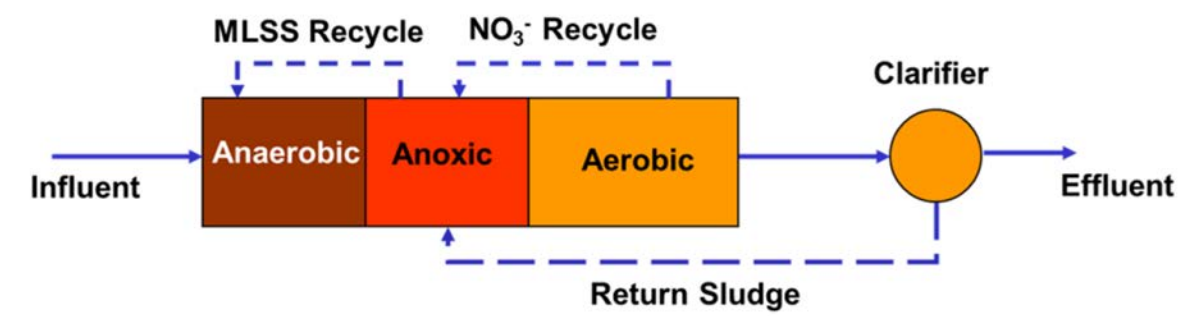


Figure 6.01-2 UCT Process Schematic

Historically, BPR systems such as the existing A/O process have relied on a group of PAOs known as Accumulibacter for phosphorus uptake and removal using combinations of anaerobic and aerated zones in the main liquid process train. A more recent development in phosphorus removal is sidestream-enhanced BPR (S2EBPR) using RAS fermentation (Figure 6.01-3). In this process, a portion of the RAS typically 10 to 25 percent) is diverted to a sidestream anaerobic tank with a detention time of 24 to 48 hours (or less with volatile fatty acids [VFA] addition) which can select for Tetrasphaera under deep anaerobic conditions (ORP less than -300 millivolts [mV]). Research suggests that Tetrasphaera can ferment higher organic compounds and produce additional VFAs for Accumulibacter to work alongside them. Therefore, it may have an advantage for situations where BPR using the A^2O process is carbon-limited. This configuration has also been shown to safeguard against Glycol Accumulating Organisms (GAOs) that compete against PAOs under certain conditions. Other advantages to sidestream enhanced BPR include some additional protection from biomass washout and reduced detention times under peak flow conditions.

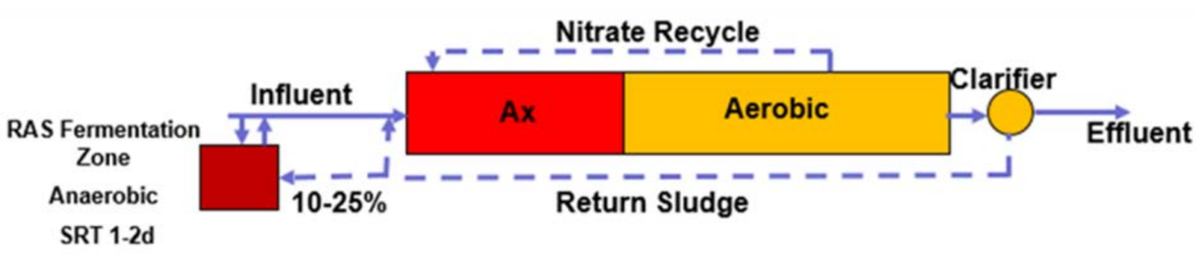


Figure 6.01-3 Modified Ludzcak-Ettinger with SEBPR Process Schematic

The A^2O process is simpler to operate than the UCT process with fewer recycle flows, and because the RAS is currently combined with the primary effluent upstream of the activated sludge system, the A^2O

process would require less modifications to implement at the WPCF. Furthermore, the influent wastewater appears to have adequate readily biodegradable COD for successful BPR performance in the current A/O operation and, therefore, the additional complexity of the S2EBPR and UCT processes do not appear to be necessary. For these reasons, the A^2O process will be evaluated for BNR in Section 7 along with the continued use of the A/O process.

An alternative to expansion of the activated sludge system would be to increase the capacity of the system within the existing tanks through the implementation of an intensification process. Intensification processes, such as integrated fixed film activated sludge (IFAS), aerobic granular sludge (AGS), membrane bioreactors (MBRs), membrane aerated biofilm reactors (MABRs), or ballasted activated sludge (BAS), increase the capacity of activated sludge systems by effectively increasing the biomass in the system through the use of fixed film, granular sludge, or ballasted settling processes. These processes can be installed within existing tanks, most requiring modifications to the tanks and aeration systems, to increase capacity without adding tankage. AGS requires deep tanks (typically greater than 20 feet) and, therefore, this process is not a cost-effective solution for the WPCF. BAS (BioMag®) involves adding magnetite to the activated sludge system to improve settling, allowing operation at a higher MLSS concentration (up to 10,000 mg/L), but requires addition chemical addition and magnetite separation equipment. In an MBR process, membranes are added to the activated sludge system for solids separation, allowing operation at a higher MLSS than achievable with final clarification. MBRs are most often used in applications where space is limited for expansion of the activated sludge system. Based on the existing clarification capacity at the WPCF and available space on-site, MBRs are not considered a cost-effective alternative. MABRs are membrane modules that are installed within activated sludge basins and provide a surface for biofilm growth. Oxygen is transferred through these gas-permeable membranes (inside-to-outside), increasing oxygen transfer efficiency compared to diffused aeration. MABRs are relatively new to the industry. IFAS is a modification to the conventional suspended growth activated sludge process that incorporates a fixed film process into the aeration basins. This is accomplished by adding fixed film media to the aeration tanks to allow biofilm growth, effectively increasing the SRT without increasing the solids loading on the clarifiers. However, in applications with high industrial loads, there is the potential for FOG to coat the IFAS media and reduce its effectiveness. Given the available space on site and existing infrastructure that was designed for additional activated sludge tankage, the intensification processes identified do not appear to be cost-effective and are not evaluated further in Section 7. In addition, the WPCF staff's familiarity and successful performance with the existing activated sludge system has demonstrated its flexibility and robustness to handle variable loadings while being reasonable to operate and maintain.

An alternative to expanding the activated sludge system to increase capacity would be to pretreat the industrial wastes, effectively reducing the loadings to the WPCF. However, this is not considered a cost-effective alternative based on the strength of the existing industrial loads (2,000 to 5,000 mg COD/L), infrastructure improvements necessary to convey industrial waste to the WPCF site, and odor concerns.

Sidestream nutrient removal from the thickening/dewatering filtrate could also be considered in conjunction with the mainstream BNR alternatives evaluated. Ferric sulfate is currently added to the filtrate from the thickening/dewatering of the digested sludge at a rate of approximately 120 gpd to precipitate soluble phosphorus, which is then removed in the primary clarifiers. This reduces soluble phosphorus to the activated sludge system while also reducing struvite formation. Sidestream struvite sequestration or harvesting could be considered to precipitate struvite in the sludge or filtrate for removal rather than returning particulate phosphorus (as iron salt) to the primary clarifiers. Potential benefits of struvite sequestration or harvesting include improved dewaterability of digested sludge, elimination of ferric sulfate dosing to the filtrate, and reduced chemical use and sludge production. However, based on the low effluent TP achieved under current plant operation and the lack of significant nuisance struvite formation, it does not appear that the implementation of struvite sequestration or harvesting will be cost-effective.

Sidestream nitrogen removal using the deammonification process is another option to reduce nutrient loadings to the mainstream liquid process, particularly for facilities with anaerobic digestion. In the deammonification process, ammonia is removed from digested sludge thickening/dewatering filtrate using significantly less oxygen than conventional nitrification processes while also accomplishing TN removal without using carbon. Potential benefits of sidestream deammonification processes are reduced ammonia loading to the activated sludge system, additional carbon availability for BPR (through reduced carbon use for denitrification), and reduced energy requirements for ammonia removal. Based on current influent characteristics and BPR performance, it does not appear that BPR performance is limited by available carbon and the potential energy savings associated with ammonia removal are not anticipated to be significant relative to the capital cost of adding a deammonification system. Therefore, deammonification was not considered a cost-effective option for the WPCF.

Equalization of return flows, particularly from dewatering of anaerobically digested sludge, is often considered to reduce slug loadings on the main biological treatment system. Based on the current WPCF dewatering operation (up to nine hours per day, seven days per week), influent characteristics, and the long HRT in the activated sludge system, the benefits of filtrate equalization are not anticipated to be significant in the design of any activated sludge improvements and is not considered further in this plan.

E. Final Clarifiers

The three existing 125-foot-diameter final clarifiers have a total surface area of approximately 36,800 sf and a total weir length of approximately 1,105 feet. The WPCF typically operates two clarifiers under normal operation. WAC NR 110 provides design parameters for clarifiers following activated sludge based on surface settling rate, weir overflow rate, and solids loading rate. A summary of the rated average, maximum day, and peak hourly flow capacities of the existing final clarifiers based on NR 110 requirements in presented in Table 6.01-3. As indicated, the rated capacity of the existing clarifiers exceed the 2045 design flows for the average day (11.0 MGD), maximum day (22.4 MGD), and maximum hour (28.3 MGD) condition. Therefore, an additional clarifier is not needed to meet future design flows.

Design Flow Basis	NR 110 Maximum Design Parameter	Rated Capacity (MGD)
Average Day		
	Solids Loading Rate: 1.4 lb/sf/hr	13.1[a]
	Weir Overflow Rate: 15,000 gpd/ft	16.6
Maximum Day	Solids Loading Rate: 2.0 lb/sf/hr	25.8[a]
Maximum Hour		
	Surface Settling Rate: 1,200 gpd/sf	44.2

[a] Determined using RAS flow of 16.5 MGD (150 percent of DAF) and MLSS concentration of 5,000 mg/L.

Table 6.01-3 Final Clarifier Capacity Evaluation Summary

The clarifier tanks and mechanisms were all constructed during the original WPCF construction in 1992. The City is currently planning to repair and rehabilitate the clarifier equipment in one tank each year for the next three years (2020 through 2022) with local funds, outside of this planning effort. Staff have also mentioned that the grout in the bottom of the clarifiers has delaminated in areas. This grout should be repaired or replaced within the next five years.

Algae commonly builds up on the weirs and within the launders of the clarifiers, especially in the summer months. Algae sloughing off the weirs and launders can create downstream issues at UV disinfection systems. For this reason, launder covers at the final clarifiers should be considered.

RAS pumping is provided by five centrifugal pumps, each with a capacity of 4,300 gpm, or approximately 6.2 MGD. WAS pumping is provided by two centrifugal pumps, each with a capacity of 1,200 gpm, or approximately 1.7 MGD. NR 110 requires RAS pumping capacity of 15 to 75 percent of the DAF for conventional activated sludge processes. Ten States Standards includes a recommended RAS pumping capacity of 150 percent of the DAF for single stage nitrification processes. Based on these requirements, the existing RAS pumps provide adequate capacity. The five RAS pumps are all original (installed when the WPCF was constructed in 1992) but have been rebuilt in the recent past. They currently have significant life remaining, but replacement should be planned in the 10- to 15-year time frame. The two WAS pumps were also installed in 1992 and have since been rebuilt. Replacement of the WAS pumps should be planned for the 11- to 15 year time frame.

The WAS pumps each have pneumatically operated isolation valves that control flow to the pumps. The pneumatic actuators on these valves have historically been difficult to maintain and replacement should be planned. Electric actuators should be considered.

Secondary scum is collected in a scum hopper attached to each final clarifier. A secondary scum pump then pumps this scum to the channel downstream of the grit tanks. Secondary Scum Pump No. 1 was replaced in 2019 and the other two secondary scum pumps have been recently rebuilt.

F. Disinfection

The WPCF current uses sodium hypochlorite for chlorination and sodium bisulfite for dichlorination. WAC NR 110.23 requires a detention time of 60 minutes at average design flow and 30 minutes at peak hourly flow. Based on these requirements, the current chlorine contact tank volume of approximately 496,000 gallons provides a DAF capacity of 11.9 MGD and a peak hourly flow capacity of 23.8 MGD. Therefore, the existing chlorine contact tank provides adequate contact time for the 2045 DAF condition but does not provide the required 30-minute contact time at the 2045 peak hourly flow condition. Furthermore, WPCF staff have expressed interest in replacing the existing sodium hypochlorite disinfection system because of chemical safety concerns and the age of the equipment. Only one of the four sodium hypochlorite pumps is typically used, as it is the only pump that can be flow paced. Staff have also reported difficulty finding parts for the sodium bisulfite pumps. The sodium hypochlorite and sodium bisulfite tanks are original (1992) but have been re-lined in the late 1990s. Staff report that there are significant leaks in the walls of the chemical containment structure. These should be repaired if continuing with chemical disinfection. Staff also report that the stop logs in the chlorine contact tanks no longer fit in the guides, rendering them unusable. Replacement of the existing disinfection system with UV disinfection is evaluated in Section 7 along with expansion of the existing chlorine contact tanks to meet NR 110 requirements for peak flow.

G. Biosolids Management

Primary sludge data from July 1, 2018 through June 30, 2019 is summarized in Table 6.01-4. This data indicates an average of approximately 6,990 pounds of primary sludge (PRS) is pumped per day. As described earlier, the existing air-operated diaphragm pumps are not able to maintain the desired sludge blanket under all conditions and, therefore, centrifugal pumps are occasionally used to pump PRS. The PRS flowrate is significantly higher when these centrifugal pumps are in operation compared to the diaphragm pumps, resulting in a lower PRS percent solids. To maintain a relatively consistent digester feed concentration under these conditions, the PRS is mixed with the WAS and thickened with the GBT when the centrifugal PRS pumps are in operation. Because the WPCF typically operates the diaphragm pumps, the data presented in Table 6.01-4 mostly includes periods of diaphragm pump operation. However, there are samples for total solids (TS) during this period that were taken during centrifugal pump operation.

Parameter	Value
Flow, gpd	21,360
Percent Solids	3.9
Percent Volatile	81
TS, lbs/day	6,990
VS, lbs/day	5,690

VS=volatile solids

Table 6.01-4 PRS Summary–July 1, 2018 through June 30, 2019

As presented earlier, the WPCF regularly measures influent and primary effluent TSS concentrations which indicate that the primary clarifiers typically removal approximately 57 percent of influent TSS. WPCF data from July 1, 2018 to June 30, 2019 suggest that approximately 6,700 lbs of solids were removed in the primary clarifiers. However, process return flows (GBT filtrate, BFP filtrate) are returned to the liquid stream between the influent and primary effluent sampling locations, understating the solids removed in the clarifiers. Based on this data, the PRS data presented in Table 6.01-4 appears to be reasonable without adjusting for the intermittent centrifugal pump operation.

WAS data from July 1, 2018 through June 30, 2019 is summarized in Table 6.01-5. WAS flow is measured using an electromagnetic flow meter and MLSS measurements are taken approximately three times per week. VS measurements are taken approximately once per week. Based on the data presented, the activated sludge system currently produces approximately 8,490 lbs TS/day and 7,050 lbs VS/day. During this time period, approximately 15,800 lbs of BOD_5 were oxidized in the activated sludge system, assuming that BOD_5 removal in the primary clarifiers is equivalent to the measured COD removal. This BOD_5 removal and WAS production corresponds with a sludge yield of approximately 0.45 lbs VSS/lb BOD_5 removed, which is reasonable for a long-SRT activated sludge process following primary clarification.

City staff indicate all WAS is thickened using a GBT before digestion. This requires thickening seven days per week, requiring staffing on the weekends. WAS thickening on the weekends could potentially be eliminated by construction of WAS storage. This would allow for more consistent wasting of WAS, not just when the GBT is running. However, staff indicate that the current operation works well and do not have a desire to reduce required weekend staffing. Therefore, WAS storage is not evaluated in this facilities plan.

TWAS data is also presented in Table 6.01-5. As shown, the calculated TS of TWAS is approximately 4,300 lbs/day higher than the calculated total WAS solids. There are several factors that could contribute to this difference, including PRS that is thickened on the GBT (as discussed earlier), the frequency of TWAS TS measurements (once per week or less), and inconsistencies in GBT performance. The data presented suggests that the TWAS measurements may not provide a good representation of solids produced in the activated sludge process and, therefore, the WAS solids production values are used in the evaluation of biosolids processes.

WAS	Value
Flow, gpd	116,700
TSS	8,730
Percent Volatile	83
TS, lbs/day	8,490
VS, lbs/day	7,050
TWAS	
Flow, gpd	21,850
Percent Solids	7.0
Percent Volatile	82
TS, lbs/day	12,750
VS, lbs/day	10,470

Table 6.01-5 WAS and TWAS Summary–July 1, 2018 through June 30, 2019

A summary of the TS feed to the anaerobic digestion system is presented in Table 6.01-6. This summary is based on the recorded PRS and WAS solids values (assuming 95 percent capture on GBT) as presented in Tables 6.01-4 and 6.01-5, respectively. It was assumed that the PRS and TWAS flow values are relatively accurate and, therefore, the total flow to the digesters were assumed to be the sum of the measured PRS and TWAS flows. The percent solids feed to the digesters was then calculated from the mass and flow values as presented.

Parameter	Value
Flow, gpd	43,210
Percent Solids[a]	4.2
Percent Volatile	82
TS, lbs/day	15,060
VS, lbs/day	12,390

[a]Calculated using lbs TS/day and total flow.

Table 6.01-6 Anaerobic Digester Feed Summary–July 1, 2018 through June 30, 2019

Biosolids stabilization is provided by two 80-foot-diameter primary mesophilic anaerobic digesters that are both heated and mixed, each with a volume of approximately 1,350,000 gallons (360,900 cf total). Using the current digester feed data presented in Table 6.01-6, the current average volumetric loading rate to the anaerobic digesters is approximately 34 lbs VS/1,000 cf/day. NR 110 indicates a maximum volumetric loading rate for completely mixed anaerobic digesters of 80 lbs VS/1,000 cf/day.

WPCF data from July 1, 2018 through June 30, 2019 indicates an average digested sludge VS content of approximately 74 percent. Based on a digester feed VS content of 82 percent, this suggests a VS reduction in the anaerobic digesters of approximately 38 percent. City staff indicate only one of the two anaerobic digesters was in operation for a majority of this period with the old digester mixing system, as modifications to the digester mixing system were installed. With one digester in operation, the average VS loading rate to the digesters during this period was approximately 69 lbs VS/1,000 cf/day. Following installation of the new digester mixing system in one digester in mid-2019, VS destruction increased to approximately 50 percent at similar volumetric loading rates. Both digesters with new mixing systems were brought online in November 2019.

Future solids production values were projected using a calibrated BioWin model of the WPCF and the projected 2045 influent loadings summarized in Table 4.06-2. The solids production values predicted by the BioWin model at the 2045 average day and maximum month conditions are presented in Table 6.01-7.

	Current Average[a]	2045 Average Day	2045 Maximum Month
Influent Loadings			
COD Load, lbs/day	38,840	76,490	119,620
BOD_5 Load, lbs/day	20,150	38,250	59,810
TSS Load, lbs/day	11,240	16,360	36,310
Solids Production			
TS	15,060	27,200	53,000
VS	12,390	23,200	35,800

[a]July 1, 2018 through June 30, 2019

Table 6.01-7 Current and Projected Solids Production Summary

The projected VS loading rate to the existing anaerobic digesters under the 2045 average day and maximum month conditions are 64 lbs VS/1,000 cf/day and 99 lbs VS/1,000 cf/day, respectively. Therefore, based on design average day loadings the existing anaerobic digesters provide adequate capacity to meet the NR 110 requirement for completely mixed anaerobic digesters.

Based on a digester feed concentration of approximately 4 percent solids, the existing digesters would provide 33 days of detention time at the projected average 2045 solids loading rate and 17 days at the projected 2045 maximum month loading rate. This meets NR 110.26 regulations for minimum detention time of 15 days.

Digested sludge is circulated from the digesters through the heat exchangers using one of two digester sludge recirculation pumps. Occasionally, these pumps bind up, causing loss of flow. They also have a very long suction line that has been troublesome in the past. The pumps were installed with original WPCF construction in 1992 and should be replaced within the next six to ten years. Consideration to relocating the pumps closer to the digesters should be given. Two spiral heat exchangers are used to transfer heat to the digesters. The heat exchangers are undersized for the conditions, as they often experience difficulty maintaining desired temperatures in the digesters. WPCF staff indicate the heat exchangers are cleaned on a regular interval to keep them clear of struvite and other scaling issues. These spiral heat exchangers should be replaced within the next five years. Two Clever Brooks boilers are used to provide hot water heat to the digesters. These boilers can run on either digester gas, natural gas, or a combination of the two. These boilers have recently been re-tubed and controls were upgraded.

They are generally in good shape, but because of age, replacement should be considered within the six- to ten-year time frame. There are three additional natural gas boilers used for digester heating. These boilers only run in extreme cold conditions, or when the primary boilers are out of service. These boilers were installed in 2009 and are in good condition.

The WPCF currently uses biogas for digester heating, with any excess biogas typically flared in a waste gas burner. While biogas to the waste gas burner is not currently recorded, biogas flow to the boilers in winter (when all of the biogas is used for digester heating) suggests a total biogas production in the range of 90,000 cubic feet per day (cfd) to 110,000 cfd. The digesters both have fixed covers. Biosolids Storage Tank No. 1, which also has a fixed cover and was originally designed to provide gas holding capacity. However, staff indicated that the cover on this tank was never gas tight and the gas was never stored in Biosolids Storage Tank No. 1. This results in minimal digester gas storage, causing significant fluctuations in gas pressures as sludge is pumped into and out of the digesters, mixing energy is applied, and gas is withdrawn for use at the boilers. Staff report gas pressures range from approximately 4.5 to 16 inches of water column. The pressure relief valves are set to vent at 18 inches of water. Staff report there were no significant issues noted with the digester covers when they were most recently taken out of service as a result of the digester mixing project. It is recommended that a detailed assessment be completed next time the digesters are taken out of service. Costs for cover rehabilitation or replacement would depend on the outcome of this detailed assessment. For the purposes of this plan and based on the age of the existing covers, it is assumed that the covers will be significantly rehabilitated or replaced in 11 to 15 years. The replacement of an existing cover with a membrane gas holder cover could also be considered to provide gas storage and more consistent digester gas pressures for potential future end-uses (for example, cogeneration or dryer).

There are pre-digestion processes, such as thermal hydrolysis or cell lysis, that have successfully been implemented at other facilities to increase anaerobic digestion VS destruction and the associated biogas production. These processes can also effectively increase digestion capacity by breaking down VS into more digestible compounds. Based on the evaluation above, the existing digesters have adequate capacity for the projected 2045 VS loading and, therefore, a pre-digestion process to increase capacity is not necessary for purposes of increasing digestion capacity. WPCF staff have also indicated that they do not desire to accept high strength waste (HSW) in the future because of the potential for odors. Furthermore, the WPCF does not plan to implement cogeneration or another means of energy recovery from biogas beyond the current operation of digester heating, making a pre-digestion process to increase biogas production likely not cost-effective. The cost-effectiveness of a pre-digestion process could be evaluated in more detail to increase gas production if biosolids drying is implemented.

A summary of the thickened digested sludge data from July 1, 2018 to June 30, 2019 is presented in Table 6.01-8. Based on this data, an average of approximately 10,200 pounds of digested sludge were thickened per day to a TS content of approximately 5.3 percent. During this period, a small portion of the digested sludge was pumped to the belt filter press (BFP) for dewatering. However, this flow rate is not currently recorded in the WPCF SCADA system. The solids data presented in Table 6.01-8 indicates that an average of approximately 2,700 pounds of inert solids were pumped out of the digesters per day, similar to the value pumped into the digesters (as presented in Table 6.01-6). This suggests that the few instances of dewatering operation during this time period had a relatively small impact on the average values over the period.

Parameter	Value
Flow, gpd	23,000
Percent Solids	5.3
Percent Volatile	74
TS, lbs/day	10,200
VS, lbs/day	7,500

Table 6.01-8 Digested Sludge Summary–July 1, 2018 through June 30, 2019

This thickened digested sludge is then pumped to the two existing biosolids storage tanks, which have a combined capacity of approximately 8,100,000 gallons. WAC NR 204.10 requires 180 days of biosolids storage for all municipal mechanical treatment plants. Under current conditions (23,000 gallons of thickened sludge per day), the existing storage tanks provide approximately 352 days of storage. At the projected 2045 condition, assuming similar solids content of the digested sludge and assuming 50 percent VS destruction in the digesters, approximately 15,600 pounds of digested sludge per day would be pumped to the storage tanks at a rate of approximately 35,300 gpd. At this rate, the existing storage tanks would provide approximately 229 days of storage under the 2045 average condition.

However, in recent years, the WPCF has not be able to completely empty its biosolids storage tanks twice per year as assumed when sizing a tank for 180 days of storage. When this occurred, the WPCF has not had adequate biosolids storage and had to dewater and landfill a portion of the biosolids. There are several factors that have led to the inability to empty the biosolids storage tanks each spring and fall, including weather patterns, changing farming practices, and limited land application capacity of existing City equipment and staff. Based on current biosolids production, the WPCF should have close to 350 days of storage; yet, the City anticipates landfilling biosolids for several months in early 2020. Because there is significant cost associated with landfilling biosolids, an evaluation of alternatives for biosolids storage and disposal is recommended.

Biosolids Storage Tank No. 1 was constructed in 1992 as part of the original WPCF construction. This tank has a flat, fixed concrete cover and is mixed by a gas mixing system. Digester gas is no longer used to mix this tank–it is now mixed with compressed air. Consideration should be given to replacing the mixing system in this tank if liquid biosolids storage is required in the future. Staff report that the mixing system does a poor job mixing the tank. The tank cover was designed to hold digester gas, but because it leaked beginning shortly after the 1992 WPCF construction it was never used to store gas. The condition of the cover is unknown, and the interior of the tank is inaccessible as it is full of biosolids. The condition of the tank and cover should be thoroughly inspected the next time the tank is emptied. Liquid biosolids from Biosolids Storage Tank No. 1 are pumped into trucks using one of two sludge loading/recirculation pumps. These pumps have been rebuilt since original installation in 1992, but replacement should be planned within the next five years. Evaluation of improvements to Biosolids Storage Tank No. 1 are included in the overall biosolids alternatives, as the need for these improvements will be dependent upon the selected alternative.

Biosolids Storage Tank No. 2 was constructed in 1997 and has an aluminum dome cover and submersible mixers. The mixers currently in this tank were installed in 2007 and are in adequate condition. However, staff report they often trip out on high amp draw, indicating the motors may be slightly undersized. Biosolids from Biosolids Storage Tank No. 2 are loaded into trucks using a submersible pump that was originally installed in 1997 and replaced in 2007. This pump is reported to be in acceptable condition. Davit cranes for removing the pumps and mixers are all in poor condition and should be replaced. Staff report that the ring trench in the bottom of the tank is generally plugged.

As indicated above, the existing biosolids storage tanks should have approximately 352 days of storage under current loading conditions and 229 days under future conditions, assuming that the tanks are emptied twice per year. WPCF staff indicate the major factor that has prevented the tanks from being emptied in recent years is the inability of City staff to land apply all of the biosolids with one applicator and current staffing in the available application time frames. Therefore, one biosolids disposal alternative is to maintain liquid storage and land application and for the City to purchase additional land application equipment to double the current biosolids application capacity. This alternative would also include additional liquid biosolids storage in the future to provide approximately 365 days. The NR 110-required 180 days of storage has not provided sufficient storage volume in the recent past because of weather and other factors limiting or preventing land application in the spring and fall seasons.

Another option that will be evaluated in Section 7 is to shift from on-site liquid storage to dewatering of all of the biosolids. This alternative includes the replacement of the existing DSD thickening GBT with a centrifuge for dewatering biosolids. The existing BFP would remain as a backup to the centrifuge. Based on the planned developments in the vicinity of the WPCF, it is anticipated that open-air storage of dewatered cake onsite could lead to odor concerns. Although the building could be enclosed to minimize odors, the loading and hauling process could lead to noticeable odors. Therefore, this alternative includes off-site storage of biosolids cake. Challenges may arise when siting an off-site storage facility, particularly if it is located outside of the City and requires approval from another municipality.

As facilities evaluate long-term options for biosolids disposal with uncertainties related to nutrient limitations, land availability, weather patterns, and emerging contaminants such as PFAS, many are considering drying as a means of providing additional flexibility. Dewatering and drying biosolids on-site significantly reduces biosolids volumes and can produce a Class A biosolid that provides additional potential avenues of disposal, including selling the material to commercial landscaping companies for use as a fertilizer. This option will also be evaluated in more detail in Section 7.

H. Biosolids Thickening and Dewatering

The WPCF has three GBTs that are used to thicken WAS and digested sludge. Two GBTs are available to thicken WAS, with a combined capacity of approximately 4,000 lbs/hour and 1,000 gpm with a 0.8 percent solids feed as indicated in the WPCF O&M Manual. Assuming GBT operation 63 hours per week (nine hours per day, seven days per week), the existing GBTs have a solids loading capacity of 36,000 lbs/day. At the projected 2045 maximum month condition, the BioWin model projects approximately 33,700 pounds of WAS per day. At the projected 2045 maximum week condition, the projected WAS production is approximately 36,600 lbs/day. Therefore, the existing GBTs have adequate capacity for the projected 2045 maximum month condition and are within 2 percent of the capacity of the 2045 maximum week condition. GBT Nos. 2 and 3 were installed in 1992 and are nearing the end of their expected service life. Finding parts for these GBTs is becoming difficult. Replacement or refurbishment will be necessary within the next five years. Costs for replacement of these two GBTs is included in the common improvements list. Thickening centrifuges were considered. However, because primary sludge is occasionally thickened, it is likely that thickening centrifuges would require upstream primary sludge screening to prevent operation issues stemming from debris in the primary sludge. Other thickening technologies such as rotary drum thickeners or disc thickeners could be considered during preliminary design.

The third GBT is used for thickening of digested sludge. According to the WPCF O&M Manual, the GBT has a capacity of 4,500 lbs/hour and 300 gpm with a 3 percent solids feed. Assuming GBT operation 63 hours per week, the existing GBT has a solids loading capacity of 40,500 lbs/day and hydraulic capacity of 162,000 gpd. The projected 2045 maximum month and maximum week solids loads to the GBT, assuming 50 percent VS destruction in the digesters, are approximately 35,100 lbs/day and 38,200 lbs/day, respectively. Therefore, the existing GBT has adequate capacity for the projected 2045 conditions. This GBT was originally installed at the previous WPCF located in downtown City. It was refurbished and installed at the current WPCF in 1992. It is becoming difficult to find parts for this GBT. Replacement will be necessary in the near future. The need for this GBT will be impacted by the selected biosolids management alternative. Costs for replacement are included in the biosolids alternatives evaluation. Digested sludge is fed to the GBT by one of two digested thickener feed pumps. Pump 1 is an original pump installed when the WPCF was constructed in 1992. Pump 2 was replaced in 2011. Replacement of these pumps should be considered with the overall biosolids management alternatives. Thickened sludge from the GBTs is pumped by one of three progressing cavity thickened sludge pumps to either the digesters or biosolids storage tanks. These pumps were installed in 1992 and have since been rebuilt. Replacement of these pumps should be considered with the overall biosolids management alternatives.

A BFP was installed at the WPCF in 2010 to provide the capability to dewater digested sludge for land application or landfilling as cake if the liquid storage tanks are full, as described earlier. The BFP is generally in good condition. However, because of the long length of piping that the dewatered cake is pumped through before discharging into a dump truck, staff cannot allow the dewatered cake to be greater than approximately 12 to 13 percent solids or it cannot be pumped by the progressing cavity dewatered cake pump. In addition, a significant amount of polymer is added to the dewatered cake in an effort to further reduce friction for pumping. In addition, the dewatered cake pump needs to be run in hand because the cake bridges the pump hopper, preventing automatic operation. Improvements to the conveyance of the dewatered cake are necessary and evaluated in the biosolids alternatives evaluations.

Polymer is provided to the thickening and dewatering processes through a dry polymer system. Dry polymer is stored in a hopper where it is conveyed through a wetting head by the dry polymer conveyance blower to a polymer mix tank. The dry polymer is mixed with water in the mix tank and then pumped to one of two polymer feed tanks. The polymer is then pumped to the GBTs or BFP by one of four pumps where it aids in dewatering the biosolids. All the polymer mixing and pumping equipment was installed with original WPCF construction in 1992 and has reached the end of its expected service life. Replacement of this equipment should be planned. The HVAC system in the dry polymer room has been troublesome in the past because of high humidity levels in this room (described in more detail in the following). The HVAC system in this space should be improved at the time the polymer system equipment is replaced.

I. Odor Control

There are currently three separate odor control systems at the WPCF: a mist scrubber system for the grit removal area, primary influent splitter structure, primary clarifier launders, and aeration distribution box; a soil biofiltration bed for Biosolids Storage Tank No. 2, and another biofiltration bed for the preliminary treatment and sludge thickening/dewatering areas of the Process Building. The biofiltration bed that was constructed to receive odorous air from Biosolids Storage Tank No. 2 is no longer in service and was partially demolished as part of the recent digester mixing project. There is currently no active odor control system for Biosolids Storage Tank No. 1 or 2. Staff have reported that the biosolids storage tanks can become odorous when they are being mixed before hauling of biosolids; however, they do not think it is significant enough to warrant construction of a new odor control system for the biosolids storage tanks. The WPCF does not currently operate the mist scrubber system in winter because of concerns with components of the system freezing. Adequate odor control is a high priority, considering the likelihood that a large casino and hotel development is planned on the property immediately north of the WPCF site.

One option for improvements to the odor control system includers rehabilitation or replacement of the existing mist scrubber system and continued use of the biofilter serving the Process Building.

A second option for improvements to the odor control systems includes construction of a new biotrickling filter to serve the primary clarifiers and splitter boxes. This would take the place of the existing mist scrubber system. The in-ground biofilter would continue to be used to serve the Process Building.

A third option includes construction of a new biotrickling filter in place of the existing mist scrubber system. All odorous air from the Process Building and the primary clarifiers and splitter boxes would be routed to this system. This would serve as the first stage of a two-stage system. Depending on concentrations of hydrogen sulfide (H_2S) and other odorous compounds, the odorous air would then be routed to a new biofilter which would be used for polishing as the second stage. A two-stage system such as this would represent the most conservative approach and should provide the highest degree of odor control. However, it is recommended that odorous air from various process areas be sampled and concentrations of odorous compounds analyzed prior to design of any odor control improvements.

J. Waste Gas Burner

Digester gas is typically used to fire boilers used for digester heating. Any excess gas is flared at the waste gas burner, which was installed during original WPCF construction in 1992. The waste gas burner is in poor condition and should be replaced in the zero- to five-year time frame.

K. Utilities

The WPCF has a plant compressed air system that provides air to pneumatic valve and damper actuators, provides mixing air to Biosolids Storage Tank No. 1, and other purposes. The current compressors were installed in 1997 and the air drying system was installed in 1992 during original WPCF construction. Staff report there is a significant amount of oil in the system that causes issues with the pneumatic operators. The compressors and dryers should be replaced within the next five years. Sizing of the compressors should be evaluated during design, as it is likely that the replacement of pneumatic

HVAC and valve operators with electric actuators, and removal or replacement of Biosolids Storage Tank No. 1 mixing system will significantly decrease compressed air demand at the WPCF.

The WPCF drain system flows to a plant drain wet well with two pumps. These pumps return WPCF drain flow to the forward flow process. The pumps were installed in 1992 as part of original WPCF construction. Replacement should be considered within the next five years.

W3 water is provided by one of four pumps located in the disinfection building. These pumps were installed in 1992 as part of the original WPCF construction. Only two of the four pumps are ever required to run at one time. Therefore, significant redundancy with this system exists. Because of this redundancy, replacement is likely not necessary until the six- to ten-year time frame.

L. Electrical Evaluation

The majority of the electrical equipment is from the original plant construction which was in 1992 which puts the age of this equipment at 28 years old. Because the equipment was installed at the same time, this evaluation will be broken down by type of equipment rather than by process building.

1. Medium Voltage Service Entrance Switchgear

The existing medium voltage switchgear is Power Vac switchgear manufactured by Powell Industries (Powell) out of Houston, Texas. Powell is still in business and is available for service and support. Medium voltage switchgear has a standard life expectancy of 30 years; however, if well maintained (which this is), it will last much longer. The circuit breakers in this switchgear are very reliable and replacement parts are available. Direct replacement circuit breakers are also available from various manufacturers should the need arise to replace or add a circuit breaker. The protection relays in this switchgear are obsolete; however, these relays are very reliable and there are local companies familiar with these types of relays that can provide service and support for them. Direct replacement relays are available from various manufacturers should the relays fail. For planning purposes, it is assumed replacement of the medium voltage service entrance switchgear will be required in the six- to ten-year planning period. Costs for replacement are included in the list of common improvement projects.

2. Medium Voltage Disconnect Switches and Dry Type Transformers

The medium voltage disconnects associated with each dry type power transformer were manufactured by Powercon Corporation (Powercon) out of Severn, Maryland. Powercon is still in business and is available for service and support. Medium voltage disconnect switches have a standard life expectancy of 20 years; however, if well maintained (which these are), they will last much longer. The dry type power transformers were manufactured by International Transformer Corporation out of Montebello, California. It does not appear that International Transformer Corporation is still in business. The life expectancy of dry type power transformers, if well maintained (which these are), is 25 years, so these transformers are past their useful life expectancy. The medium voltage disconnects and transformers should be replaced at the same time. An option for consideration would be to switch to liquid filled power transformers located outdoors. The benefits of liquid filled transformers is that they are not affected by dust and dirt, would free up space inside the buildings, and would eliminate the heat radiated to the room. The associated medium voltage disconnect switch would also be located outdoors. For planning purposes, it is assumed replacement of the medium voltage disconnect switches will be required in six to ten years. Replacement of the dry type transformers with liquid filled power transformers would be completed at the same time. Costs for replacement are included in the list of common improvement projects.

3. Low Voltage Switchboards

The low voltage switchboards served by the dry type power transformers discussed previously were manufactured by General Electric (GE). Low voltage switchboards have a standard life expectancy of 30 years; however, if well maintained (which these are), they will last much longer. The main and tie circuit breakers in these switchboards are obsolete and no longer available; however, direct replacement circuit breakers are available for these units. The trip units on these circuit breakers are also obsolete; however, there are various companies that can provide retrofit trip units for the circuit breakers if necessary. If a trip unit were to fail or need replacement, Strand's recommendation would be to replace the entire circuit breaker at that time. The feeder circuit breakers in these switchboards are molded case circuit breakers which, according to GE, will be obsolete in the near future. Like the main and tie breakers, there are direct replacement circuit breakers available for these units. For planning purposes, it is assumed that the low voltage switchboards will require replacement in six to ten years. Costs for replacement are included in the list of common improvement projects.

4. MCC

The existing MCCs are GE 8000 line. MCCs typically have a life expectancy of 30 years so the existing MCCs are nearing the end of their useful life expectancy. Some issues with the existing MCCs that were noted during Strand's walk-through included problems with pilot lights, buss stab issues, control power transformers, and internal bucket wiring. The GE MCC line of products has been purchased by ABB. According to the manufacturer, there are still numerous parts available, it has the ability to build new buckets, and new sections are available in its new 9000 line product. Strand recommends replacing the existing MCCs in either a phased approach or as part of the next major WPCF upgrade. One option available with new MCCs would be Ethernet connectivity to each starter and variable frequency drive (VFD), which would eliminate a significant amount of hardwiring for the various signals monitored at the SCADA system and would also allow monitoring of additional signals (such as amps), if desired. Another option that could be implemented would be the use of power monitors in each MCC that would provide electrical usage data to the SCADA system. This data could potentially be used to make process controls decisions that would result in energy savings for the WPCF. For planning purposes, costs for replacement of the MCCs are included with the costs for replacement of the various equipment they are associated with.

5. Low Voltage Panelboards

The existing low voltage panelboards are GE AF series. There is not a published life expectancy for low voltage panelboards and replacement circuit breakers for these panelboards are still available. Therefore, Strand feels replacement of these panelboards is a low priority.

6. Automatic Transfer Switches (ATS)

The existing ATSs are Zenith Model ZBTS in the Administration Building and Model ZTS in the Blower Building and Process Building. The life expectancy of automatic transfer switches is 20 to 25 years, so these units are past their useful life expectancy. In addition, replacement parts are no available for the existing ATSs. Therefore, Strand recommends replacing the ATSs. Replacement of the ATS should be completed soon. Costs for replacement are included in the common improvements project list, in the zero- to five-year time frame.

7. Lighting Uninterruptible Power Supplies (UPS)

The existing lighting UPSs are manufactured by Holophane. Replacement parts for these units are no longer available. Therefore, Strand recommends replacing the ATSs. Before replacing the UPSs, consideration may want to be given to reviewing where emergency lighting is being used and the level (footcandles) of light being provided by the emergency lighting to verify that emergency lighting is required in all areas where it is currently installed and that the lighting levels provided meet current emergency lighting egress codes. For planning purposes, it is assumed that lighting and the associated uninterruptible power supplies will be replaced as major projects are completed in various areas of the facility. Therefore, costs for replacement of lighting are included in the various alternatives and common improvements projects.

8. Programmable Logic Controllers (PLC)

All the PLC that make up the backbone of the SCADA system are Allen Bradley SLC series PLCs with SLC 5/05 processors. The one exception to this is the Disinfection Building which has SLC Input/Output (I/O) cards connected to the Allen Bradley CompactLogix processor. There are also Allen Bradley MicroLogix 1100 and 1200 PLCs that are used to collect data from various VFDs via Modbus. There is an Allen Bradley MicroLogix 1400 PLC in the Administration Building that is the master for communication with the water system PLCs.

The SLC series of PLCs is classified by Allen Bradley as “Active Mature,” which has a description of “Product is fully supported, but a newer product exists. Gain value by migrating.” The cost of the SLC components has increased significantly over the past several years and are expected to continue rising. Allen-Bradley has not yet determined a date of obsolescence for this product family. Therefore, Strand recommends replacing the existing SLC PLCs with Allen Bradley CompactLogix PLCs. An option to complete replacement of the SLC PLCs would be to replace the existing SLC 5/05 processors with CompactLogix processors and then tie the new processor into the existing I/O cards similar to what has been done in the Disinfection Building. The benefit of replacing only the processor is that it will reduce the overall cost of the upgrade. However, Allen

Bradley has indicated that it expects an "End of Life" date for the SLC I/O cards to be announced in the next two to three years.

The existing MicroLogix 1100 PLCs, like the SLC series PLCs, have an Active Mature status. The MicroLogix 1200 PLCs are classified by Allen Bradly as "End of Life" and have a discontinuation date of February 28, 2021. The MicroLogix 1400 PLCs are still a current product for Allen Bradley.

For planning purposes, costs for replacement of the PLCs are included with the costs for replacement of the various equipment they are associated with.

9. SCADA PLC Network

The existing SCADA PLCs are all connected via fiber-optic cable back to the master in the Administration Building. It is Strand's understanding that the network is currently set up in a star type configuration. The downside to a star type configuration is that there is no redundancy in the event of a fiber failure. Strand recommends providing new managed network switches and reconfiguring the system so that it is set up in a self-healing ring-type configuration. With the self-healing ring configuration, if a fiber were to fail, the managed network switch would automatically switch to two backup fibers and allow the system to function as normal. An alarm would also be sent to the SCADA system alerting the operators to the failure. For planning purposes, costs for improvements to the SCADA PLC network are included with the various other project costs.

10. Standby Generator

The existing standby generator is manufactured by Cummins and is a 1500 kW, 277/480-volt, three-phase, diesel generator. The generator was installed in the 2009 to 2010 time frame and feeds into the medium voltage service entrance switchgear via a 480-volt to 12,470-volt step-up transformer. Transfer of power to the standby generator is done manually through operation of circuit breakers in the medium voltage service entrance switchgear. The size of the generator allows the WPCF staff to run all necessary loads during a power outage. Standby generators have a standard life expectancy of 30 to 40 years or more if well maintained because of the low hours of use. The existing standby generator appears to be well maintained and should last for the duration of the planning period.

M. HVAC Evaluation

As part of the evaluation the HVAC systems and equipment were reviewed. The intent of the review was to assess the condition and performance of the existing HVAC equipment in each building.

1. Process Building

The lower level is open and there are no partitions to separate the different areas of the structure. This level is served by multiple fans, unit heaters, and make-up air units (MAUs). The MAUs serving this level are located in the first-floor mechanical room. These units are difficult to access and are approaching the end of their typical service life. When the make-up air equipment is replaced, Strand recommends reviewing alternate locations for the equipment to provide better access. One avenue would be to consider locating some equipment outside at grade. The lower level is also served by a dehumidification unit mounted at grade outside. This unit is beyond its typical service life. When this unit is replaced, Strand recommends reviewing alternate dehumidification technologies.

The upper levels are served by multiple fans, unit heaters, and make-up air equipment. In general, each space is provided with dedicated heating and ventilation equipment. The majority of the equipment is functional, and the condition appears in line with its age. The following items were noted during the review:

a. Exhaust and supply fans serving the boiler room are functional but appear in poor condition.

b. At the time of the site visit, the room storing the dry polymer in the thickening area was hot compared to the rest of the structure. The heat and humidity are problematic for the polymer. Building envelope and HVAC modifications are required to address these issues.

2. Primary Sludge Pump Station

This area is part of the tunnel system. From an HVAC standpoint, the area is served by unit heaters and an exhaust fan. The unit heaters are in good working condition. The exhaust fan is functional, but the motor is beyond its typical service life.

3. Blower Building

The building is broken to a blower room and an electrical room. The HVAC equipment serving the electrical room is in good working order. The majority of the equipment is functional, and the condition appears in line with its age. The following items were noted during the review:

a. The office off the electrical room is served by a fan coil unit. This unit was functional at the time of Strand's visit, but appears in poor condition.

b. The MAU located in the upper level was functional at the time of Strand's visit, but is nearing the end of its typical service life.

c. There is a fan within the blower building that serves the tunnel. The fan was functional at the time of Strand's visit, but is in a difficult to access location.

4. RAS Pumping Station

This area is part of the tunnel system. From an HVAC standpoint, the area has unit heaters and multiple exhaust fans. There is also a supply fan located at grade that is ducted to the tunnel. All the HVAC equipment is functional and appears in a condition in line with the age. No specific items to note.

5. Disinfection Facility

A portion of the building has a basement. The remainder of the building is at grade. The basement at the time of the visit was humid and odorous. The basement is served by a dedicated dehumidification unit. This unit is in poor condition and did not appear to be functional at the time of Strand's visit. There is a laboratory testing area in the basement that is not provided with any ventilation or exhaust. Strand recommends providing additional HVAC to serve this area.
At grade there are multiple spaces each provided with dedicated HVAC equipment. The following items were noted during the review:

a. There is a large air handling unit (AHU) hung within a control room. This unit was not functional at the time of the visit. The spaces served by this AHU may not require this type of equipment based on the current use of the space.

b. The HVAC equipment within the chemical room is showing signs of accelerated corrosion

6. Tunnel System

The tunnel connects to the majority of structures at the WPCF site. The ventilation equipment that serves the tunnels includes MAUs, supply fans, and exhaust fans. This equipment is located within multiple structures and have been mentioned in the different sections. It is recommended that an overall assessment be performed for the ventilation serving the tunnels to determine if the ventilation being provided to the tunnels is in line with current codes and standards.

7. Administration Building

The administration is served by multiple pieces of air handling equipment. A dedicated AHU serves the laboratory area. A different AHU serves the remainder of the office area. There is an AHU in the lower level that serves the electrical room and the tunnel. The following items were noted during the review:

a. The exhaust stack serving the boiler shows signs of condensation and corrosion. This may indicate the boilers are not exhausting effectively and can contribute to premature failure of the boiler.

b. There is a single chiller to serve both AHUs. If the chiller fails, the laboratory is not able to perform the necessary testing. The chiller is approaching the end of its typical service life. When it is time to replace the chiller, there should be consideration for redundancy in the event the chiller is under maintenance. Replacement of the chiller should be considered in the zero- to five-year time frame.

c. The airflow within the building appears to be out of balance causing some areas to be over ventilated and other under ventilated. Consider having a HVAC balancing firm review the design and rebalance to the design specifications.

d. The temperature controls system for the equipment within the administration building is not comprehensive. Some equipment is controlled and monitored through an electronic system and other equipment is not. Additionally, the existing main temperature control equipment is beyond its service life and in need of an upgrade. At the time the controls are upgraded, Strand recommends installing an open source platform. Strand recommends upgrading controls in this building when the chiller is replaced.

8. HVAC System Controls

Some equipment within the WPCF is currently controlled electronically, but some systems are currently controlled with pneumatics. Strand recommends converting all existing pneumatic controls systems to be electronically controlled. Strand recommends setting up the system to allow each fan or AHU to be monitored and controlled electronically. This can be accomplished through SCADA or a temperature control system. As new equipment is installed, we recommend installing the infrastructure to allow for remote control and monitoring.

For planning purposes, costs for HVAC improvements in the Process Building, tunnels (including the primary sludge pumping station and RAS pumping station), Blower Building, and Disinfection Building are included in the associated alternatives or specific equipment replacement items located in those areas. A separate Administration Building HVAC improvements project is included in the common improvements list. This project would include replacement of the boiler exhaust stack, replacement of the chiller, balancing of the HVAC equipment, and upgrading the HVAC controls.

6.02 SCREENING OF POTENTIAL ALTERNATIVES

This section identifies alternatives to remedy capacity and other deficiencies in WPCF processes noted previously in Section 6.01. The alternatives considered herein represent major long-term direction for the WPCF that will provide the required capacity for the flow and loading projections for the year 2045 and beyond.

A. Activated Sludge Alternatives

As described earlier, the activated sludge system at the WPCF has demonstrated the ability to meet permit limits under the current flows and loadings. However, additional capacity is required to consistently meet anticipated permit limits under the projected 2045 conditions. Two treatment alternatives have been identified to expand biological treatment capacity for further evaluation in Section 7:

1. Alternative AS1–Expansion of Activated Sludge System with Current A/O Configuration:

   a. Two new forward flow trains adjacent to existing trains including anaerobic and aerated zones in an A/O configuration.

   b. New anaerobic mixers and diffusers in activated sludge trains.

   c. Replacement of anaerobic mixers and diffusers in existing trains.

d. Replacement of two existing blowers with three high speed turbo blowers.

e. Replacement of air distribution piping (as necessary)

2. Alternative AS2–Expansion of Activated Sludge System with A^2O Configuration:

   a. Two new forward flow trains adjacent to existing trains including anaerobic, anoxic, and aerated zones in an A^2O configuration.

   b. New anaerobic/anoxic mixers, nitrate recycle pumps, and diffusers in new activated sludge trains.

   c. Reconfiguration of existing A/O trains to A^2O configuration with baffle walls, new anaerobic/anoxic mixers, new nitrate recycle pumps and piping, and new diffusers.

   d. Replacement of two existing blowers with three high speed turbo blowers.

   e. Replacement of air distribution piping (as necessary).

B. <u>Disinfection Alternatives</u>

The existing chlorination and dichlorination equipment has reached its useful life and the chlorine contact tank does not provide 30 minutes of contact time at peak flows as required by NR 110. Therefore, improvements to the existing disinfection system are required within the planning period. Many facilities have shifted from chlorination to UV disinfection, eliminating chemical use associated with the disinfection process. Peracetic acid is beginning to be used in some WWTFs for disinfection, but uncertainties related to residual concentrations and byproducts may lead to regulatory changes regarding its use in the future. Based on the deficiencies of the existing disinfection system, the following disinfection alternatives are evaluated in Section 7:

1. Alternative D1–Sodium Hypochlorite Chlorination/Sodium Bisulfite Dechlorination:

   a. Replacement of existing chemical storage tanks, feed pumps, and associated piping.

   b. Replacement of nonfunctional gates and stop logs.

   c. Expansion of chlorine contact tank to meet NR 110 requirements for PHF.

2. Alternative D2–UV Disinfection:

   a. Demolition of existing chemical storage tanks, feed pumps, and associated piping

   b. Modifications to existing chlorine contact tanks for installation of UV disinfection equipment

   c. New UV disinfection equipment with peak capacity of 28.3 MGD.

C. Odor Control Alternatives

Odor control is a critical consideration of any modifications to the WPCF, particularly with planned development in the area. To address odor control throughout the WPCF, the following alternatives are evaluated in Section 7:

1. Alternative OC1–Rehabilitation of Existing Systems, New Biofilter to Serve Biosolids Storage Tanks:

    a. Rehabilitate the existing mist scrubber system and make improvements to prevent freezing in winter.

    b. Continue use of the Bohn biofilter for odorous air from the Process Building.

2. Alternative OC2–Construction of New Biofilters to Serve Primary Treatment and Biosolids Storage:

    a. Replace the existing mist scrubber system with a new two-stage odor control system consisting of a biotrickling filter followed by a biofilter.

    b. Continue use of the Bohn biofilter for odorous air from the Process Building.

3. Alternative OC3–Construction of New Two-Stage System to Serve Process Building and Primary Treatment, New Biofilter to Serve Biosolids Storage:

    a. Replace the existing mist scrubber with a new biotrickling filter. Route all odorous air from the Process Building and primary treatment areas to this biotrickling filter to serve as first stage odor control. Construct a new biofilter as a second stage for polishing.

D. Biosolids Management

Existing biosolids disposal practices require a portion of the biosolids to be landfilled, which is not a cost-effective solution particularly as biosolids production increases and landfills place limitations on biosolids disposal. As discussed, maintaining thickened liquid sludge storage will require the addition of land application and sludge storage capacity. In addition to maintaining thickened sludge storage, dewatering and drying of all the biosolids will be reviewed. Major components of the biosolids management alternatives evaluated in Section 7 are identified in the following.

1. Alternative B1–Liquid Biosolids Storage, Additional Land Application Equipment:

    a. Replacement of existing GBT with another GBT or alternate thickening technology.

    b. Additional land application equipment, including two tanker trucks, and a one land applicator.

c. Replace Biosolids Storage Tank No. 1 mixing system.

d. Replace Biosolids Storage Tank No. 1 recirculation and loadout pumps

e. Biosolids Storage Tank No. 1 cover improvements

f. Additional sludge storage tank to provide 365 days of storage at 2045 projected solids production values.

g. Replacement of biosolids cake conveyance equipment for backup BFP.

h. Construction of a new cake loadout bay, closer to the BFP.

i. Replace thickened sludge pump.

2. Alternative B2–Dewatering and Off-Site Storage:

   a. Replacement of existing GBT with centrifuge.

   b. New centrifuge feed pump.

   c. Maintain existing BFP as backup to centrifuge.

   d. Replacement of biosolids cake conveyance equipment.

   e. Construction of a new cake loadout bay, closer to the centrifuge and BFP.

   f. Purchase of site and new pre-engineered metal building for off-site storage of dewatered biosolids cake.

3. Alternative B3–Drying

   a. Replacement of existing GBT with centrifuge.

   b. New centrifuge feed pump.

   c. Replacement of biosolids cake conveyance equipment.

   d. New drying equipment installed in an addition to the Process Building.

   e. Dried biosolids storage in an addition to the Process Building.

6.03 COMMON UPGRADE RECOMMENDATIONS

Performance and upgrade requirements of certain processes and facilities at the WPCF are independent of the alternatives previously discussed. Based on the evaluation of the existing facilities presented earlier, the following 0- to 5-year, 6- to 10-year, and 11- to 15-year improvements are shown in Tables 6.03-1, 6.03-2, and 6.03-2, respectively. These recommended improvements are common to all of the alternatives evaluated.

Item	Recommended Timeframe	Notes
Replacement of grit collector equipment.	0 to 5 years	
Replacement of grit classifiers.	0 to 5 years	
Rehabilitation of Primary Clarifier No. 1.	0 to 5 years	City planning to complete this rehabilitation in 2020.
Repairs to primary clarifier splitter box and replacement of gates.	0 to 5 years	
Replacement of scum concentrator.	0 to 5 years	
Repair concrete in aeration distribution box.	0 to 5 years	Gates should be inspected in the near future and may require replacement.
Final clarifier equipment repair/rehabilitation.	0 to 5 years	City planning to complete this rehabilitation in 2020 to 2022.
Install launder covers on final clarifiers.	0 to 5 years	
Repair grout on primary and final clarifiers.	0 to 5 years	
Replace digester spiral heat exchangers.	0 to 5 years	
Replace davit cranes at Biosolids Storage Tank No. 2.	0 to 5 years	
Replace two GBTs used to thicken WAS.	0 to 5 years	Note–Replacement of third GBT is included in biosolids alternatives evaluation.
Replacement of polymer system equipment.	0 to 5 years	
Replacement of waste gas burner.	0 to 5 years	
Replacement of WPCF air system compressors and dryers.	0 to 5 years	
Replacement of WPCF drain system pumps.	0 to 5 years	
Replace automatic transfer switches.	0 to 5 years	
Administration Building HVAC Improvements.	0 to 5 years	
Gas Compressor Room and Control Room National Fire Protection Association (820) Improvements	0 to 5 years	

Table 6.03-1 Recommended 0- to 5-Year Common Improvements

Item	Recommended Timeframe	Notes
Replacement of Influent Fine Screens.	6 to 10 years	
Replacement of grit slurry pumps.	6 to 10 years	
Replacement of concentrated scum tank and concentrated scum pump.	6 to 10 years	
Replace two primary digester boilers.	6 to 10 years	
Replace digester recirculation pumps.	6 to 10 years	Consider relocated closer to digesters.
Replace Biosolids Storage Tank No. 2 mixers.	6 to 10 years	
Replace Biosolids Storage Tank No. 2 loadout pump.	6 to 10 years	
Replacement of W3 system pumps.	6 to 10 years	
Replacement of medium voltage service entrance switchgear.	6 to 10 years	
Replace medium voltage disconnect switches and dry-type transformers.	6 to 10 years	
Replace low voltage switchboards.	6 to 10 years	

Table 6.03-2 Recommended 6- to 10-Year Common Improvements

Item	Recommended Timeframe	Notes
Replacement of diaphragm primary sludge pumps.	11 to 15 years	
Replacement of primary scum pumps.	11 to 15 years	
Replacement of RAS pumps.	11 to 15 years	
Replacements of WAS pumps.	11 to 15 years	
Rehabilitation of Digester Covers.	11 to 15 years	Replacement could also be considered, depending on condition and need for biogas storage.

Table 6.03-3 Recommended 11- to 15-Year Common Improvements

SECTION 7
EVALUATION OF ALTERNATIVES

This section of the report presents the analyses of the alternatives identified in Section 6 as well as recommended plan elements that are common to each of the alternatives.

7.01 INTRODUCTION

The design flows and loadings that provide the basis for the alternative analysis presented in this section were developed in Section 4. Section 6 describes the deficiencies of the existing facilities to meet the future design conditions and anticipated WPDES permit limits and identifies treatment alternatives recommended for evaluation. This section evaluates the activated sludge, UV disinfection, odor control, and biosolids management alternatives identified in Section 6 on a 20-year present worth cost basis. Nonmonetary considerations for each alternative are also presented. A detailed breakdown of costs for each alternative evaluated is included in Appendix G. When alternatives have a total present worth value within approximately 10 percent of each other, the alternatives are considered equal on a cost-effectiveness basis.

7.02 ACTIVATED SLUDGE ALTERNATIVES ANALYSIS

As described in Section 6, an expansion to the existing activated sludge system is recommended for the anticipated future flow and loadings, particularly considering slug loadings and potential future stringent effluent ammonia limits. In this section, two alternatives for expansion of the activated sludge process are evaluated.

A. Description of Alternatives

1. Alternative AS1–Expansion of Activated Sludge System with Current Anaerobic/Oxic (A/O) Configuration

In this alternative, the existing activated sludge system would be expanded and the current A/O configuration for BPR of an anaerobic zone followed by an aerobic zone would be maintained (see Figure 7.02-1). The anaerobic zone provides an environment to select for PAOs, resulting in the uptake of phosphorus in the aerobic zones and phosphorus removal through sludge wasting. Along with phosphorus uptake, carbon oxidation and nitrification also occur in the aerobic zone. As described in Section 3, the existing activated sludge system has shown successful BPR performance, with effluent TP concentrations typically approximately 0.2 to 0.4 mg/L. This alternative builds on the proven success of the existing system with improved aeration systems and controls. The following elements are included in this alternative:

a. Addition of two activated sludge trains adjacent to existing tanks, each with a volume of approximately 1.95 million gallons (MGs) to match existing trains.

b. Addition of new submersible anaerobic mixers in new trains and replacement of existing anaerobic mixers in existing trains.

c. Addition of new fine bubble diffusers in all activated sludge trains. The condition of existing diffusers could be evaluated during design for the potential to maintain existing diffusers in some trains

d. Replacement of two existing blowers with three high speed turbo blowers, each with a capacity of approximately 10,000 scfm. The three existing blowers are maintained to serve as backup to new blowers and provide additional air during peak demands, if necessary. Final blower sizing to be determined during design.

e. Replacement of air distribution piping as necessary for installation of new blowers and construction of new activated sludge trains. For planning purposes it is assumed the existing aeration headers to each train remains and new distribution piping is limited to within the Blower Building, from the Blower Building to the activated sludge system, and along the new activated sludge trains.

f. Addition of a new blower control system, including new instrumentation and wiring.

g. HVAC improvements in the Blower Building.

Figure 7.02-1 Alternative AS1

2. Alternative AS2–Expansion of Activated Sludge System with A^2O Configuration

This alternative includes two additional activated sludge trains in an A^2O configuration as well as modifications to the existing activated sludge trains to implement the A^2O process for biological phosphorus and nitrogen removal. These modifications include the separation of each existing activated sludge train into three zones: an unaerated anaerobic zone, an unaerated anoxic zone, and an aerobic zone (see Figure 7.02-2). Nitrate from the oxidation of influent ammonia is returned from the aerobic zone to the anoxic zone through a nitrified ML recycle, where it can be used by heterotrophic organisms instead of dissolved oxygen. This results in denitrification and carbon oxidation without aeration as well as alkalinity recovery. ML is typically returned at a rate of 100 to 400 percent of the influent flow and RAS is returned to the anaerobic zone where it is mixed with the primary effluent. As in the A/O process, the anaerobic zone provides an environment to select for PAOs, resulting in the uptake of phosphorus in the aerobic zones. In addition to achieving effluent TP concentrations below 1.0 mg/L (as evidenced by the current BPR performance), this process can also typically produce effluent TN concentrations less than 10 mg/L, depending on influent TN concentrations.

The conversion of the existing activated sludge system to the A^2O process includes the following elements:

a. Addition of two activated sludge trains adjacent to existing tanks, each with a volume of approximately 1.95 MGs to match existing trains.

b. Addition of new submersible anaerobic mixers in new trains and replacement of existing anaerobic mixers in existing trains.

c. Addition of new nitrate recycle pumps and piping in all activated sludge trains.

d. Addition of a concrete baffle wall in existing activated sludge trains to convert a portion of the existing aerated zone to an anoxic zone.

e. Addition of new fine bubble diffusers in all activated sludge trains. The condition of existing diffusers could be evaluated during design for the potential to maintain existing diffusers in some trains.

f. Replacement of two existing blowers with three high speed turbo blowers, each with a capacity of approximately 10,000 scfm. Maintain three existing blowers to serve as backup to new blowers and provide additional air during peak demands, if necessary. Final blower sizing to be determined during design.

g. Replacement of air distribution piping as necessary for installation of new blowers and construction of new activated sludge trains. For planning purposes it is assumed the existing aeration headers to each train remains and new distribution piping is limited to within the Blower Building, from the Blower Building to the activated sludge system, and along the new activated sludge trains.

h. Addition of a new blower control system, including new instrumentation and wiring.

i. Improvements of HVAC in the Blower Building.

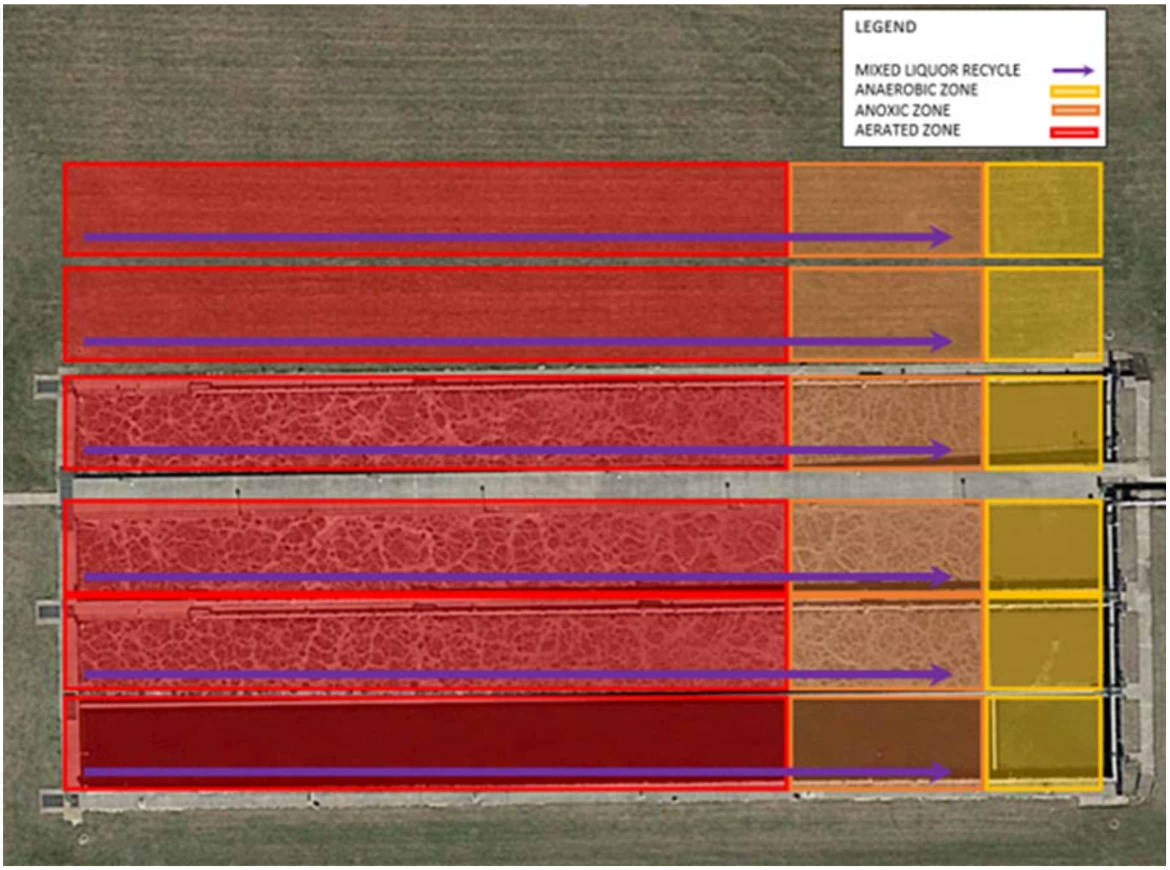


Figure 7.02-2 Alternative AS2

B. Monetary Comparison

Table 7.02-1 provides a summary of the opinion of present worth values for the alternatives. Overall, the present worth of the two alternatives are within 6 percent of each other, which at this level of planning is considered to be approximately equal. While Alternative AS2 is anticipated to have reduced aeration demand because of oxygen recovered during denitrification, these savings alone are less than the increased capital costs associated with the nitrate recycle pumps, mixers, and other additional work required to implement the A^2O process.

	Alternative AS1 *Expansion of Activated Sludge System with Current A/O Configuration*	Alternative AS2 *Expansion of Activated Sludge System with A^2O Configuration*
Capital Costs		
Equipment and Structure Subtotal	$6,270,000	$6,700,000
Mechanical	$1,260,000	$1,340,000
Electrical	$1,570,000	$1,680,000
HVAC	$440,000	$470,000
Sitework	$320,000	$340,000
Contractor's General Conditions	$990,000	$1,060,000
Contingencies, Legal, and Engineering	$4,430,000	$4,640,000
Total Opinion of Capital Cost	**$15,190,000**	**$16,230,000**
Annual Operation and Maintenance (O&M) Costs		
Relative Labor	$0	$0
Power	$381,500	$388,500
Maintenance and Supplies	$46,000	$54,000
Total	$427,500	$442,500
Present Worth of O&M	**$6,150,000**	**$6,360,000**
Summary of Present Worth Costs		
Capital Cost	$15,010,000	$16,020,000
Replacement	$530,000	$430,000
O&M	$6,150,000	$6,360,000
Salvage	($1,620,000)	($1,600,000)
Total Opinion of Present Worth	**$20,250,000**	**$21,420,000**

Notes: All costs in 2nd Quarter 2020 dollars.

Table 7.02-1 Activated Sludge Alternative Opinion of Present Worth Summary

C. Nonmonetary Considerations

Nonmonetary considerations for each alternative were evaluated and are summarized in Table 7.02-2.

Alternative	Benefits	Limitations
Alternative AS1 *Expansion of Activated Sludge System with Current A/O Configuration*	▪ WPCF staff is familiar with current system operation. ▪ BPR has been successful with current configuration. ▪ Can be converted to A^2O in the future if future TN removal is required.	▪ Does not provide TN removal or alkalinity recovery.
Alternative AS2 *Expansion of Activated Sludge System with A^2O Configuration*	▪ Provides TN removal and alkalinity recovery, setting the WPCF up for potential future TN limits. ▪ Reduced nitrate concentration in RAS can result in improved BPR performance.	▪ Slightly more complex operation than existing process with an internal ML recycle. ▪ Uncertainty regarding process performance compared to current configuration that has proven to provide successful BPR.

Table 7.02-2 Activated Sludge Alternative Nonmonetary Considerations

D. Recommended Treatment Alternative

Based on the preceding evaluation, Alternative AS1 is the recommended activated sludge treatment alternative. Implementation of this alternative provides the lowest capital and present worth cost, while allowing for relatively simple conversion to an A^2O configuration should total nitrogen removal be required in the future.

7.03 DISINFECTION ALTERNATIVES ANALYSIS

As described in Section 6, the existing sodium hypochlorite and sodium bisulfite disinfection system does not provide the require 30-minute contact time at the 2045 peak hourly flow condition. WPCF staff have also expressed interest in replacing the existing sodium hypochlorite disinfection system to eliminate the risks associated with handling these chemicals. In this section, two alternatives for the disinfection process are evaluated.

A. Description of Alternatives

1. Alternative D1–Sodium Hypochlorite Chlorination and Sodium Bisulfite Dechlorination.

In this alternative, the existing chlorine contact tank would be expanded to provide a 30-minute detention time at peak hourly flow. This addition would equate to adding approximately 94,000 gallons of volume. New sodium hypochlorite and sodium bisulfite feed pumps and storage tanks would be provided. A preliminary layout of this alternative is presented in Figure 7.03-1.

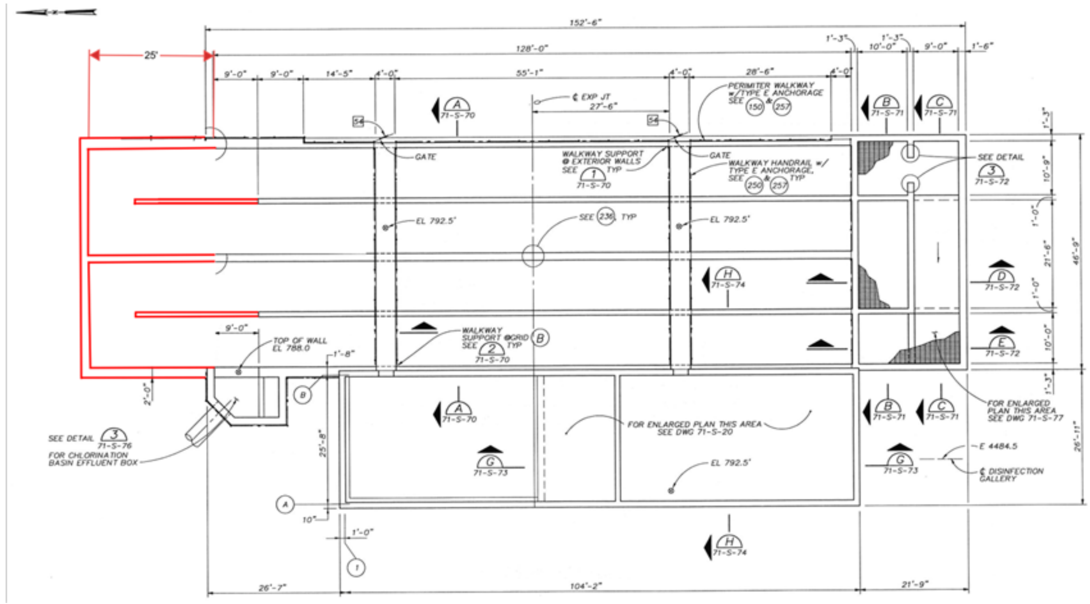


Figure 7.03-1 Chlorine Contact Tank Modifications Preliminary Layout

The following elements are included in this alternative:

a. Modification of chlorine contact tank to increase volume.

b. Replacement of stop logs and stop log frame.

c. Rehabilitation of chemical containment structure.

d. Replacement of sodium hypochlorite feed pumps and bulk storage tank.

e. Replacement of sodium bisulfite feed pumps and bulk storage tank.

2. Alternative D2–UV Disinfection

In this alternative, the chlorine contact tank would be modified to house a UV disinfection system with a peak hourly flow capacity. The UV disinfection system would consist of two channels. One channel would house inclined UV lamps at 45 degrees, the other channel would serve as a spare channel for future expansion. Lamp replacement can be performed while the system is in service by raising the banks out of the channel with the automatic lifting system. Depending on the manufacturer, the lifting system and cleaning system would be an electric or hydraulic system. Level control within the channels would be maintained by using a fixed weir system downstream of the channels. The existing electrical room would be modified to accommodate the new electrical equipment for the UV disinfection system. Remaining space in the disinfection building will be reserved for possible CPR equipment and chemical storage, potentially offsetting the need for construction of these facilities if ever needed in the future. A preliminary layout of this alternative is presented in Figure 7.03-2.

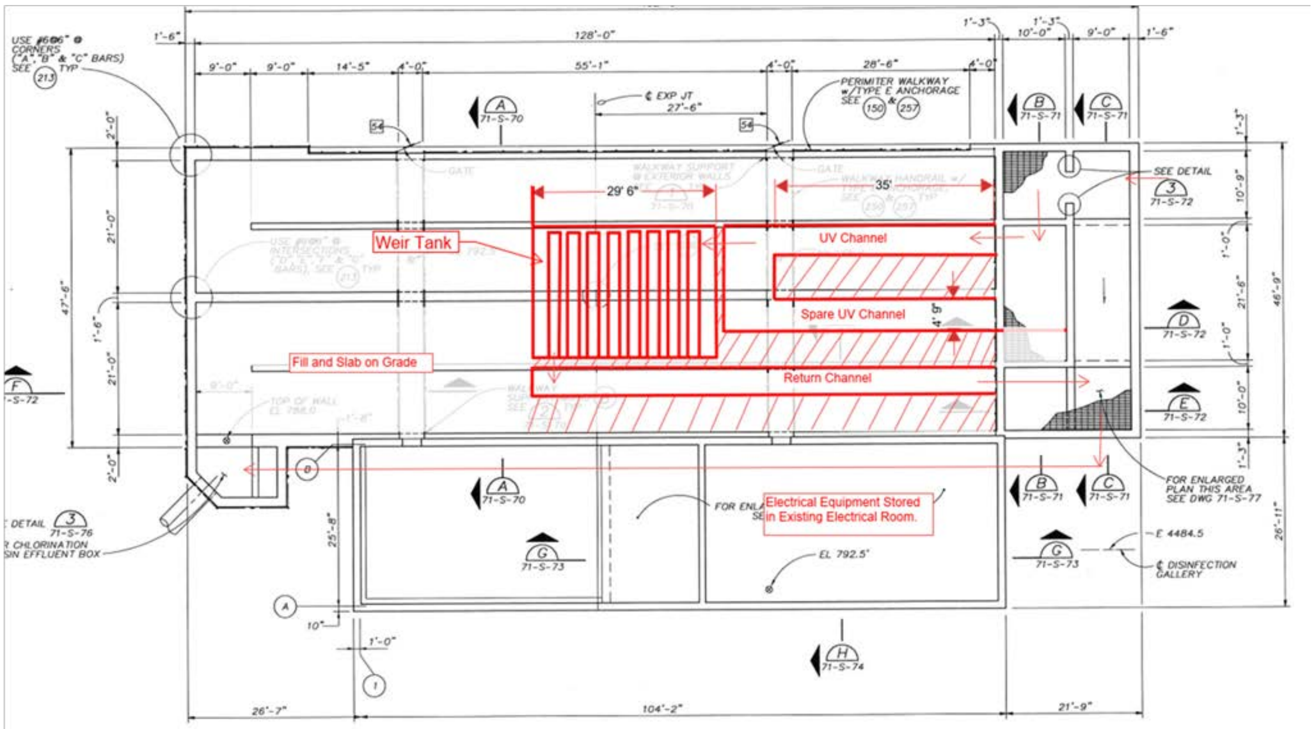


Figure 7.03-2 UV Disinfection Preliminary Layout

The following elements are included in this alternative:

a. Modification of channels and walls of the chlorine contact tank for the installation of a UV disinfection system and fixed weir tank. Provide channel covers to minimize the growth of algae.

b. Installation of fixed weir troughs for level control.

c. Installation of the UV disinfection system.

d. Installation of slide gates.

e. Replacement of grit pumps and associated piping.

f. Removal of existing chlorination equipment.

g. Installation of the metal roof over the UV disinfection system.

B. Monetary Comparison

Table 7.03-1 provides a summary of the opinion of present worth values for the alternatives. Alternative D1 has a lower total present worth than Alternative D2. Alternative D1 has significantly fewer capital costs but higher annual O&M costs with the continually addition of chemicals. The majority of the capital costs for Alternative D2 include chlorine contact tank modifications and UV equipment. Major O&M costs for Alternative D2 include the replacement of lamps, lamp sleeves, and ballasts, as well as increased power usage.

	Alternative D1 *Sodium Hypochlorite Chlorination/Sodium Bisulfite Dechlorination*	**Alternative D2** *UV Disinfection*
Capital Costs		
Equipment and Structure Subtotal	$544,000	$1,430,000
Mechanical	$120,000	$80,000
Electrical	$120,000	$360,000
HVAC	$50,000	$80,000
Sitework	$30,000	$80,000
Contractor's General Conditions	$90,000	$210,000
Contingencies, Legal, and Engineering	$390,000	$900,000
Total Opinion of Capital Cost	**$1,354,000**	**$3,140,000**
Annual O&M Costs		
Relative Labor	$0	$0
Power	$1,000	$5,000
Chemical	$36,000	$0
Maintenance and Supplies	$3,000	$7,000
Total	$40,000	$12,000
Present Worth of O&M	**$570,000**	**$170,000**
Summary of Present Worth Costs		
Capital Cost	$1,354,000	$3,140,000
Replacement	$0	$0
O&M	$570,000	$170,000
Salvage	($80,000)	($190,000)
Total Opinion of Present Worth	**$1,844,000**	**$3,120,000**

Notes: All costs in 2nd Quarter 2020 dollars.

Table 7.03-1 Disinfection Alternative Opinion of Present Worth Summary

C. Nonmonetary Considerations

Nonmonetary considerations for each alternative were evaluated and are summarized in Table 7.03-2.

Alternative	Benefits	Limitations
Alternative D1 *Sodium Hypochlorite Chlorination and Sodium Bisulfite Dechlorination*	▪ Reuses existing tanks that have adequate remaining service life for the planning period. ▪ WPCF staff is familiar with current system operation.	▪ Requires chemicals to be used and stored on-site. ▪ Chemical pumping adds complexity.
Alternative D2 *UV Disinfection*	▪ Reuses existing chlorine contact tank and electrical room. ▪ Additional space for UV expansion. ▪ Use existing disinfection facilities for future phosphorus removal and avoid constructing new facilities.	▪ None identified.

Table 7.03-2 Disinfection Alternative Nonmonetary Considerations

D. Recommended Treatment Alternative

Based on the preceding evaluations, Strand recommends Alternative D2, UV Disinfection, as the preferred disinfection alternative. Although Alternative D2 has higher initial capital costs than Alternative D1, implementation of Alternative D2 has the potential to save significantly more money in the future if CPR is required, as the existing chemical containment area of the Disinfection Building could be re-purposed for phosphorus removal chemical storage. This would prevent the need to construct these facilities new in the future. In addition, there are significant nonmonetary benefits associated with Alternative D2, including elimination of chemical handling for disinfection purposes.

7.04 ODOR CONTROL ALTERNATIVES

In this section, two alternatives for odor control are evaluated. Both odor control systems are preliminarily sized for 7,000 scfm and an inlet hydrogen sulfide (H_2S) concentration of 25 ppm to match the design criteria of the existing system, as presented in the WPCF O&M Manual. Additional odorous air sampling is recommended during preliminary design to confirm system sizing and configuration. The selected biosolids alternative may also impact odor control system sizing and configuration.

A. Description of Alternatives

1. Alternative OC1–Chemical Scrubber

In this alternative, the existing chemical scrubber tank and associated fans, feed piping, and chemical feed systems would be replaced with a new chemical odor control system. The new chemical scrubber consists of a two-stage system with a hydrogen sulfide pretreatment stage using sodium hydroxide followed by an oxidation stage using sodium hypochlorite within a fiberglass reinforced plastic (FRP) tower. Winterization is provided by heaters, insulation, and heat tracing. A new chemical scrubber would fit in the footprint of the existing chemical scrubber between the two primary clarifiers.

The following elements are included in this alternative:

a. Replacement of existing chemical scrubber with new chemical scrubber, including new fans and controls.

b. Modification of odorous air ducts to connect to the new scrubber.

c. Replacement of existing chemical storage tanks and chemical feed systems.

2. Alternative OC2–Biofilter

In this alternative, the existing chemical scrubber tank and associated fans, feed piping, and chemical feed systems would be replaced with a new biological odor control system. The biological odor control system consists of a stainless steel vessel that houses a humidification chamber and a biofilter chamber with a permanent biofilter media. A 15-hp fan is used to convey odorous air through the vessel. A winterization system is included, consisting of heaters for the water recirculation system and a space heater for the control panel. A biofilter sized for 7,000 scfm and 25 ppm inlet H_2S is larger than the existing chemical scrubber and would not fit in the existing scrubber location. Figure 7.04-1 presents a potential biofilter location adjacent to the existing scrubber.

Figure 7.04-1 Potential Odor Control Biofilter Location

The following elements are included in this alternative:

a. Replacement of existing chemical scrubber with biofilter, including new fans and controls.

b. Modification of odorous air ducts to connect to the new biofilter.

c. Addition of concrete pavement at the location of the new biofilter.

d. Modification of water piping to connect to the new biofilter.

B. Monetary Comparison

Table 7.04-1 provides a summary of the opinion of present worth values for the alternatives.

	Alternative OC1 *Chemical Scrubber*	Alternative OC2 *Biofilter*
		Capital Costs
Equipment and Structure Subtotal	$500,000	$690,000
Mechanical	$130,000	$110,000
Electrical	$100,000	$110,000
HVAC	$0	$0
Sitework	$30,000	$40,000
Contractor's General Conditions	$80,000	$100,000
Contingencies, Legal, and Engineering	$340,000	$420,000
Total Opinion of Capital Cost	**$1,180,000**	**$1,470,000**
Annual O&M Costs		
Relative Labor	$0	$0
Power	$11,000	$11,000
Chemical	$20,000	$0
Maintenance and Supplies	$10,000	$10,000
Total	$41,000	$21,000
Present Worth of O&M	**$590,000**	**$300,000**
Summary of Present Worth Costs		
Capital Cost	$1,180,000	$1,470,000
Replacement	$10,000	$-
O&M	$590,000	$300,000
Salvage	($40,000)	($10,000)
Total Opinion of Present Worth	**$1,740,000**	**$1,760,000**

Notes: All costs in 2nd Quarter 2020 dollars.

Table 7.04-1 Odor Control Alternative Opinion of Present Worth Summary

C. Nonmonetary Considerations

Nonmonetary considerations for each alternative were evaluated and are summarized in Table 7.03-2.

Alternative	Benefits	Limitations
Alternative OC1 *Chemical Scrubbing*	▪ Existing operation; WPCF staff is familiar with process and equipment. ▪ Existing process seems to perform well when operating. ▪ Small footprint.	▪ Continued use of chemicals and safety concerns related to chemical handling and storage.
Alternative OC2 *Biofilter*	▪ Elimination of hazardous chemicals for odor control.	▪ New process and uncertainty regarding performance compared to existing system. ▪ Larger footprint than chemical scrubber.

Table 7.04-2 Odor Control Alternative Nonmonetary Considerations

D. Recommended Treatment Alternative

Alternative OC2 is the recommended odor control treatment alternative.

7.05 BIOSOLIDS MANAGEMENT ALTERNATIVES

As presented in Sections 3 and 6, the City currently land applies the majority of its biosolids as a liquid, using City staff, tanker trucks, and land application equipment. However, weather patterns and changes in farming practices in recent years have prevented the City from land applying all its biosolids generated in the time available using its current equipment. When this occurs, biosolids are dewatered with a BFP and landfilled at a significantly higher cost to the City. The City has indicated that local landfills have limited the amount of biosolids that they are willing to accept. Based on challenges that the City faces with its current biosolids management program, three biosolids management alternatives are evaluated in this section. While contracting its land application program could be considered, it is anticipated that the unit cost for contract operation would be higher than the City's current unit cost to land apply as a liquid (approximately $0.03 to $0.05 per gallon). For this analysis, it is assumed the City continues to use its own staff and equipment for the biosolids management program.

A. Description of Alternatives

1. Alternative B1–Liquid Biosolids Storage with Additional Land Application Equipment

In this alternative, the existing liquid biosolids storage operation would remain, with an increased land application equipment capacity to allow more biosolids to be removed from the existing tanks during the time periods that are available for spreading. An additional liquid storage tank is also included as a future capital improvement to provide approximately 365 days of storage at the projected 2045 condition. The proposed location of this future tank is shown in Figure 7.05-1. The BFP would remain as a backup should the liquid storage tanks become full and a new truck loadout area is provided to allow higher dewatered cake solids to be transported to the landfill, if necessary. The proposed location of the new truck loadout bay is shown in Figure 7.05-2

For this analysis, a high-level evaluation of labor and O&M expenses for the City's existing biosolids management program was conducted. Based on this evaluation, a labor cost of approximately $0.013 per gallon and land application equipment O&M cost of $0.020 per gallon were used as the baseline unit costs for biosolids disposal. For future conditions, these unit costs were escalated by 25 percent to account for increased unit costs associated with greater travel distances to the additional land application sites, as necessary to accommodate additional biosolids production. While a truck loadout area is included in this alternative to reduce tipping fees should landfilling of biosolids ever be necessary, the O&M costs assume that all biosolids are land-applied as a liquid. An average of the current and 2045 projected annual O&M costs was used in the determination of the present worth cost for this alternative.

The following elements are included in this alternative:

a. New 4.8-MG liquid biosolids storage tank on WPCF to provide 365 days of storage at projected 2045 loadings. It is assumed that this storage tank would be of similar construction to the existing Biosolids Storage Tank No. 2 and would be constructed in approximately 10 years.

b. Replacement of Biosolids Storage Tank No. 1 mixing system and loadout pump.

c. Replacement of one existing GBT and associated thickened sludge pump. Refurbishment of existing GBT can also be considered during design.

d. Construction of a new truck loadout area east of the existing thickening and dewatering room, including new biosolids conveyors from existing BFP to truck loadout area.

e. Additional two tanker trucks and one additional liquid biosolids spreader to increase land application capacity.

f. Replacement of three existing tanker trucks and liquid biosolids spreader in approximately 10 years.

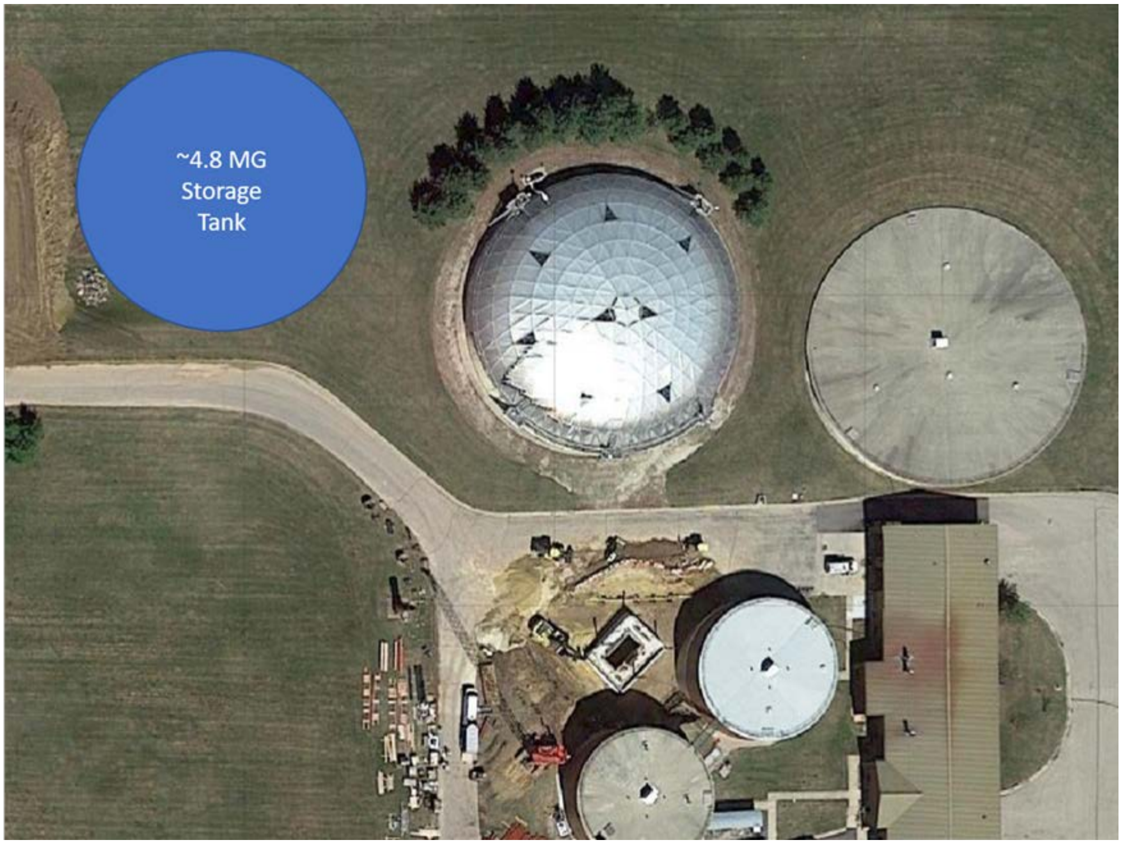


Figure 7.05-1 Future Biosolids Storage Tank Proposed Location

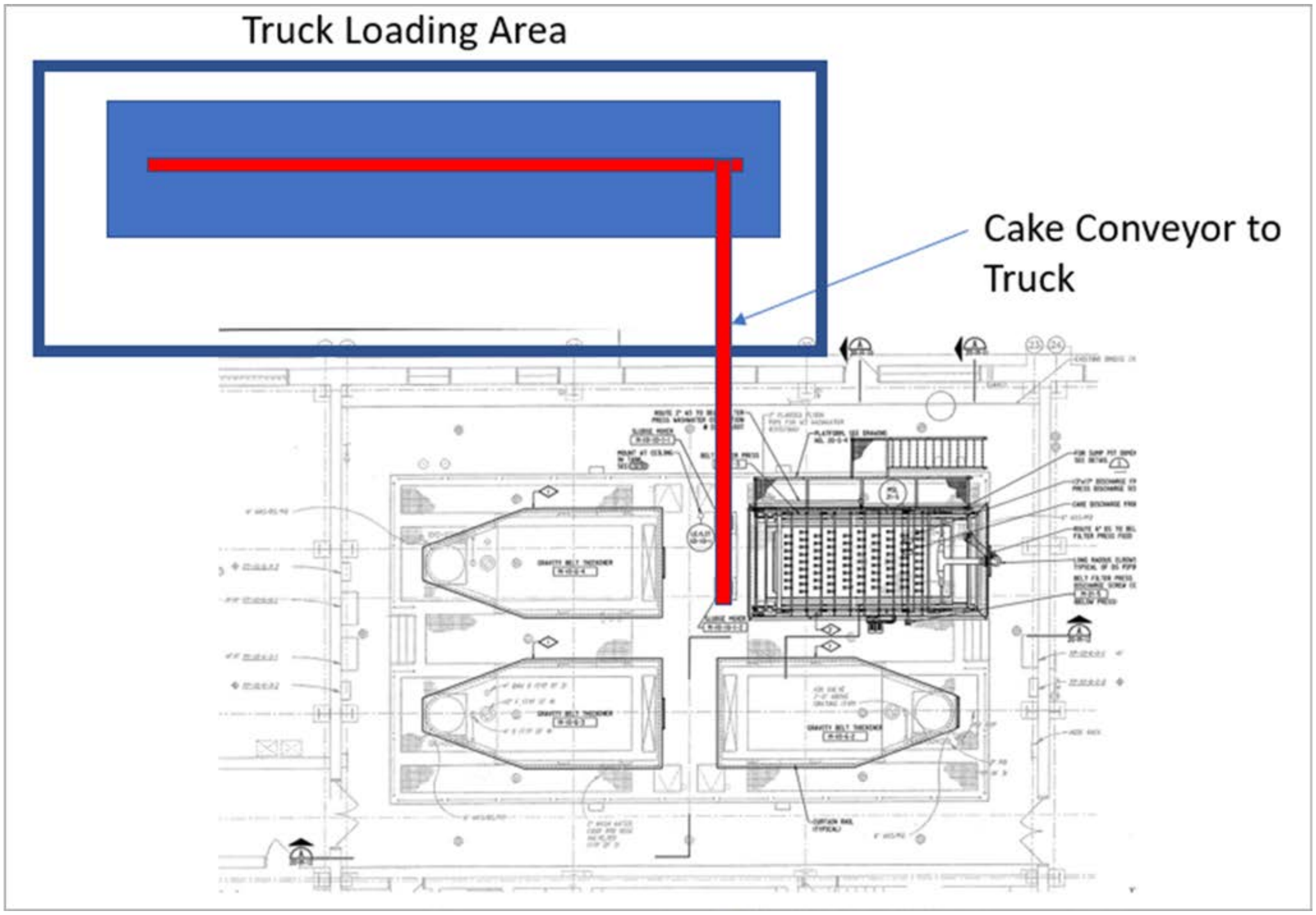


Figure 7.05-2 Truck Loading Area Schematic

2. Alternative B2–Dewatering and Off-Site Storage

In this alternative, biosolids management would shift to dewatering of all biosolids and the existing liquid storage tanks would no longer be used. The existing GBT used for thickening of digested sludge would be replaced with a dewatering centrifuge and the existing BFP would remain as a backup. A new truck loadout area would be provided to allow the generation of a higher solids content cake, reducing hauling costs. The proposed location of the centrifuge and loadout bay is shown in Figure 7.05-3. Because of odor concerns associated with on-site storage of biosolids, it is assumed that an off-site storage facility would be constructed in a more remote area on land acquired by the City specifically for that purpose. Dewatered biosolids would be transported to the off-site facility and stored until fields are available for land-application. Because land application of dewatered cake would likely require the material to be incorporated into the soil, two new tractors and chisel plows are included in this alternative as well as new trucks to transport the dewatered material to the off-site facility.

Similar to Alternative B1, the existing biosolids management costs were used as the basis for the projected O&M costs for Alternative B2. While dewatering of biosolids on-site significantly reduces the biosolids volume, the dewatered cake is transported twice in this alternative: once to the off-site storage facility and again to the field for land application. Furthermore, while it is anticipated that the dewatered cake may be able to be spread faster than liquid biosolids are injected, it would require additional staff to incorporate the cake into the soil following spreading. Therefore, it is assumed the labor costs for this alternative are approximately equal to the liquid biosolids alternative and the trucking O&M costs are approximately one-half of the liquid biosolids alternative (to account for reduced volume, double handling, and additional land application equipment maintenance). As with Alternative B1, this alternative assumes that all of the biosolids are land applied (no landfill tipping fees) and an average of the current and 2045 projected annual O&M costs was used in the determination of the present worth cost.

The following elements are included in this alternative:

a. Replacement of GBT with a dewatering centrifuge with capacity of approximately 3,600 pounds per hour (lbs/hour).

b. Addition of new centrifuge feed pumps to replace existing GBT feed pump.

c. Construction of a new truck loadout area east of the existing thickening and dewatering room, including new biosolids conveyors from the centrifuge and BFP to truck loadout area.

d. Acquisition of approximately 20 acres of land for construction of off-site dewatered biosolids storage facility

e. Construction of biosolids storage facility, with an overall footprint of approximately 85,000 square feet (sf).It is assumed that the facility is constructed in two phases to provide approximately 365 days of storage under current and projected 2045 loadings.

f. Site development for off-site storage facility, including site security, electric, and drainage.

g. A new truck and dump trailer to transport biosolids to the off-site facility, a skid steer to handle biosolids at the off-site facility, two truck-mounted biosolids cake spreaders, and two tractors with chisel plows to incorporate the dewatered cake after spreading.

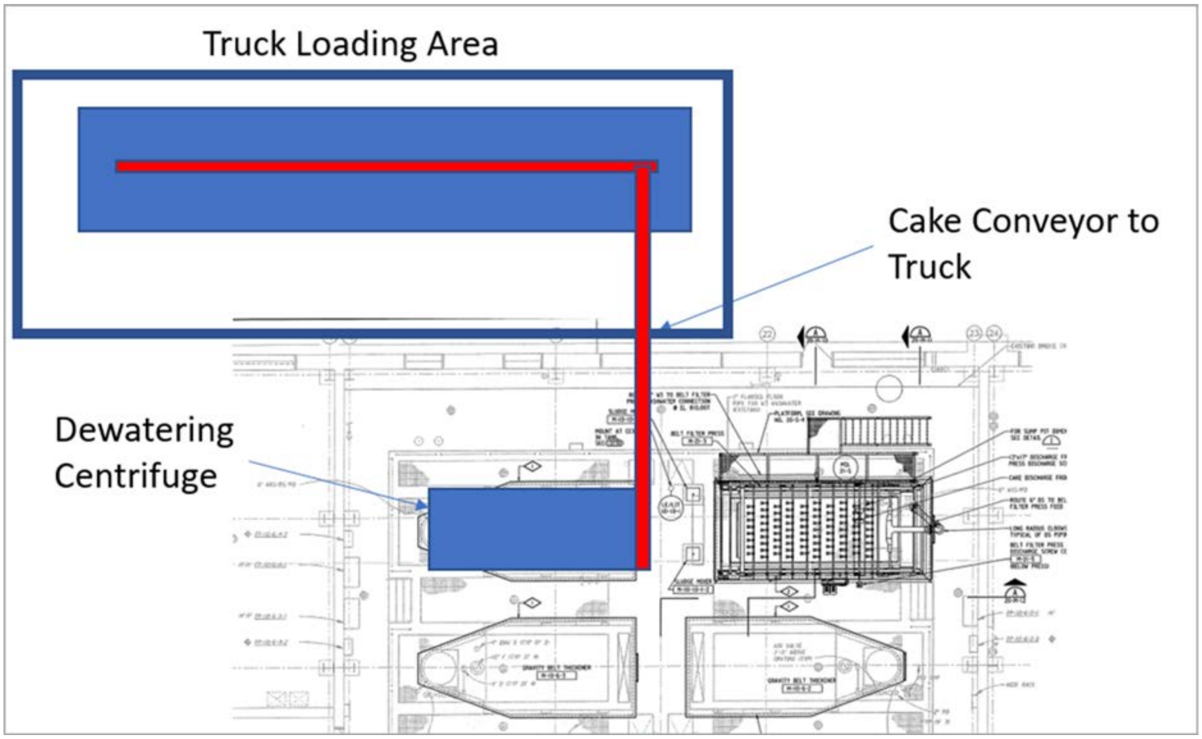


Figure 7.05-3 Proposed Centrifuge and Truck Loading Bay

3. Alternative B3–Drying

Alternative B3 represents a major shift in biosolids management at the WPCF to on-site dewatering and drying of all biosolids. In this alternative, a new dewatering centrifuge would be installed in place of the existing digested sludge thickening GBT and new drying equipment would be installed in an adjacent addition to the Process Building. Digested sludge would be stored in the existing Biosolids Storage Tank No. 2 for a short period until enough biosolids are available for a several-day period of continuous operation of the drying equipment. Based on preliminary dryer sizing, it is anticipated the dryer would operate 24 hours per day, three days per week under current loading conditions and five or six days per week under projected year 2045 loading conditions. While dryers could be sized to operate every day for shorter periods, O&M costs are higher under this mode of operation. Liquid biosolids would first be pumped to a dewatering centrifuge, which is anticipated to produce a biosolids cake of approximately 25 percent solids. This cake would be conveyed to a hopper on a new screw conveyor. From the hopper the biosolids would be conveyed directly to the dryer. Dried biosolids (over 90 percent solids) would then be conveyed from the dryer to a truck loadout area where it would be deposited in a truck or roll-off dumpster. Alternatively, a silo could be used for storage of dried biosolids before discharging into a truck. A preliminary conceptual layout of the process building addition that would house the drying equipment and loadout area are shown in Figure 7.05-4. A preliminary equipment layout within the process building addition is shown in Figure 7.05-5.

Figure 7.05-4 Process Building Addition Preliminary Layout

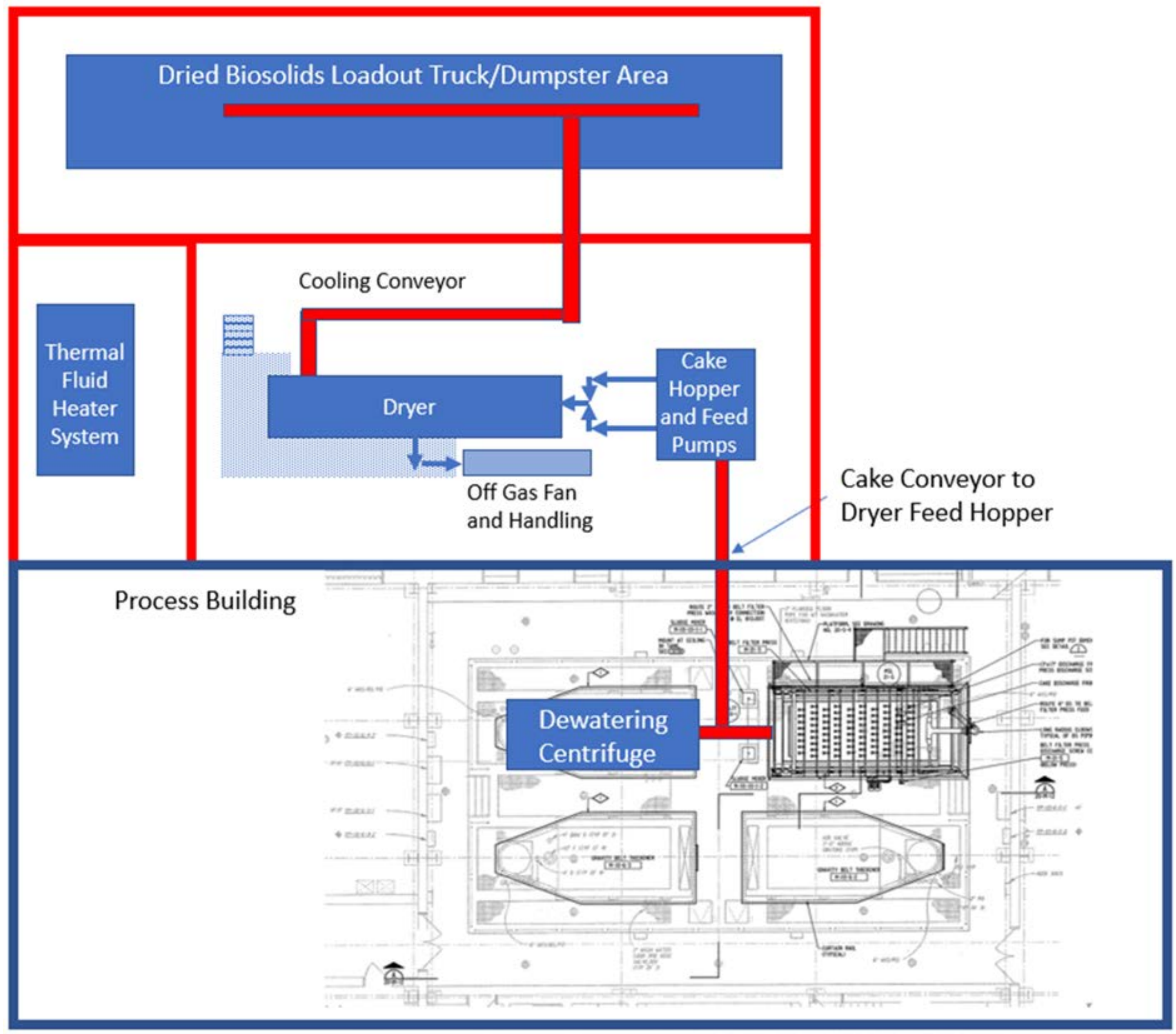


Figure 7.05-5 Process Building Preliminary Equipment Layout

The two main dryer technologies that have been used for drying of municipal biosolids are belt dryers and paddle dryers. Belt dryers, such as those manufactured by Huber Technology, use a direct drying process by which biosolids are conveyed along a belt and hot air is applied directly to the biosolids. In paddle dryers, such as those manufactured by BCR Solids Solutions and Komline-Sanderson, the biosolids pass through an enclosed system through which hot fluid is circulated, increasing the temperature and drying the biosolids. In general, belt dryers are larger than the paddle dryers and would require a larger addition to the Process Building to house. Therefore, this evaluation is based on the installation of a paddle dryer. A more detailed evaluation of dryer types could be conducted during preliminary design should the City proceed with the alternative.

As discussed in Section 3, the WPCF currently uses the biogas generated in the anaerobic digestion process for digester heating. While the WPCF produces excess biogas that is flared in the summer, it does not produce enough to maintain the desired digester temperatures in the winter and must supplement biogas with natural gas in its boilers. Because the gas flow to the flare is not metered, an estimate of excess biogas in the summer months was made using data provided by the City on biogas flowrates to the boilers. When comparing the maximum biogas flow in the winter (when natural gas is used to supplement biogas for digester heating) to the flow in the summer (when excess biogas is flared), it appears that there is approximately 40,000 to 60,000 cfd of excess biogas in the summer months. While the paddle dryers used in this evaluation can run on biogas, the lack of biogas storage at the WPCF and the desired dryer operation (continuous operation for an extended period after bringing the dryer up to temperature) may limit to amount of excess biogas that can be used by the dryer. For purposes of this study, it is assumed that an average of approximately 30,000 cfd of excess biogas would be available during the days that the dryer is in operation and the excess biogas generated when the dryer is not in operation would be flared. This results in an overall offset of approximately 8 percent of the natural gas demand for dryer operation. A more extensive evaluation of dryer runtimes and biogas usage options could be considered during preliminary design should the City proceed with this alternative.

The drying process results in a Class A biosolid, opening additional avenues for disposal. While these avenues include the potential for revenue generation from the dried product, for the purposes of this study it is assumed that the City can give away the dried product at no cost. Based on experiences of other drying facilities in the state, this appears to be a reasonable and conservative assumption.

The following elements are included in this alternative:

a. Replacement of GBT with a dewatering centrifuge with capacity of approximately 1,200 lbs/hour.

b. Addition of new centrifuge feed pumps to replace the existing GBT feed pump.

c. Addition of new drying equipment, including cake feed hopper, conveyors, heat exchanges, thermal fluid heater system, dryer, and off-gas handling equipment.

d. Addition to the Process Building to house drying equipment and a new truck loadout area east of the existing thickening and dewatering room, including new biosolids conveyors from the centrifuge and BFP to dryer.

B. Monetary Comparison

Table 7.05-1 provides a summary of the opinion of present worth values for the alternatives.

	Alternative B1 Liquid Biosolids Storage, Additional Land Application Equipment	Alternative B2 Dewatering and Off-Site Storage	Alternative B3 Drying
Capital Costs			
Equipment and Structure Subtotal	$2,020,000	$5,230,000	$6,370,000
Mechanical	$310,000	$270,000	$640,000
Electrical	$310,000	$1,050,000	$1,280,000
HVAC	$150,000	$160,000	$320,000
Sitework	$210,000	$1,050,000	$320,000
Contractor's General Conditions	$300,000	$780,000	$900,000
Land Acquisition	$0	$500,000	$0
Land Application Equipment	$600,000	$1,000,000	$0
Contingencies, Legal, and Engineering	$1,320,000	$3,420,000	$3,940,000
Total Opinion of Capital Cost	**$5,220,000**	**$13,460,000**	**$13,770,000**
Annual O&M Costs			
Relative Labor	$230,000	$230,000	$100,000
Power	$10,000	$15,000	$75,000
Chemical	$50,000	$115,000	$115,000
Gas	$0	$0	$85,000
Biosolids Disposal	$260,000	$130,000	$0
Maintenance and Supplies	$25,000	$20,000	$90,000
Total	$575,000	$510,000	$465,000
Present Worth of O&M	**$8,270,000**	**$7,330,000**	**$6,680,000**
		Summary of Present Worth Costs	
Capital Cost	$5,220,000	$13,460,000	$13,770,000
Future Capital Costs/Replacement	$6,970,000	$2,790,000	$0
O&M	$8,270,000	$7,330,000	$6,680,000
Salvage	($2,401,000)	($1,848,000)	($650,000)
Total Opinion of Present Worth	**$18,059,000**	**$21,732,000**	**$19,800,000**

Notes: All costs in 2nd Quarter 2020 dollars.

Table 7.05-1 Biosolids Management Alternative Opinion of Present Worth Summary

C. Nonmonetary Considerations

Nonmonetary considerations for each alternative were evaluated and are summarized in Table 7.05-2.

Alternative	Benefits	Limitations
Alternative B1 *Liquid Storage*	▪ Existing operation; City staff is familiar with processes and equipment. ▪ Expansion of biosolids storage provides more flexibility for timing of land application. ▪ Improved biosolids conveying and loadout reduces nuisance maintenance issues with sludge piping.	▪ Uncertainty regarding the ability to find adequate land application sites as biosolids production increases. ▪ Concerns with future phosphorus limitations on land application program. ▪ Potential for future limitations on land application based on PFAS or other predicted environmental concentrations (PECs).
Alternative B2 *Off-site dewatered cake storage*	▪ Provides more storage than existing facilities for flexibility of land application timing. ▪ Improved biosolids conveying and loadout reduces nuisance maintenance issues with sludge piping	▪ Uncertainty regarding the ability to find adequate land application sites as biosolids production increases. ▪ Concerns with future phosphorus limitations on land application program. ▪ Cake spreading may limit available application sites. ▪ May be challenging to site a biosolids storage facility, particularly outside of City limits. ▪ Regular transport of dewatered cake can be source of odors.
Alternative B3 *Drying*	▪ Produces Class A product. ▪ Free fertilizer provides opportunities for positive public relations. ▪ Biosolids disposal no longer tied to weather patterns and farm operations. ▪ Avoid concerns regarding future limitations on land application based on phosphorus loadings. ▪ Odor potential expected to be lower than other alternatives. ▪ As a preceding step to incineration, drying sets the WPCF up for a process to address PFAS or other PEC in biosolids, should they become regulated in the future.	▪ Major shift in operations results in learning curve for new processes and equipment.

Table 7.05-2 Biosolids Management Alternative Nonmonetary Considerations

D. Recommended Treatment Alternative

Based on the preceding evaluation, Strand recommends Alternative B3, Drying, as the preferred biosolids treatment alternative. Total present worth costs for Alternative B3 are within 10 percent of the lowest cost alternative (Alternative B1), yet Alternative B3 offers significant nonmonetary benefits as compared Alternative B1. Implementation of Alternative B1 significantly reduces the risk associated with short land application windows and future regulatory requirements.

7.06 OTHER RECOMMENDED PLAN ELEMENTS

Other recommended improvements were identified in Section 6, along with recommended implementation timeframes for each. These recommended improvements were based on several criteria, including equipment age and maintenance issues, process reliability issues, and operational flexibility. The timing of each project is also considered, and grouped into 0- to 5-year project, 6- to 10-year projects, and 11- to 15-year projects. The opinions of probable cost for each of these improvements are presented in Tables 7.06-1 through 7.06-3.

Item	Opinion of Capital Cost
Replace grit collector equipment.	$345,000
Replace grit classifiers.	$441,000
Rehabilitate Primary Clarifier No. 1.	Included in current budget
Repairs the primary clarifier splitter box and replace gates.	$509,000
Replace scum concentrator.	$523,000
Repair concrete in aeration distribution box.	$486,000
Repair or rehabilitate final clarifier equipment.	Included in current budget
Install launder covers on final clarifiers.	$847,000
Repair grout on primary and final clarifiers.	$215,000
Replace digester spiral heat exchangers.	$301,000
Replace davit cranes at Biosolids Storage Tank No. 2.	$ 35,000
Replace two GBTs used to thicken WAS.	$1,386,000
Replace polymer system equipment.	$983,000
Replace waste gas burner.	$591,000
Replace plant air system compressors and dryers.	$821,000
Replace plant drain system pumps.	$181,000
Replace automatic transfer switches.	$303,000
Improve the Administration Building HVAC.	$811,000
Improve the Gas Compressor Room and Control Room National Fire Protection Association (NFPA) 820	$108,000
Total	**$8,886,000**

Notes: All costs in 2nd Quarter 2020 dollars.

Table 7.06-1 Recommended Common Improvements–0 to 5 Years

Item	Opinion of Capital Cost
Replace influent fine screens.	$1,399,000
Replace grit slurry pumps.	$181,000
Replace concentrated scum tank and concentrated scum pump.	$311,000
Replace two primary digester boilers.	$838,000
Replace digester recirculation pumps.	$150,000
Replace Biosolids Storage Tank No. 2 mixers.	$425,000
Replace Biosolids Storage Tank No. 2 loadout pump.	$ 68,000
Construct biofilter at biosolids storage tanks.	$579,000
Replace W3 system pumps.	$359,000
Replace medium voltage service entrance switchgear.	$607,000
Replace medium voltage disconnect switches and dry type transformers.	$1,078,000
Replace low voltage switchboards.	$1,232,000
Total	**$7,227,000**

Notes: All costs in 2nd Quarter 2020 dollars.

Table 7.06-2 Recommended Common Improvements–6 to 10 Years

Item	Opinion of Capital Cost
Replace diaphragm primary sludge pumps.	$182,000
Replace primary scum pumps.	$93,000
Replace RAS pumps.	$1,395,000
Replace WAS pumps.	$181,000
Rehabilitate digester covers.	$863,000
Total	**$2,714,000**

Notes: All costs in 2nd Quarter 2020 dollars.

Table 7.06-3 Recommended Common Improvements–11 to 15 Years

SECTION 8–SELECTION OF RECOMMENDED ALTERNATIVES AND FISCAL IMPACT SUMMARY

Previous sections of this report presented background information, described and evaluated the City's WPCF, projected flows and loadings, and reviewed alternatives necessary to meet the projected 10- and 25-year needs at the WPCF. This section presents a summary of the proposed modifications to the City's WPCF, an overall cost summary, preliminary financing plan for the proposed improvements, and the fiscal impact of the recommended plan on the City's wastewater-related user rates.

8.01 RECOMMENDED PLAN SUMMARY

The recommended plan includes modifications to many treatment processes at the WPCF. Figure 8.01-1 presents a preliminary site plan for the recommended improvements affecting the site, and Table 8.01-1 presents a summary of preliminary design criteria for the recommended plan. Criteria for processes or equipment are not listed in Table 8.01-1 when criteria for that particular equipment will be further refined during design. A brief summary of the recommended improvements follows. Projects recommended for implementation in the 6- to 10-year and 11- to 15-year timeframes are shown in *italics.*

A. Wastewater Screening and Scum Concentration

1. Replace the scum concentrator.
2. *Replace the concentrated scum tank and concentrated scum pump.*
3. *Replace influent fine screens.*

B. Grit Removal

1. Replace the grit collector equipment.
2. Replace the grit classifiers.
3. *Replace the grit slurry pumps.*

C. Primary Clarification

1. Complete rehabilitation of Primary Clarifier No. 1 equipment (note, costs for this project are included in the current budget and are not included in this plan).
2. Repair the corroded concrete on the primary clarifier splitter box and replace the flow control gates.
3. Repair the grout on the primary clarifiers.
4. *Replace the diaphragm primary sludge pumps*
5. *Replace the primary scum pumps*

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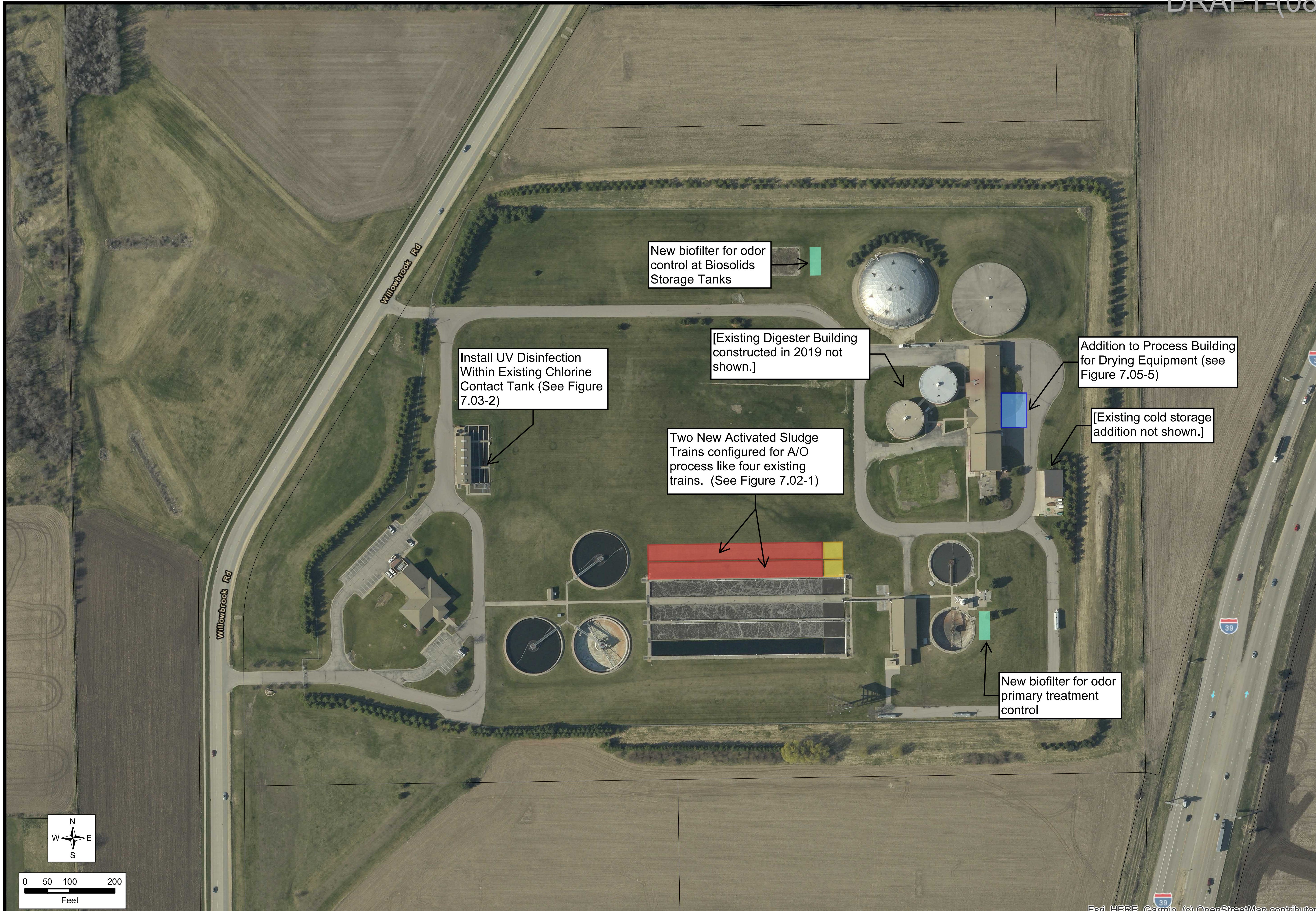


RECOMMENDED PLAN PRELIMINARY SITE LAYOUT

WPCF FACILITIES PLANNING
CITY OF BELOIT
ROCK COUNTY, WISCONSIN

STRAND ASSOCIATES®

FIGURE 8.01-1
1743.016

D. Activated Sludge Basins and Aeration Facilities

1. Repair the corroded concrete in the aeration distribution box.

2. Construct two additional activated sludge trains adjacent to the existing tanks.

3. Install new anaerobic zone mixers in the new trains and replace the existing anaerobic zone mixers in the existing trains.

4. Install new fine bubble diffusers in the new and existing activated sludge trains.

5. Replace two of the existing blowers with two new high-speed turbo blowers.

6. Add a third high-speed turbo blower when the two additional activated sludge trains are constructed.

7. Replace the air distribution piping within the Blower Building. Install new air distribution piping for the two new activated sludge trains.

8. Install a new blower control system, including new instrumentation and wiring.

E. Final Clarification

1. Rehabilitate the final clarifier equipment (note, costs for this project are included in the current budget and are not included in this plan).

2. Install launder covers on final clarifiers.

3. Repair the grout on final clarifiers.

4. Replace RAS pumps.

5. Replace WAS pumps.

F. Disinfection

Construct a new ultraviolet (UV) disinfection system and ancillary components within the existing chlorine contact tank and disinfection building. Provide channel covers to minimize growth of algae.

G. Biosolids Thickening, Stabilization, and Drying

1. Replace the GBT with a dewatering centrifuge.

2. Install new centrifuge feed pumps to replace the existing GBT feed pumps.

3. Construct an addition to the Process Building to house drying equipment and a new truck loadout area east of the existing thickening and dewatering room.

4. Install new drying equipment including cake feed hopper, conveyors, heat exchangers, thermal fluid heater system (depending on final dryer type selected), dryer, and off-gas handling equipment.

5. Replace two primary digester boilers.

6. Replace the digester recirculation pumps.

7. Replace the digester spiral heat exchangers.

8. Replace the davit cranes at Biosolids Storage Tank No. 2.

9. Replace the Biosolids Storage Tank No. 2 mixers.

10. Replace the Biosolids Storage Tank No. 2 loadout pump.

11. Construct the odor control biofilter at biosolids storage tanks.

12. Replace two GBTs used to thicken WAS.

13. Replace the polymer system equipment.

14. Rehabilitate the digester covers.

H. Miscellaneous Improvements

1. Replace the existing chemical odor scrubber with a new biofilter for odor control.

2. Replace waste gas burner.

3. Replace the plant air system compressors and dryers.

4. Replace the plant drain system pumps.

5. Replace the W3 system pumps.

6. Replace the automatic transfer switches.

7. Replace the medium-voltage service entrance switchgear.

8. Replace the medium-voltage disconnect switches and dry type transformers.

9. Replace the low-voltage switchboards.

10. Complete improvements to the Administration Building HVAC system.

11. Complete improvements to the Gas Compressor Room and Control Room to bring into compliance with National Fire Protection Association (NFPA) 820.

8.02 OPINION OF CAPITAL COSTS AND PROJECT FINANCING

It is anticipated that the recommended improvements will be completed in three phases (0 to 5 years, 6 to 10 years, and 11 to 15 years). The opinion of capital costs for the recommended improvements associated with each phase are shown in Table 8.02-1 (second quarter 2020 costs basis). The detailed breakdown of these costs is presented in Section 7.

Table 8.02-1 Summary of Recommended Improvement Costs

	Item	Opinion of Capital Cost[1]		
		0 to 5 Years	**6 to 10 Years**	**11 to 15 Years**
Selected Alternatives	Install two high speed turbo blowers, replace existing diffusers (Alternative AS1).	$3,650,000		
	Construct two additional activated sludge trains, install a third high-speed turbo blower (Alternative AS1).[2]	$11,540,000		
	Construct the UV disinfection (Alternative D2).	$3,140,000		
	Construct the biosolids drying process (Alternative B3).	$13,770,000		
	Install a biofilter for primary treatment odor control (Alternative OC2).	$1,470,000		
Common Improvements	Replace the grit collector equipment.	$345,000		
	Replace the grit classifiers.	$441,000		
	Rehabilitate Primary Clarifier No. 1.	Included in current budget		
	Repair the primary clarifier splitter box and replace gates.	$509,000		
	Replace the scum concentrator.	$523,000		
	Repair the concrete in the aeration distribution box.	$486,000		
	Repair or replace the final clarifier equipment	Included in current budget		
	Install launder covers on the final clarifiers.	$847,000		
	Repair the grout on the primary and final clarifiers.	$215,000		
	Replace the digester spiral heat exchangers.	$301,000		
	Replace the davit cranes at Biosolids Storage Tank No. 2.	$35,000		
	Replace two GBTs used to thicken WAS.	$1,386,000		
	Replace the polymer system equipment.	$983,000		
	Replace the waste gas burner.	$591,000		
	Replace the plant air system compressors and dryers.	$821,000		
	Replace the plant drain system pumps.	$181,000		
	Replace the automatic transfer switches.	$303,000		
	Improve the Administration Building HVAC.	$811,000		
	Improve the gas compressor room and control room in accordance with NFPA 820.	$108,000		
	Replace the influent fine screens.		$1,399,000	
	Replace the grit slurry pumps.		$181,000	
	Replace the concentrated scum tank and concentrated scum pump.		$311,000	
	Replace two primary digester boilers.		$838,000	
	Replace the digester recirculation pumps.		$150,000	
	Replace the Biosolids Storage Tank No. 2 mixers.		$425,000	
	Replace the Biosolids Storage Tank No. 2 loadout pump.		$ 68,000	
	Construct the biofilter at the biosolids storage tanks.		$579,000	
	Replace the W3 system pumps.		$359,000	
	Replace the medium-voltage service entrance switchgear.		$607,000	
	Replace the medium-voltage disconnect switches and dry type transformers.		$1,078,000	
	Replace the low-voltage switchboards.		$1,232,000	
	Replace the diaphragm primary sludge pumps.			$182,000
	Replace the primary scum pumps.			$93,000
	Replace the RAS pumps.			$1,395,000
	Replace the WAS pumps.			$181,000
	Rehabilitate the digester covers.			$863,000
	Total	**$42,456,000**	**$7,222,000**	**$2,714,000**

Notes:
[1]All costs in second quarter, 2020 dollars.
[2]This component of the project was split from the alternative in even the City chooses to delay construction of these activated sludge trains and installation of the third blower.

The opinion of probable cost of the 0- to 5-year WPCF improvements total $42,456,000. Anticipating an early 2022 bid date and inflation of 3 percent per year results in an anticipated 2022 project cost of $45,040,000. It is anticipated the project will be funded by a combination of the equipment reserve funds that were previously earmarked for land application equipment replacement, existing fund balance, anticipated future surplus revenue, and a Clean Water Fund (CWF) low interest loan. In addition, it is likely that the project will be eligible for $750,000 in regular principal forgiveness through the CWF, further reducing the principal amount. A potential grant through the United States Economic Development Administration (EDA) may provide an additional approximately $3,000,000 in grand funds. Table 8.02-2 shows the sources of funds that are anticipated to be used to fund the project.

Source	Amount
Vehicle Replacement Fund	$1,500,000
Existing Fund Balance	$5,000,000
New and Future Surplus Revenue[1]	$6,160,000
CWF Principal Forgiveness	$750,000
EDA Grant (estimated)	$3,000,000
CWF Loan	$28,630,000
Total Project Cost	**$45,040,000**

[1]Based on anticipated rate increases of 3.0 percent in 2021 and 4.5 percent annually from 2023 to 2024.

Table 8.02-2 Sources of Funds for 0- to 5-Year WPCF Project

The effective rate for a CWF loan is a composite rate based on a blend of the subsidized interest rate (55 percent of the market rate as of June 2020) for the low interest rate eligible portions of the project and a market rate for market rate eligible portions of the project. The current market interest rate for the Wisconsin CWF program (as of June 2020) is 3.200 percent. The market rate has varied from 2.80 percent to 3.35 percent over the last five years. The current subsidized interest rate is 1.760 percent. The composite rate for the project will be determined in accordance with the provisions of the Wisconsin Administrative Code (WAC) NR 162. Project elements needed for industrial capacity and future capacity (growth more than 10 years in the future) are not eligible for the subsidized rate. An effective interest rate of 2.50 percent is used for estimating the annual debt service payment, which is expected to be approximately $1,840,000.

Additional grants from Focus on Energy will likely be available and applicable to components of the project that significantly reduce energy such as new blowers, variable frequency drives, and more efficient lighting. The CWF program may also provide a match of any grants from Focus on Energy up to $50,000. These grants change annually based on the Focus on Energy's annual programs and the CWF program annual intended use plan. These additional grants are not included in the previous projections, but if additional grant funds are secured, the loan balance would be further reduced.

8.03 FISCAL IMPACT ANALYSIS

Based on the projected debt service payment of $1,840,000, a preliminary analysis of the impact on sewer user charges was made. The first principal and interest payment would be due around substantial completion of the project (June 2024). Therefore, sewer rate increases could be phased in over the next four years. The current monthly average residential sewer bill for the City (assuming seven units of sewer usage per month) is $31.24. Based on the estimated increase in annual debt service required for the project, a total increase in revenue of approximately 17.5 percent is required. Applying this rate increase to the average residential user results in an average monthly sewer bill of $36.72, a total increase of $5.48 per month. This total increase could be phased in as a 3 percent rate increases in 2021, and 4.5 percent increases annually from 2022 to 2024. when the first debt service payment becomes due.

8.04 PROJECT IMPLEMENTATION SCHEDULE

The preliminary project implementation schedule for the 0- to 5-year improvements is presented in Table 8.04-1. This schedule was developed to allow the project to be bid in late 2021. Bidding projected in early December typically results in very competitive bids. This also allows for the contractor to start construction around March 2022, allowing the full non-winter construction season to be used. The schedule assumes the project is funded through the fiscal year 2022 CWF program.

Task	Schedule Date
Submit Preliminary Facilities Plan to WDNR	August 2020
Public Hearing on Facilities Plan	September 2020
Submit Final Facilities Plan (with Public Participation Summary) to WDNR	September 2020
Begin Design	October 2020
Submit CWF Program ITA and PERF Forms	October 31, 2020
Site Survey	November 2020
Soil Borings	November 2020
Pass Reimbursement Resolution	November 2020
Submit Drawings and Specifications to WDNR[1]	July 2021
Submit CWF Program Loan Application[1]	July 2021
WDNR Plan and Specification Approval	October 2021
Publish Advertisement to Bid	Early November 2021
Bid Opening	Early December 2021
Begin Construction	March 2022
Complete Construction	June 2024

[1]CWF Program Deadline for fiscal year 2022 Funding is September 30, 2021.
ITA=Intent to Apply, PERF=Priority Evaluation and Ranking Formula

Table 8.04-1 Project Implementation Schedule

SECTION 9
RESOURCE IMPACT SUMMARY

This section summarizes project environmental impacts and is included as an aid to the WDNR in its review of the project.

9.01 PROJECT IDENTIFICATION

Applicant:	City of Beloit, Wisconsin
Mailing Address:	2400 Springbrook Court, Beloit, WI 53511
WPCF Address:	555 Willowbrook Road, Beloit, WI 53511
Title of Proposal:	Water Pollution Control Facility Facilities Plan
Project Location:	City of Beloit WPCF

9.02 PROJECT DESCRIPTION

A. <u>Why is this Project Needed?</u>

The project will provide new and upgraded facilities for the City's WPCF required to provide adequate service for future growth, address aging equipment, and comply with current and future regulatory requirements. The recommended project generally consists of expanding biological capacity for anticipated growth, converting the existing chlorine disinfection system to an ultraviolet light disinfection system, implementing a biosolids drying process, and replacing various equipment throughout the facility.

B. <u>What is to be Constructed and Where?</u>

The new and modified facilities will be constructed at the existing WPCF site (see Figure 8.01-1-1). The following is a list of significant project elements:

1. Wastewater Screening and Scum Concentration

    a. Replace the scum concentrator.

    b. Replace the concentrated scum tank and concentrated scum pump.

    c. Replace the influent fine screens.

2. Grit Removal

    a. Replace the grit collector equipment.

    b. Replace the grit classifiers.

    c. Replace the grit slurry pumps.

3. Primary Clarification

    a. Complete rehabilitation of the Primary Clarifier No. 1 equipment (note, costs for this project are included in the current budget and are not included in this plan).

b. Repair the corroded concrete on the primary clarifier splitter box and replace the flow control gates.

c. Repair the grout on primary clarifiers.

d. Replace the diaphragm primary sludge pumps.

e. Replace the primary scum pumps.

4. Activated Sludge Basins and Aeration Facilities

a. Repair the corroded concrete in the aeration distribution box.

b. Construct two additional activated sludge trains adjacent to the existing tanks.

c. Install new anaerobic zone mixers in the new trains and replace the existing anaerobic zone mixers in the existing trains.

d. Install new fine bubble diffusors in the new and existing activated sludge trains.

e. Replace two of the existing blowers with two new high-speed turbo blowers.

f. Add a third high-speed turbo blower when the two additional activated sludge trains are constructed.

g. Replace the air distribution piping within the Blower Building and from the Blower Building to the activated sludge system. Install new air distribution piping for the two new activated sludge trains.

h. Install a new blower control system, including new instrumentation and wiring.

5. Final Clarification

a. Rehabilitate the final clarifier equipment (note, costs for this project are included in current budget and are not included in this plan).

b. Install launder covers on the final clarifiers.

c. Repair the grout on final clarifiers.

d. Replace RAS pumps.

e. Replace WAS pumps.

6. Disinfection

Construct a new UV disinfection system and ancillary components within the existing chlorine contact tank and disinfection building. Provide channel covers to minimize growth of algae.

7. Biosolids Thickening, Stabilization, and Drying

   a. Replace the GBT with a dewatering centrifuge.

   b. Install new centrifuge feed pumps to replace the existing GBT feed pumps.

   c. Construct an addition to Process Building to house drying equipment and a new truck loadout area east of the existing thickening and dewatering room.

   d. Install new drying equipment including a cake feed hopper, conveyors, heat exchangers, thermal fluid heater system, dryer, and off-gas handling equipment.

   e. Replace two primary digester boilers.

   f. Replace the digester recirculation pumps.

   g. Replace the digester spiral heat exchangers.

   h. Replace the davit cranes at Biosolids Storage Tank No. 2.

   i. Replace the Biosolids Storage Tank No. 2 mixers.

   j. Replace the Biosolids Storage Tank No. 2 loadout pump.

   k. Construct a biofilter at the biosolids storage tanks.

   l. Replace two GBTs used to thicken WAS.

   m. Replace the polymer system equipment.

   n. Rehabilitate the digester covers.

8. <u>Miscellaneous Improvements</u>

   a. Replace the existing chemical odor scrubber with a new biofilter for odor control.

   b. Replace the waste gas burner.

   c. Replace the plant air system compressors and dryers.

   d. Replace the plant drain system pumps.

e. *Replace the W3 system pumps.*

f. Replace the automatic transfer switches.

g. *Replace the medium-voltage service entrance switchgear.*

h. *Replace the medium-voltage disconnect switches and dry type transformers.*

i. *Replace the low-voltage switchboards.*

j. Complete the improvements to the Administration Building HVAC system.

k. Complete the improvements to the gas compressor room and control room to bring into compliance with NFPA 820.

Figure 8.01-1 presents the preliminary site plan for the recommended improvements at the existing site.

C. What Area is to be Served (Service Area and Projected Population)?

The existing City sewer service area is shown in Figure 1.02-1. The existing population is 36,683 (2018 WDOA estimate). The projected year 2045 service population is 40,276.

D. What is the Design Flow and Loadings?

The design flow and loadings are summarized in Tables 4.06-1 and 4.06-2.

E. What are the Applicable Stream Classifications and Effluent Limits?

The receiving water body is the Rock River, which is classified as warm water sport fishery at the outfall of the WWTP. Effluent limits are presented in Table 3.04-1 and a copy of the July 1, 2015, WPDES Permit is included in Appendix B.

F. How will the Project be implemented (construction schedules, financing, and user charges)?

Table 9.02-1 presents the proposed implementation schedule for the recommended projects and associated costs for each phase. Project funding and impacts to user rates are discussed in Section 8.

Project	Opinion of Capital Cost
0- to 5-Year Improvements	$42,456,000
6- to 10-Year Improvements	$7,227,000
11- to 15-Year Improvements	$2,714,000

Table 9.02-1 Implementation Schedule and Project Capital Costs

9.03 AFFECTED ENVIRONMENT

A. Physical: Describe Existing Resource Features (including wetlands, lakes, streams, shorelands, floodplains, groundwater, soils, and topography) that may be affected by the Proposed Project.

1. Wetlands–There will be no lands classified as wetlands that will be affected by the proposed project.
2. Lakes–There will be no lands classified as lakes that will be affected by the proposed project.
3. Streams–The current discharge for the City's WPCF is the Rock River near the state line. The proposed project will provide improved treatment plant reliability and performance.
4. Shorelands–No shorelands will be affected by the proposed project.
5. Floodplains–The proposed project will be completed at the WPCF site, which is not located within a floodplain.
6. Groundwater–Groundwater elevations will possibly be affected during construction. No long-term impacts are expected as a result of the project.
7. Soils–The soils on the site will be disturbed for construction of new facilities.
8. Topography–There will be very minor changes to the topography at select locations on the site.

B. Biological: Identify plant and animal communities in the planning area with an emphasis upon those species likely to be impacted. Threatened or endangered status should be discussed where applicable.

The existing project site is located in an area already designated for the WWTPs. No project work will be completed outside of the existing WPCF site.

C. Cultural: Describe zoning and land use, ethnic and cultural groups, and archaeological and historic resources that may be affected by the Proposed Project. Describe the economic setting of the area.

1. Zoning and Land Use–The existing project site is located in an area already designated for the WPCFs. No project work will be completed outside of the existing WPCF site.
2. Ethnic and Cultural Groups–The WPCF site is adjacent to a proposed casino development owned by The Ho-Chunk Nation. The proposed project includes enhanced odor control and biosolids processing components.
3. Archaeological and Historic Resources–The proposed improvements on the existing WPCF site will have no known impacts on archaeological or historical resources.

4. Economic Setting–The City has several established commercial and industrial operations.

D. Other Resource Features: Identify Parks, Natural Areas, Prime Agricultural Land, etc.

The existing project site is located in an area already designated for the WWTPs. No project work will be completed outside of the existing WPCF site.

9.04 PROJECT IMPACTS

A. Primary

1. Describe expected changes in surface water or groundwater quality. List any required Chapter 30 permits.

The proposed improvements will allow the WPCF to continue to produce an effluent quality required by the WPDES permit.

Groundwater quality will not be affected.

The proposed improvements do not include any stream crossings. It is unlikely a Chapter 30 permit will be required.

2. Describe construction-related impacts such as noise, traffic disruptions, and air emissions.

During the period of construction, there would likely be an unavoidable increase in noise levels, dust, and congestion near construction sites. In addition, the construction process may necessitate the disturbance of surface improvements and vegetation, excavation, storage of materials, and backfill operations. Movement of heavy equipment to and from the site, delivery of construction materials, and traffic of workers to and from the construction locations would also be necessary.

There will be no construction near residences.

3. Describe impacts on natural flora and fauna.

Construction on the WPCF site will not have an impact on the flora and fauna of the area because all construction occurs on lands currently used for wastewater treatment.

4. Describe loss of prime agricultural land or disruption of agricultural activities.

The project will not result in a loss of agricultural land.

5. Describe project impacts on wetlands and floodplains. Explain why such impacts are necessary.

There will be no impacts on wetlands or construction within the floodplain.

6. Describe project impacts upon scenic or other aesthetic resource features.

There are no scenic or unique areas that would be impacted by the proposed project.

7. Describe impacts on cultural, historic, and archaeological features.

There are no known resources that would be impacted.

B. Secondary

1. Describe the future environmental impacts resulting from increased urbanization and land use changes potentially induced by the availability of wastewater collection and treatment services. Special attention should be given to impacts upon wetlands and other surface water including those resulting from stormwater runoff and erosion. Other secondary impacts on flora, fauna, air quality, agriculture, urban services, science values, and cultural, historic, and archaeological resources should also be addressed.

The proposed project is consistent with anticipated and planned growth in the area. Providing adequate municipal WWTPs would promote controlled development.

9.05 MITIGATED MEASURES

Describe measures proposed to mitigate adverse primary and secondary impacts.

A. Construction Impacts

During construction, certain practices would be required of contractors including compliance with any applicable stormwater-related construction ordinances. These practices include backfill, reseeding, and restoration of excavated and disturbed areas as soon as possible after construction; runoff control measures to minimize sediment runoff from construction sites; and appropriate scheduling of heavy equipment. Roadway access would be maintained during construction.

B. Noise

Equipment and processes having high noise levels, except for blowers, are not included in the design. The blowers will be equipped with appropriate noise suppression, where applicable. Construction activities would be expected to follow City noise ordinances for construction activities.

C. Odors and Visual Impacts

The proposed facilities will mitigate the impacts of odors and noise in the vicinity of the WPCF. Appropriate design features will be included to improve the overall appearance of both modified and new structures.

9.06 ALTERNATIVES CONSIDERED

A. Provide a Description and Cost Comparison of Alternatives Considered. List the capital cost, annual O&M cost, and total present worth cost for each alternative.

Section 7 of this report includes the alternatives that were considered, descriptions of the alternatives, and summaries of the present worth evaluations. Detailed present worth calculations are included in Appendix G. Project components that were necessary regardless of alternatives chosen were not evaluated on a present worth basis. Those project elements are listed in Section 7.

B. Describe the environmental impacts of the non-selected alternatives identified above that differ from those expected for the selected alternative.

1. Impact evaluations for nonselected alternatives are included in Section 7 of this report.

2. No-Action Alternative–Should the City not proceed with the construction of necessary facilities to comply with environmental protection regulations, there would be a number of negative impacts, such as the following.

   a. Additional maintenance of existing equipment will be required because of the age of the facility and current loadings. Costs for maintaining the existing equipment would deplete the existing funds for equipment replacement.

   b. Potential loss of benefits gained through labor efficiency.

   c. Potential loss of equipment reliability through advanced age.

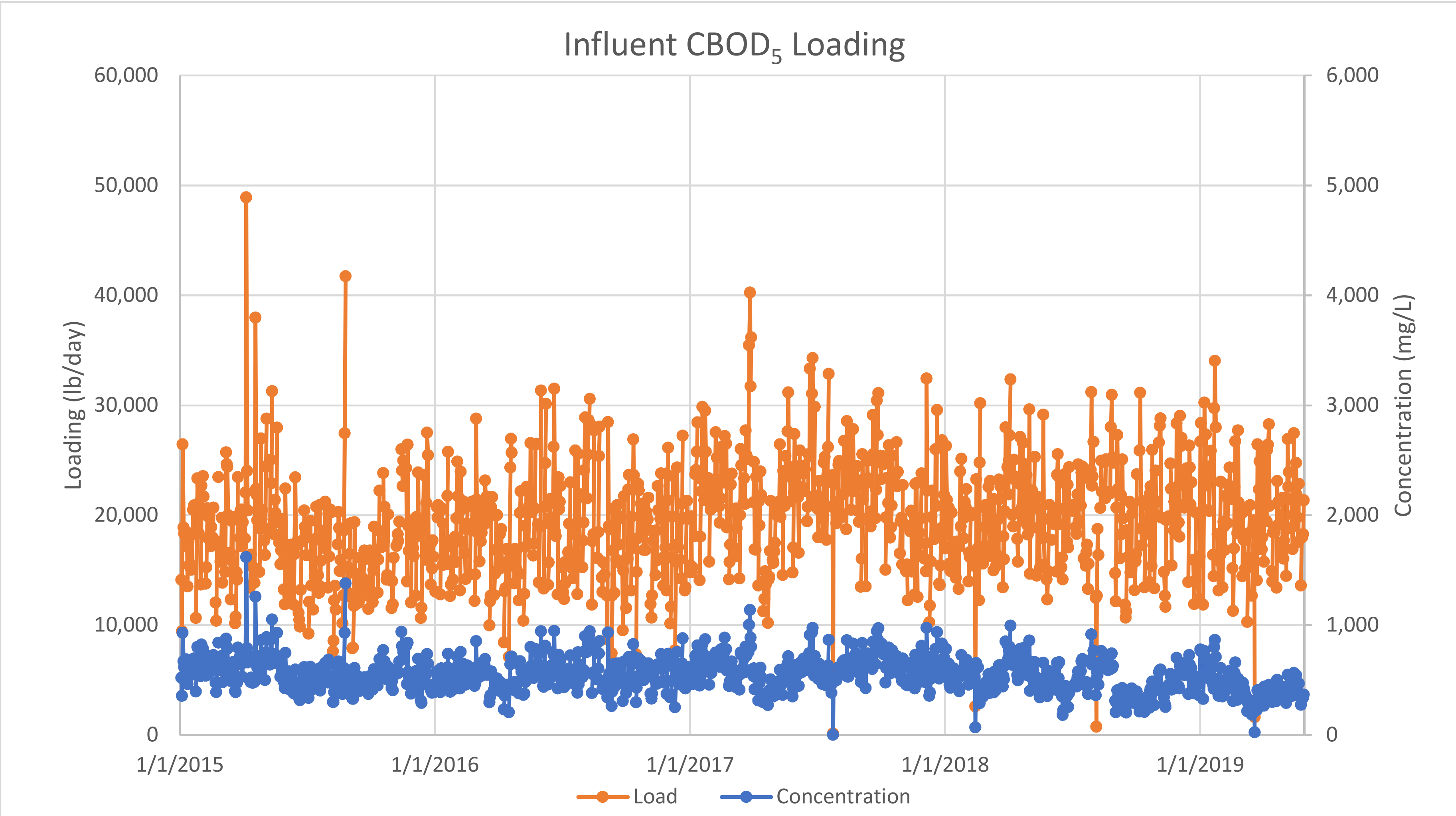
   d. The existing facilities do not have adequate capacity to treat the projected loadings.

9.07 CONTACTS

List agencies, groups, and individuals contacted regarding the proposed projects.

1. City of Beloit–Bill Frisbee, Director of Water Resources; Rodney Knoble, WPCF Operations and Maintenance Supervisor; Scot Prindiville, City Engineer and Deputy Director of Public Works; Laura Pigatti Williamson, Public Works Director.

APPENDIX A
INFLUENT LOADS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1/1/2018
1/1/2019
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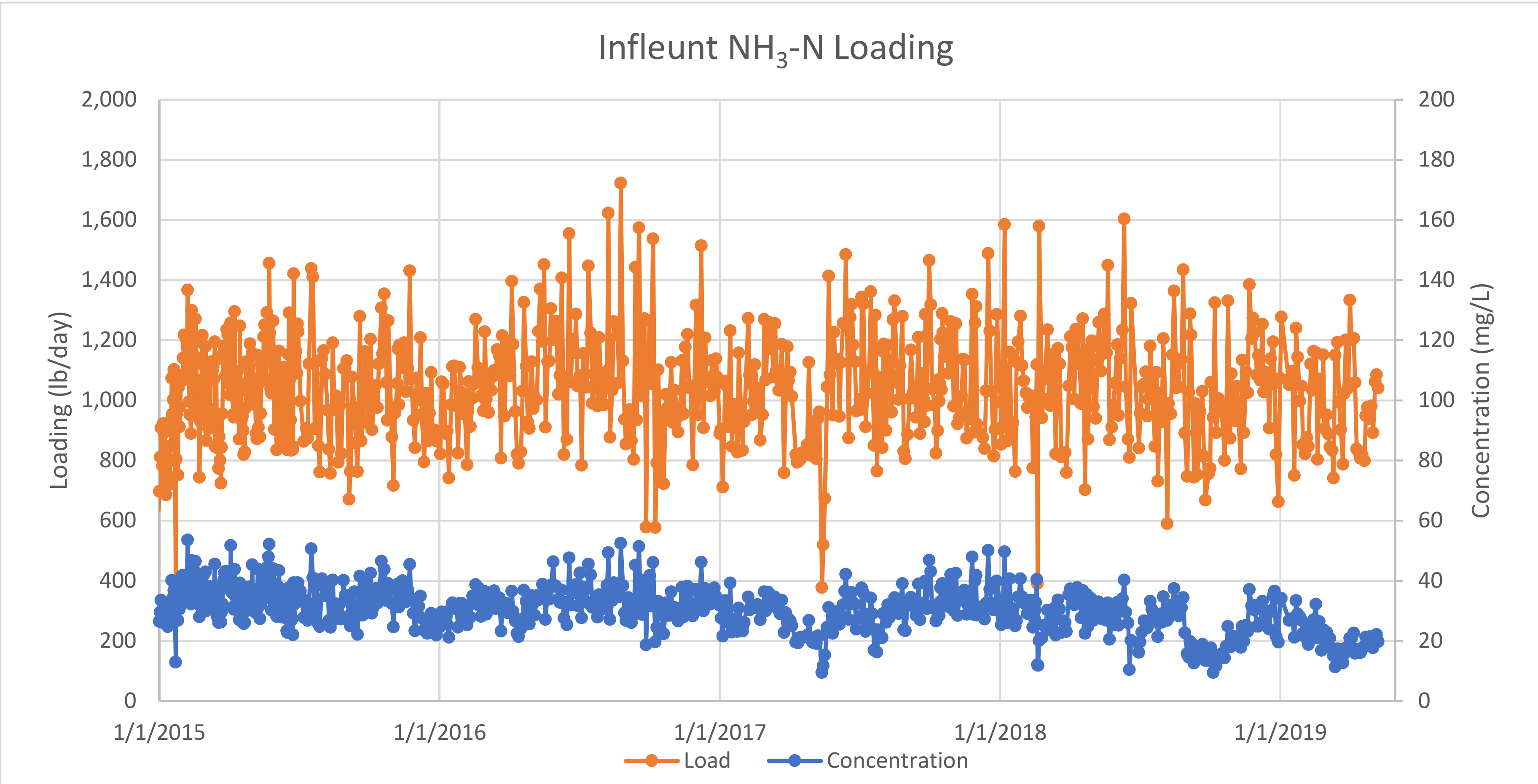
Concentration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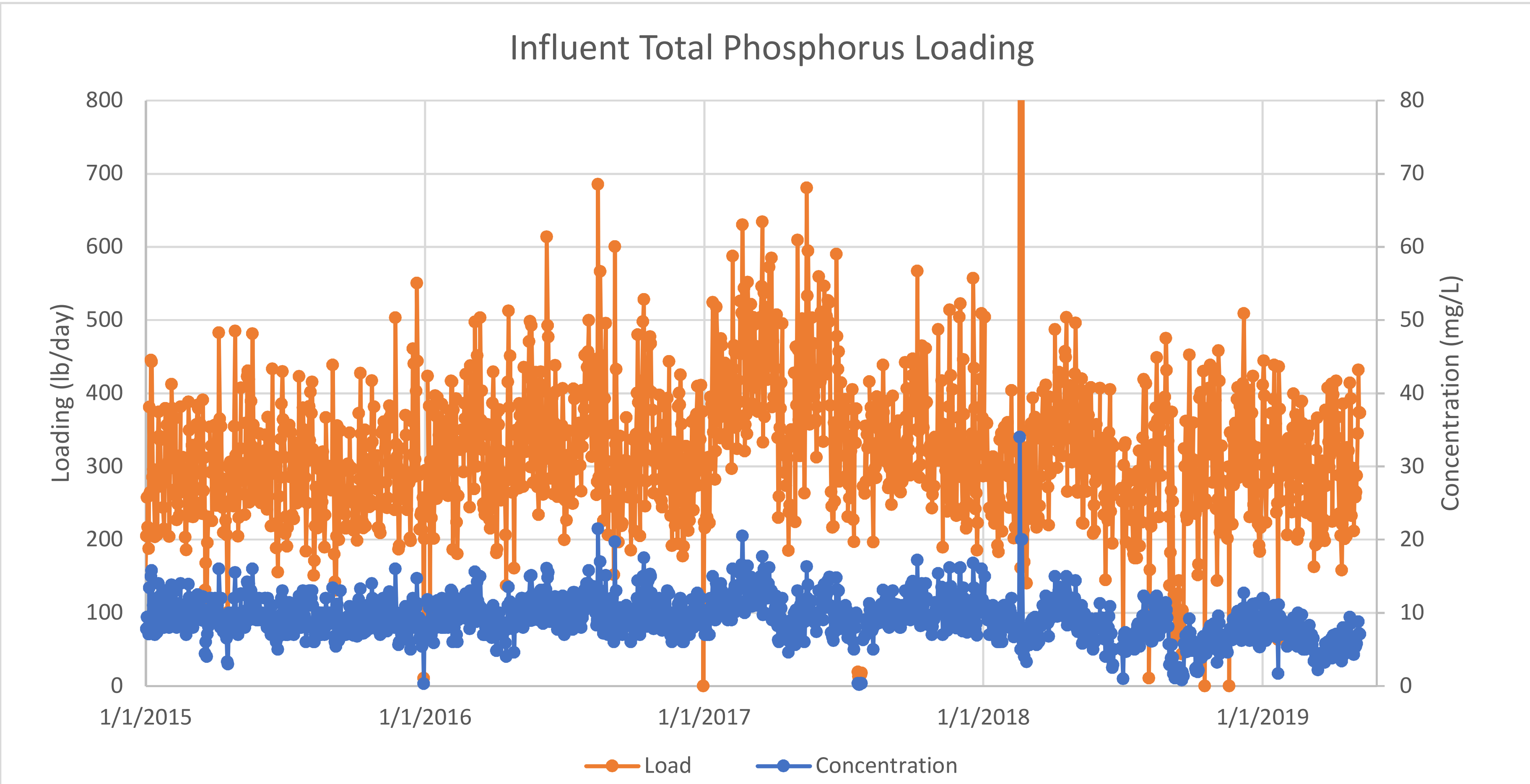
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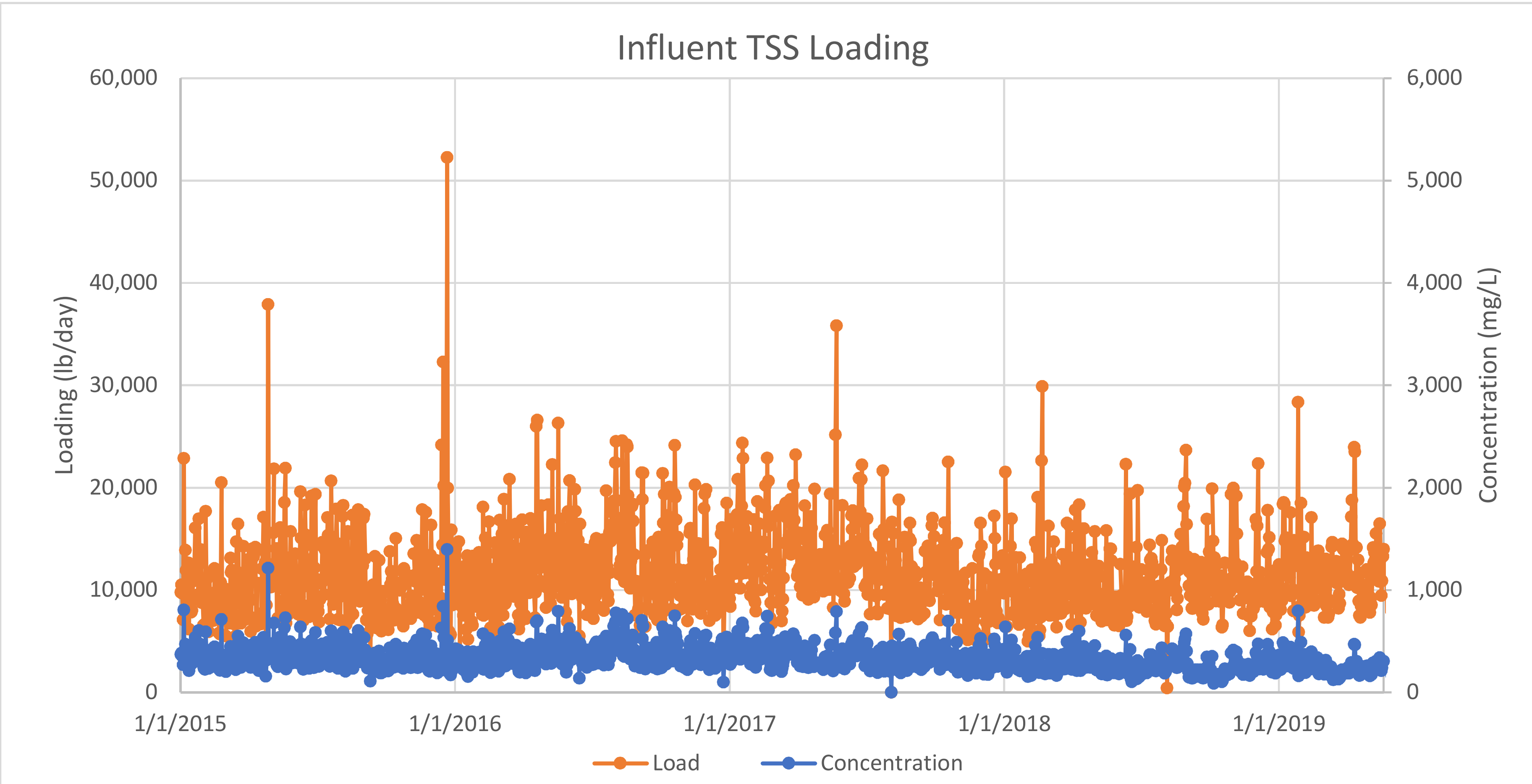
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1/1/2015
1/1/2016
1/1/2017
1/1/2018
1/1/2019
Load
Concentration

APPENDIX B
WPDES PERMIT

WPDES PERMIT

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES

PERMIT TO DISCHARGE UNDER THE WISCONSIN POLLUTANT DISCHARGE ELIMINATION SYSTEM

BELOIT CITY

is permitted, under the authority of Chapter 283, Wisconsin Statutes, to discharge from a facility located at
555 Willowbrook Road, City of Beloit
(SE ¼ of Section 31, T1N-R13E)
to

ROCK RIVER (TURTLE CREEK WATERSHED, LR01 – LOWER ROCK RIVER BASIN) IN ROCK COUNTY

in accordance with the effluent limitations, monitoring requirements and other conditions set forth in this permit.

The permittee shall not discharge after the date of expiration. If the permittee wishes to continue to discharge after this expiration date an application shall be filed for reissuance of this permit, according to Chapter NR 200, Wis. Adm. Code, at least 180 days prior to the expiration date given below.

State of Wisconsin Department of Natural Resources
For the Secretary

By ___________________________
Tim Ryan
Wastewater Field Supervisor

____
Date Permit Signed/Issued

PERMIT TERM: EFFECTIVE DATE - July 01, 2015 **EXPIRATION DATE - June 30, 2020**

TABLE OF CONTENTS

1 Influent Requirements

1.1 Sampling Point(s)

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
701	Representative influent samples shall be collected after preliminary screening but before grit removal.

1.2 Monitoring Requirements

The permittee shall comply with the following monitoring requirements.

1.2.1 Sampling Point 701 - INFLUENT TO PLANT

Monitoring Requirements					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Continuous	Continuous	
$CBOD_5$		mg/L	5/Week	24-Hr Flow Prop Comp	
Suspended Solids, Total		mg/L	Daily	24-Hr Flow Prop Comp	
Cadmium, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Chromium, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Copper, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Lead, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Nickel, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Zinc, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Mercury, Total Recoverable		ng/L	Quarterly	24-Hr Flow Prop Comp	See "Mercury Monitoring" subsection below.

1.2.1.1 Total Metals Analyses

Measurements of total metals and total recoverable metals shall be considered as equivalent.

1.2.1.2 Sample Analysis

Samples shall be analyzed using a method which provides adequate sensitivity so that results can be quantified, unless not possible using the most sensitive approved method. See subsection 6.1.2 for more information.

1.2.1.3 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wisconsin Administrative Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

2 In-Plant Requirements

2.1 Sampling Point(s)

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
107	Mercury field blanks shall be colledted using Clean Hands/Dirty Hands sample handling procedures.

2.2 Monitoring Requirements

The permittee shall comply with the following monitoring requirements.

2.2.1 Sampling Point 107 - Mercury Field Blank

Monitoring Requirements					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Mercury, Total Recoverable		ng/L	Quarterly	Blank	See "Mercury Monitoring" subsection below.

2.2.1.1 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wisconsin Administrative Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

3 Surface Water Requirements

3.1 Sampling Point(s)

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
001	Representative final effluent samples shall be collected after the chlorinate/dechlorinate disinfection in the chlorine contact tank, prior to discharge to the Rock River.

3.2 Monitoring Requirements and Effluent Limitations

The permittee shall comply with the following monitoring requirements and limitations. Unless otherwise noted below, limitations are effective year-round beginning on the effective date of this permit.

3.2.1 Sampling Point (Outfall) 001 - EFFLUENT

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Continuous	Continuous	
$CBOD_5$	Monthly Avg	25 mg/L	5/Week	24-Hr Flow Prop Comp	See standard requirement 6.4.6 below for percent removal requirements for CBOD and Suspended Solids.
$CBOD_5$	Weekly Avg	40 mg/L	5/Week	24-Hr Flow Prop Comp	
Suspended Solids, Total	Monthly Avg	30 mg/L	Daily	24-Hr Flow Prop Comp	
Suspended Solids, Total	Weekly Avg	45 mg/L	Daily	24-Hr Flow Prop Comp	
Suspended Solids, Total	Monthly Avg	1,778 lbs/day	Daily	Calculated	Limit effective January annually.
Suspended Solids, Total	Monthly Avg	2,196 lbs/day	Daily	Calculated	Limit effective February annually.
Suspended Solids, Total	Monthly Avg	2,465 lbs/day	Daily	Calculated	Limit effective March annually.
Suspended Solids, Total	Monthly Avg	2,323 lbs/day	Daily	Calculated	Limit effective April annually.
Suspended Solids, Total	Monthly Avg	2,141 lbs/day	Daily	Calculated	Limit effective May annually.
Suspended Solids, Total	Monthly Avg	2,015 lbs/day	Daily	Calculated	Limit effective June annually.
Suspended Solids, Total	Monthly Avg	1,596 lbs/day	Daily	Calculated	Limit effective July annually.
Suspended Solids, Total	Monthly Avg	1,248 lbs/day	Daily	Calculated	Limit effective August annually.

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Suspended Solids, Total	Monthly Avg	845 lbs/day	Daily	Calculated	Limit effective September annually.
Suspended Solids, Total	Monthly Avg	1,367 lbs/day	Daily	Calculated	Limit effective October annually.
Suspended Solids, Total	Monthly Avg	2,094 lbs/day	Daily	Calculated	Limit effective November annually.
Suspended Solids, Total	Monthly Avg	1,746 lbs/day	Daily	Calculated	Limit effective December annually.
Suspended Solids, Total	Weekly Avg	2,276 lbs/day	Daily	Calculated	Limit effective January annually.
Suspended Solids, Total	Weekly Avg	2,811 lbs/day	Daily	Calculated	Limit effective February annually.
Suspended Solids, Total	Weekly Avg	3,155 lbs/day	Daily	Calculated	Limit effective March annually.
Suspended Solids, Total	Weekly Avg	2,973 lbs/day	Daily	Calculated	Limit effective April annually.
Suspended Solids, Total	Weekly Avg	2,740 lbs/day	Daily	Calculated	Limit effective May annually.
Suspended Solids, Total	Weekly Avg	2,579 lbs/day	Daily	Calculated	Limit effective June annually.
Suspended Solids, Total	Weekly Avg	2,043 lbs/day	Daily	Calculated	Limit effective July annually.
Suspended Solids, Total	Weekly Avg	1,597 lbs/day	Daily	Calculated	Limit effective August annually.
Suspended Solids, Total	Weekly Avg	1,082 lbs/day	Daily	Calculated	Limit effective September annually.
Suspended Solids, Total	Weekly Avg	1,750 lbs/day	Daily	Calculated	Limit effective October annually.
Suspended Solids, Total	Weekly Avg	2,680 lbs/day	Daily	Calculated	Limit effective November annually.
Suspended Solids, Total	Weekly Avg	2,235 lbs/day	Daily	Calculated	Limit effective December annually.
Nitrogen, Ammonia (NH_3-N) Total	Daily Max	17 mg/L	3/Week	24-Hr Flow Prop Comp	
Chlorine, Total Residual	Daily Max	38 µg/L	Daily	Grab	Limit effective May 1 through September 30 annually.
Chlorine, Total Residual	Weekly Avg	31 µg/L	Daily	Grab	Limit effective May 1 through September 30 annually.
Fecal Coliform	Geometric Mean	400 #/100 ml	2/Week	Grab	Limit effective May 1 through September 30 annually. See standard requirement 6.4.7 below.

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Phosphorus, Total	Monthly Avg	2.0 mg/L	Daily	24-Hr Flow Prop Comp	This is an interim limit. See the "Phosphorus Limitation(s)" subsection at 3.2.1.5 below for the final water quality based phosphorus limits and subsection 5.1 for the phosphorus compliance schedule.
Phosphorus, Total		lbs/day	Daily	Calculated	See the "Phosphorus Limitation(s)" subsection at 3.2.1.5 below for final phosphorus mass limits. Calculate the daily mass discharge of phosphorus on the same days phosphorus sampling occurs. Daily mass (lbs/day) = daily concentration (mg/L) x daily flow (MGD) x 8.34.
pH Field	Daily Max	9.0 su	Daily	Grab	
pH Field	Daily Min	6.0 su	Daily	Grab	
Mercury, Total Recoverable	Daily Max	3.3 ng/L	Quarterly	Grab	This is an Alternative Mercury Effluent Limit. See the "Mercury Monitoring" subsection at 3.2.1.9 below for sampling and analysis requirements and subsection 5.2 for the mercury PMP compliance schedule.
Acute WET		TU_a	See Listed Qtr(s)	24-Hr Flow Prop Comp	See "Whole Effluent Toxicity (WET) Testing" subsection at 3.2.1.10 below for monitoring dates and WET requirements.
Chronic WET		rTU_c	See Listed Qtr(s)	24-Hr Flow Prop Comp	See "Whole Effluent Toxicity (WET) Testing" subsection at 3.2.1.10 below for monitoring dates and WET requirements.
Cadmium, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	Monitor Only
Chromium, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	Monitor Only
Copper, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	Monitor Only

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Lead, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	Monitor Only
Nickel, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	Monitor Only
Zinc, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	Monitor Only
Chloride		mg/L	Monthly	24-Hr Flow Prop Comp	Monitor Only - January 1, 2019 to December 31, 2019
Temperature Maximum		deg F	3/Week	Continuous	Monitor Only - January 1, 2019 to December 31, 2019 See the "Effluent Temperature Monitoring" subsection at 3.2.1.11 below for monitoring requirements.
Nitrogen, Total Kjeldahl		mg/L	Quarterly	24-Hr Flow Prop Comp	Monitor Only
Nitrogen, Nitrite + Nitrate Total		mg/L	Quarterly	24-Hr Flow Prop Comp	Monitor Only
Nitrogen, Total		mg/L	Quarterly	Calculated	Monitor Only

3.2.1.1 Average Annual Design Flow

The average annual design flow of the permittee's wastewater treatment facility is 11.0 MGD.

3.2.1.2 Total Metals Analyses

Measurements of total metals and total recoverable metals shall be considered as equivalent.

3.2.1.3 Sample Analysis

Samples shall be analyzed using a method which provides adequate sensitivity so that results can be quantified, unless not possible using the most sensitive approved method. See subsection 6.1.2 for more details.

3.2.1.4 TSS Limitation(s)

The Rock River TMDL for Total Phosphorus (TP) and Total Suspended Solids (TSS) was approved by the Environmental Protection Agency (EPA) September 2011. The TMDL derived limits are expressed as weekly average and monthly average effluents limits, and are effective immediately. The approved total suspended solids TMDL limits for this permittee are included in the following table:

Total Suspended Solids (TSS) Effluent Limitations

Month	Monthly Avg. TSS Effluent Limit (lbs/day)	Weekly Avg. TSS Effluent Limit (lbs/day)
Jan	1778	2276
Feb	2196	2811
March	2465	3155
April	2323	2973
May	2141	2740
June	2015	2579

Month	Monthly Avg. TSS Effluent Limit (lbs/day)	Weekly Avg. TSS Effluent Limit (lbs/day)
July	1596	2043
Aug	1248	1597
Sept	845	1082
Oct	1367	1750
Nov	2094	2680
Dec	1746	2235

3.2.1.5 Phosphorus Limitation(s)

The Rock River TMDL for Total Phosphorus (TP) and Total Suspended Solids (TSS) was approved by the Environmental Protection Agency (EPA) September 2011. The TMDL derived limits are expressed as monthly average effluent limits. The approved total phosphorus TMDL limits for this permittee are included in the following table:

Total Phosphorus Effluent Limitations

Month	Monthly Avg. Total P Effluent Limit (lbs/day)
Jan	33.0
Feb	35.1
March	30.8
April	33.0
May	31.3
June	30.4
July	23.5
Aug	20.3
Sept	18.5
Oct	20.2
Nov	24.4
Dec	29.5

3.2.1.6 Phosphorus Water Quality Based Effluent Limitation(s)

The final TMDL-derived water quality based effluent limits for phosphorus, as described above, will take effect July 1, 2024 unless:

(A) As part of the application for the next reissuance, or prior to filing the application, the permittee submits either: 1.) a watershed adaptive management plan and a completed Watershed Adaptive Management Request Form 3200-139; or 2.) an application for water quality trading; or 3.) an application for a variance; or 4.) new information or additional data that supports a recalculation of the numeric limitation; and

(B) The Department modifies, revokes and reissues, or reissues the permit to incorporate a revised limitation before the expiration of the compliance schedule*.

Note: The permittee may also submit an application for a variance within 60 days of this permit reissuance, as noted in the permit cover letter, in accordance with s. 283.15, Stats.

If Adaptive Management or Water Quality Trading is approved as part of the permit application for the next reissuance or as part of an application for a modification or revocation and reissuance, the plan and specifications submittal, construction, and final effective dates for compliance with the total phosphorus WQBEL may change in the reissued or modified permit. In addition, the numeric value of the water quality based effluent limit may change based on new information (e.g. a TMDL) or additional data. If a variance is approved for the next reissuance, interim limits and conditions will be imposed in the reissued permit in accordance with s. 283.15, Stats., and applicable regulations. A permittee may apply for a variance to the phosphorus WQBEL at the next reissuance even if the permittee did not apply for a phosphorus variance as part of this permit reissuance.

Additional Requirements: If a water quality based effluent limit has taken effect in a permit, any increase in the limit is subject to s. NR 102.05(1) and ch. NR 207, Wis. Adm. Code. When a six-month average effluent limit is specified for Total Phosphorus the applicable averaging periods are May through October and November through April.

*Note: The Department will prioritize reissuances and revocations, modifications, and reissuances of permits to allow permittees the opportunity to implement adaptive management or nutrient trading in a timely and effective manner.

3.2.1.7 Alternative Approaches to Phosphorus WQBEL Compliance

Rather than upgrading its wastewater treatment facility to comply with WQBELs for total phosphorus, the permittee may use Water Quality Trading or the Watershed Adaptive Management Option, to achieve compliance under ch. NR 217, Wis. Adm. Code, provided that the permit is modified, revoked and reissued, or reissued to incorporate any such alternative approach. The permittee may also implement an upgrade to its wastewater treatment facility in combination with Water Quality Trading or the Watershed Adaptive Management Option to achieve compliance, provided that the permit is modified, revoked and reissued, or reissued to incorporate any such alternative approach. If the Final Compliance Alternatives Plan concludes that a variance will be pursued, the Plan shall provide information regarding the basis for the variance.

3.2.1.8 Submittal of Permit Application for Next Reissuance and Adaptive Management or Pollutant Trading Plan or Variance Application

The permittee shall submit the permit application for the next reissuance at least 6 months prior to expiration of this permit. If the permittee intends to pursue adaptive management to achieve compliance with the phosphorus water quality based effluent limitation, the permittee shall submit with the application for the next reissuance: a completed Watershed Adaptive Management Request Form 3200-139, the completed Adaptive Management Plan and final plans for any system upgrades necessary to meet interim limits pursuant to s. NR 217.18, Wis. Adm. Code. If the permittee intends to pursue pollutant trading to achieve compliance, the permittee shall submit an application for water quality trading with the application for the next reissuance. If system upgrades will be used in combination with pollutant trading to achieve compliance with the final water quality-based limit, the reissued permit will specify a schedule for the necessary upgrades. If the permittee intends to seek a variance, the permittee shall submit an application for a variance with the application for the next reissuance.

3.2.1.9 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wisconsin Administrative Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

3.2.1.10 Whole Effluent Toxicity (WET) Testing

Primary Control Water: Rock River upstream/out of the influence of the mixing zone and any other known discharge

Instream Waste Concentration (IWC): 24%

Dilution series: At least five effluent concentrations and dual controls must be included in each test.

- **Acute:** 100, 50, 25, 12.5, 6.25% and any additional selected by the permittee.
- **Chronic:** 100, 30, 10, 3, 1% and any additional selected by the permittee.

WET Testing Frequency:

Acute tests shall be conducted once each year in rotating quarters in order to collect seasonal information about the discharge. Tests are required during the following quarters:

- **Acute:** *October 1 – December 31, 2015; July 1 – September 30, 2016; April 1 – June 30, 2017; January 1 – March 31, 2018; July 1 – September 30, 2019; and January 1 – March 31, 2020*

Annual Acute WET testing shall continue after the permit expiration date (until the permit is reissued) in accordance with the WET requirements specified for the fourth calendar year of this permit. For example, the next test would be required in July 1 – September 30, 2021.

Chronic tests shall be conducted once each year in rotating quarters in order to collect seasonal information about the discharge. Tests are required during the following quarters:

- **Chronic:** *October 1 – December 31, 2015; July 1 – September 30, 2016; April 1 – June 30, 2017; January 1 – March 31, 2018; July 1 – September 30, 2019; and January 1 – March 31, 2020*

Annual Chronic WET testing shall continue after the permit expiration date (until the permit is reissued) in accordance with the WET requirements specified for the fourth calendar year of this permit. For example, the next test would be required in July 1 – September 30, 2021.

Testing: WET testing shall be performed during normal operating conditions. Permittees are not allowed to turn off or otherwise modify treatment systems, production processes, or change other operating or treatment conditions during WET tests.

Reporting: The permittee shall report test results on the Discharge Monitoring Report form, and also complete the "Whole Effluent Toxicity Test Report Form" (Section 6, "*State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, 2nd Edition*"), for each test. The original, complete, signed version of the Whole Effluent Toxicity Test Report Form shall be sent to the Biomonitoring Coordinator, Bureau of Water Quality, 101 S. Webster St., P.O. Box 7921, Madison, WI 53707-7921, within 45 days of test completion. The Discharge Monitoring Report (DMR) form shall be submitted electronically by the required deadline.

Determination of Positive Results: An acute toxicity test shall be considered positive if the Toxic Unit - Acute (TU_a) is greater than 1.0 for either species. The TU_a shall be calculated as follows: If $LC_{50} \geq 100$, then $TU_a = 1.0$. If LC_{50} is < 100, then $TU_a = 100 \div LC_{50}$. A chronic toxicity test shall be considered positive if the Relative Toxic Unit - Chronic (rTU_c) is greater than 1.0 for either species. The rTU_c shall be calculated as follows: If $IC_{25} \geq IWC$, then $rTU_c = 1.0$. If $IC_{25} < IWC$, then $rTU_c = IWC \div IC_{25}$.

Additional Testing Requirements: Within 90 days of a test which showed positive results, the permittee shall submit the results of at least 2 retests to the Biomonitoring Coordinator on "Whole Effluent Toxicity Test Report Forms". The 90 day reporting period shall begin the day after the test which showed a positive result. The retests shall be completed using the same species and test methods specified for the original test (see the Standard Requirements section herein).

3.2.1.11 Effluent Temperature Monitoring

For manually measuring effluent temperature, grab samples should be collected at 6 evenly spaced intervals during the 24-hour period. Alternative sampling intervals may be approved if the permittee can show that the maximum effluent temperature is captured during the sampling interval. For monitoring temperature continuously, collect measurements in accordance with s. NR 218.04(13). This means that discrete measurements shall be recorded at intervals of not more than 15 minutes during the 24-hour period. In either case, report the maximum temperature measured during the day on the DMR.

4 Land Application Requirements

4.1 Sampling Point(s)

The discharge(s) shall be limited to land application of the waste type(s) designated for the listed sampling point(s) on Department approved land spreading sites or by hauling to another facility.

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
002	Anaerobically digested, thickened, Liquid, Class B. Representative sludge samples shall be collected from the on-site storage tank recirculation line.
005	Anaerobically digested, thickened, Cake, Class B. Representative sludge samples shall be collected from the cake pump after the belt press.

4.2 Monitoring Requirements and Limitations

The permittee shall comply with the following monitoring requirements and limitations.

4.2.1 Sampling Point (Outfall) 002 - Anaerobic Liquid Sludge and 005- Anaerobic Cake Sludge

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Solids, Total		Percent	1/ 2 Months	Composite	
Arsenic Dry Wt	Ceiling	75 mg/kg	1/ 2 Months	Composite	
Arsenic Dry Wt	High Quality	41 mg/kg	1/ 2 Months	Composite	
Cadmium Dry Wt	Ceiling	85 mg/kg	1/ 2 Months	Composite	
Cadmium Dry Wt	High Quality	39 mg/kg	1/ 2 Months	Composite	
Copper Dry Wt	Ceiling	4,300 mg/kg	1/ 2 Months	Composite	
Copper Dry Wt	High Quality	1,500 mg/kg	1/ 2 Months	Composite	
Lead Dry Wt	Ceiling	840 mg/kg	1/ 2 Months	Composite	
Lead Dry Wt	High Quality	300 mg/kg	1/ 2 Months	Composite	
Mercury Dry Wt	Ceiling	57 mg/kg	1/ 2 Months	Composite	
Mercury Dry Wt	High Quality	17 mg/kg	1/ 2 Months	Composite	
Molybdenum Dry Wt	Ceiling	75 mg/kg	1/ 2 Months	Composite	
Nickel Dry Wt	Ceiling	420 mg/kg	1/ 2 Months	Composite	
Nickel Dry Wt	High Quality	420 mg/kg	1/ 2 Months	Composite	
Selenium Dry Wt	Ceiling	100 mg/kg	1/ 2 Months	Composite	
Selenium Dry Wt	High Quality	100 mg/kg	1/ 2 Months	Composite	
Zinc Dry Wt	Ceiling	7,500 mg/kg	1/ 2 Months	Composite	
Zinc Dry Wt	High Quality	2,800 mg/kg	1/ 2 Months	Composite	
Nitrogen, Total Kjeldahl		Percent	1/ 2 Months	Composite	
Nitrogen, Ammonium (NH_4-N) Total		Percent	1/ 2 Months	Composite	

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Phosphorus, Total		Percent	1/ 2 Months	Composite	
Phosphorus, Water Extractable		% of Tot P	1/ 2 Months	Composite	
Potassium, Total Recoverable		Percent	1/ 2 Months	Composite	
PCB Total Dry Wt	Ceiling	50 mg/kg	Once	Composite	Report the sum of all PCB congener or aroclor results from the Priority Pollutant scan to be done in 2018.
PCB Total Dry Wt	High Quality	10 mg/kg	Once	Composite	Report the sum of all PCB congener or aroclor results from the Priority Pollutant scan to be done in 2018.
Municipal Sludge Priority Pollutant Scan			Once	Composite	As specified in ch. NR 215.03 (1-4), Wis. Adm. Code. Priority Pollutant Scan required in 2018.

Other Sludge Requirements	
Sludge Requirements	**Sample Frequency**
List 3 Requirements – Pathogen Control: The requirements in List 3 shall be met prior to land application of sludge.	**BiMonthly**
List 4 Requirements – Vector Attraction Reduction: The vector attraction reduction shall be satisfied prior to, or at the time of land application as specified in List 4.	**BiMonthly**

4.2.1.1 List 2 Analysis

If the monitoring frequency for List 2 parameters is more frequent than "Annual" then the sludge may be analyzed for the List 2 parameters just prior to each land application season rather than at the more frequent interval specified.

4.2.1.2 Changes in Feed Sludge Characteristics

If a change in feed sludge characteristics, treatment process, or operational procedures occurs which may result in a significant shift in sludge characteristics, the permittee shall reanalyze the sludge for List 1, 2, 3 and 4 parameters each time such change occurs.

4.2.1.3 Multiple Sludge Sample Points (Outfalls)

If there are multiple sludge sample points (outfalls), but the sludges are not subject to different sludge treatment processes, then a separate List 2 analysis shall be conducted for each sludge type which is land applied, just prior to land application, and the application rate shall be calculated for each sludge type. In this case, List 1, 3, and 4 and PCBs need only be analyzed on a single sludge type, at the specified frequency. If there are multiple sludge sample points (outfalls), due to multiple treatment processes, List 1, 2, 3 and 4 and PCBs shall be analyzed for each sludge type at the specified frequency.

4.2.1.4 Sludge Which Exceeds the High Quality Limit

Cumulative pollutant loading records shall be kept for all bulk land application of sludge which does not meet the high quality limit for any parameter. This requirement applies for the entire calendar year in which any exceedance of Table 3 of s. NR 204.07(5)(c), is experienced. Such loading records shall be kept for all List 1 parameters for each site land applied in that calendar year. The formula to be used for calculating cumulative loading is as follows:

[(Pollutant concentration (mg/kg) x dry tons applied/ac) ÷ 500] + previous loading (lbs/acre) = cumulative lbs pollutant per acre

When a site reaches 90% of the allowable cumulative loading for any metal established in Table 2 of s. NR 204.07(5)(b), the Department shall be so notified through letter or in the comment section of the annual land application report (3400-55).

4.2.1.5 Sludge Analysis for PCBs

The permittee shall analyze the sludge for Total PCBs one time during **2018**. The results shall be reported as "PCB Total Dry Wt". Either congener-specific analysis or Aroclor analysis shall be used to determine the PCB concentration. The permittee may determine whether Aroclor or congener specific analysis is performed. Analyses shall be performed in accordance with Table EM in s. NR 219.04, Wis. Adm. Code and the conditions specified in Standard Requirements of this permit. PCB results shall be submitted by January 31, following the specified year of analysis.

4.2.1.6 Lists 1, 2, 3, and 4

List 1 **TOTAL SOLIDS AND METALS** See the Monitoring Requirements and Limitations table above for monitoring frequency and limitations for the List 1 parameters
Solids, Total (percent)
Arsenic, mg/kg (dry weight)
Cadmium, mg/kg (dry weight)
Copper, mg/kg (dry weight)
Lead, mg/kg (dry weight)
Mercury, mg/kg (dry weight)
Molybdenum, mg/kg (dry weight)
Nickel, mg/kg (dry weight)
Selenium, mg/kg (dry weight)
Zinc, mg/kg (dry weight)

List 2 **NUTRIENTS** See the Monitoring Requirements and Limitations table above for monitoring frequency for the List 2 parameters
Solids, Total (percent)
Nitrogen Total Kjeldahl (percent)
Nitrogen Ammonium (NH4-N) Total (percent)
Phosphorus Total as P (percent)
Phosphorus, Water Extractable (as percent of Total P)
Potassium Total Recoverable (percent)

List 3
PATHOGEN CONTROL FOR CLASS B SLUDGE

The permittee shall implement pathogen control as listed in List 3. The Department shall be notified of the pathogen control utilized and shall be notified when the permittee decides to utilize alternative pathogen control.

The following requirements shall be met prior to land application of sludge.

Parameter	Unit	Limit
Fecal Coliform*	MPN/gTS or CFU/gTS	2,000,000
OR, ONE OF THE FOLLOWING PROCESS OPTIONS		
Aerobic Digestion	Air Drying	
Anaerobic Digestion	Composting	
Alkaline Stabilization	PSRP Equivalent Process	

***** The Fecal Coliform limit shall be reported as the geometric mean of 7 discrete samples on a dry weight basis.

List 4
VECTOR ATTRACTION REDUCTION

The permittee shall implement any one of the vector attraction reduction options specified in List 4. The Department shall be notified of the option utilized and shall be notified when the permittee decides to utilize an alternative option.

One of the following shall be satisfied prior to, or at the time of land application as specified in List 4.

Option	Limit	Where/When it Shall be Met
Volatile Solids Reduction	≥38%	Across the process
Specific Oxygen Uptake Rate	≤1.5 mg O_2/hr/g TS	On aerobic stabilized sludge
Anaerobic bench-scale test	<17 % VS reduction	On anaerobic digested sludge
Aerobic bench-scale test	<15 % VS reduction	On aerobic digested sludge
Aerobic Process	>14 days, Temp >40°C and Avg. Temp > 45°C	On composted sludge
pH adjustment	>12 S.U. (for 2 hours) and >11.5 (for an additional 22 hours)	During the process
Drying without primary solids	>75 % TS	When applied or bagged
Drying with primary solids	>90 % TS	When applied or bagged
Equivalent Process	Approved by the Department	Varies with process
Injection	-	When applied
Incorporation	-	Within 6 hours of application

4.2.1.7 Daily Land Application Log

Daily Land Application Log		
Discharge Monitoring Requirements and Limitations The permittee shall maintain a daily land application log for biosolids land applied each day when land application occurs. The following minimum records must be kept, in addition to all analytical results for the biosolids land applied. The log book records shall form the basis for the annual land application report requirements**.**		
Parameters	**Units**	**Sample Frequency**
DNR Site Number(s)	Number	Daily as used
Outfall number applied	Number	Daily as used
Acres applied	Acres	Daily as used
Amount applied	As appropriate * /day	Daily as used
Application rate per acre	unit */acre	Daily as used
Nitrogen applied per acre	lb/acre	Daily as used
Method of Application	Injection, Incorporation, or surface applied	Daily as used

*gallons, cubic yards, dry US Tons or dry Metric Tons

5 Schedules

5.1 Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus

The permittee shall comply with the WQBELs for Phosphorus as specified. No later than 30 days following each compliance date, the permittee shall notify the Department in writing of its compliance or noncompliance. If a submittal is required, a timely submittal fulfills the notification requirement.

Required Action	Due Date
Operational Evaluation Report: The permittee shall prepare and submit to the Department for approval an operational evaluation report. The report shall include an evaluation of collected effluent data, possible source reduction measures, operational improvements or other minor facility modifications that will optimize reductions in phosphorus discharges from the treatment plant during the period prior to complying with final phosphorus WQBELs and, where possible, enable compliance with final phosphorus WQBELs by June 30, 2018. The report shall provide a plan and schedule for implementation of the measures, improvements, and modifications as soon as possible, but not later than June 30, 2018 and state whether the measures, improvements, and modifications will enable compliance with final phosphorus WQBELs. Regardless of whether they are expected to result in compliance, the permittee shall implement the measures, improvements, and modifications in accordance with the plan and schedule specified in the operational evaluation report. If the operational evaluation report concludes that the facility can achieve final phosphorus WQBELs using the existing treatment system with only source reduction measures, operational improvements, and minor facility modifications, the permittee shall comply with the final phosphorus WQBEL by June 30, 2018 and is not required to comply with the milestones identified below for years 3 through 9 of this compliance schedule ('Preliminary Compliance Alternatives Plan', 'Final Compliance Alternatives Plan', 'Final Plans and Specifications', 'Treatment Plant Upgrade to Meet WQBELs', 'Complete Construction', 'Achieve Compliance'). STUDY OF FEASIBLE ALTERNATIVES - If the Operational Evaluation Report concludes that the permittee cannot achieve final phosphorus WQBELs with source reduction measures, operational improvements and other minor facility modifications, the permittee shall initiate a study of feasible alternatives for meeting final phosphorus WQBELs and comply with the remaining required actions of this schedule of compliance. If the Department disagrees with the conclusion of the report, and determines that the permittee can achieve final phosphorus WQBELs using the existing treatment system with only source reduction measures, operational improvements, and minor facility modifications, the Department may reopen and modify the permit to include an implementation schedule for achieving the final phosphorus WQBELs sooner than July 1, 2024.	06/30/2016
Compliance Alternatives, Source Reduction, Improvements and Modifications Status: The permittee shall submit a 'Compliance Alternatives, Source Reduction, Operational Improvements and Minor Facility Modification' status report to the Department. The report shall provide an update on the permittee's: (1) progress implementing source reduction measures, operational improvements, and minor facility modifications to optimize reductions in phosphorus discharges and, to the extent that such measures, improvements, and modifications will not enable compliance with the WQBELs, (2) status evaluating feasible alternatives for meeting phosphorus WQBELs.	06/30/2017
Preliminary Compliance Alternatives Plan: The permittee shall submit a preliminary compliance alternatives plan to the Department. If the plan concludes upgrading of the permittee’s wastewater treatment facility is necessary to achieve final phosphorus WQBELs, the submittal shall include a preliminary engineering design	06/30/2018

report. If the plan concludes Adaptive Management will be used, the submittal shall include a completed Watershed Adaptive Management Request Form 3200-139 without the Adaptive Management Plan. If water quality trading will be undertaken, the plan must state that trading will be pursued.	
Final Compliance Alternatives Plan: The permittee shall submit a final compliance alternatives plan to the Department. If the plan concludes upgrading of the permittee's wastewater treatment is necessary to meet final phosphorus WQBELs, the submittal shall include a final engineering design report addressing the treatment plant upgrades, and a facility plan if required pursuant to ch. NR 110, Wis. Adm. Code. If the plan concludes Adaptive Management will be implemented, the submittal shall include a completed Watershed Adaptive Management Request Form 3200-139 and an engineering report addressing any treatment system upgrades necessary to meet interim limits pursuant to s. NR 217.18, Wis. Adm. Code. If the plan concludes water quality trading will be used, the submittal shall identify potential trading partners. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.	06/30/2019
Progress Report on Plans & Specifications: Submit progress report regarding the progress of preparing final plans and specifications. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.	06/30/2020
Final Plans and Specifications: Unless the permit has been modified, revoked and reissued, or reissued to include Adaptive Management or Water Quality Trading measures or to include a revised schedule based on factors in s. NR 217.17, Wis. Adm. Code, the permittee shall submit final construction plans to the Department for approval pursuant to s. 281.41, Stats., specifying treatment plant upgrades that must be constructed to achieve compliance with final phosphorus WQBELs, and a schedule for completing construction of the upgrades by the complete construction date specified below. (Note: Permit modification, revocation and reissuance, and reissuance are subject to s. 283.53(2), Stats.) Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.	06/30/2021
Treatment Plant Upgrade to Meet WQBELs: The permittee shall initiate construction of the upgrades. The permittee shall obtain approval of the final construction plans and schedule from the Department pursuant to s. 281.41. Stats. Upon approval of the final construction plans and schedule by the Department pursuant to s. 281.41, Stats., the permittee shall construct the treatment plant upgrades in accordance with the approved plans and specifications. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.	09/30/2021
Construction Upgrade Progress Report #1: The permittee shall submit a progress report on construction upgrades. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.	09/30/2022
Construction Upgrade Progress Report #2: The permittee shall submit a progress report on construction upgrades. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.	09/30/2023

Complete Construction: The permittee shall complete construction of wastewater treatment system upgrades. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.	05/31/2024
Achieve Compliance: The permittee shall achieve compliance with final phosphorus WQBELs. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.	07/01/2024

5.2 Mercury Pollutant Minimization Program

The permittee shall implement or continue to implement a pollutant minimization program as defined in s. NR 106.145(7), Wis. Adm. Code.

Required Action	Due Date
Implement the Mercury Pollutant Minimization Program: The permittee shall continue to implement the Mercury PMP initially submitted to and approved by the Department in March 2007 and as subsequently updated by the Annual Status Reports with the agreement of the permitee and the Department.	07/01/2015
Submit Annual Status Reports: The permittee shall submit to the Department annual status reports on the progress of the PMP as required by s. NR 106.145(7), Wis. Adm. Code. Submittal of the first annual status report covering the period from January 1, 2015 to December 31, 2015 is required by the Date Due. The report shall include a summary of any sector outreach accomplished or planned.	03/31/2016
Submit Annual Status Report #2: Submit second annual status report covering PMP activities conducted between January 1, 2016 to December 31, 2016. The report shall include a summary of any sector outreach accomplished or planned.	03/31/2017
Submit Annual Status Report #3: Submit third annual status report covering PMP activities conducted between January 1, 2017 to December 31, 2017. The report shall include a summary of any sector outreach accomplished or planned.	03/31/2018
Submit Annual Status Report #4: Submit fourth annual status report covering PMP activities conducted between January 1, 2018 to December 31, 2018. The report shall include a summary of any sector outreach accomplished or planned.	03/31/2019
Submit Annual Status Report #5: Submit fifth annual status report covering PMP activities conducted between January 1, 2019 to December 31, 2019. The report shall include a summary of any sector outreach accomplished or planned. Note: If the permittee wishes to apply for an alternative mercury effluent limitation, that application is due with the application for permit reissuance by 6 months prior to permit expiration. The permittee should submit or reference the PMP plan as updated by the Annual Status Report or more recent developments as part of that application.	03/31/2020
Submittal of Annual PMP Status Reports After Permit Expiration: In the event that this permit is not reissued on time for an July 1, 2020 effective date, the permittee shall continue to submit annual PMP status reports by March 31 each year summarizing sector outreach accomplished or planned during the previous calendar year. For example, a PMP status report covering the period from January 1, 2020 through December 31, 2020 would be due March 31, 2021.	

5.3 CMOM (Capacity, Management, Operation and Maintenance) Program Development

Required Action	Due Date
Complete Program Development: The permittee shall complete development of a CMOM Program. See CMOM requirements in Standard Requirement section 6.3.2 of this permit.	08/01/2016

6 Standard Requirements

NR 205, Wisconsin Administrative Code: The conditions in ss. NR 205.07(1) and NR 205.07(2), Wis. Adm. Code, are included by reference in this permit. The permittee shall comply with all of these requirements. Some of these requirements are outlined in the Standard Requirements section of this permit. Requirements not specifically outlined in the Standard Requirement section of this permit can be found in ss. NR 205.07(1) and NR 205.07(2).

6.1 Reporting and Monitoring Requirements

6.1.1 Monitoring Results

Monitoring results obtained during the previous month shall be summarized and reported on a Department Wastewater Discharge Monitoring Report. The report may require reporting of any or all of the information specified below under 'Recording of Results'. This report is to be returned to the Department no later than the date indicated on the form. A copy of the Wastewater Discharge Monitoring Report Form or an electronic file of the report shall be retained by the permittee.

Monitoring results shall be reported on an electronic discharge monitoring report (eDMR). The eDMR shall be certified electronically by a principal executive officer, a ranking elected official or other duly authorized representative. The 'eReport Certify' page certifies that the electronic report form is true, accurate and complete.

If the permittee monitors any pollutant more frequently than required by this permit, the results of such monitoring shall be included on the Wastewater Discharge Monitoring Report.

The permittee shall comply with all limits for each parameter regardless of monitoring frequency. For example, monthly, weekly, and/or daily limits shall be met even with monthly monitoring. The permittee may monitor more frequently than required for any parameter.

6.1.2 Sampling and Testing Procedures

Sampling and laboratory testing procedures shall be performed in accordance with Chapters NR 218 and NR 219, Wis. Adm. Code and shall be performed by a laboratory certified or registered in accordance with the requirements of ch. NR 149, Wis. Adm. Code. Groundwater sample collection and analysis shall be performed in accordance with ch. NR 140, Wis. Adm. Code. The analytical methodologies used shall enable the laboratory to quantitate all substances for which monitoring is required at levels below the effluent limitation. If the required level cannot be met by any of the methods available in NR 219, Wis. Adm. Code, then the method with the lowest limit of detection shall be selected. Additional test procedures may be specified in this permit.

6.1.3 Pretreatment Sampling Requirements

Sampling for pretreatment parameters (cadmium, chromium, copper, lead, nickel, zinc, and mercury) shall be done during a day each month when industrial discharges are occurring at normal to maximum levels. The sampling of the influent and effluent for these parameters shall be coordinated. All 24 hour composite samples shall be flow proportional.

6.1.4 Recording of Results

The permittee shall maintain records which provide the following information for each effluent measurement or sample taken:

- the date, exact place, method and time of sampling or measurements;
- the individual who performed the sampling or measurements;
- the date the analysis was performed;
- the individual who performed the analysis;

- the analytical techniques or methods used; and
- the results of the analysis.

6.1.5 Reporting of Monitoring Results

The permittee shall use the following conventions when reporting effluent monitoring results:

- Pollutant concentrations less than the limit of detection shall be reported as < (less than) the value of the limit of detection. For example, if a substance is not detected at a detection limit of 0.1 mg/L, report the pollutant concentration as < 0.1 mg/L.

- Pollutant concentrations equal to or greater than the limit of detection, but less than the limit of quantitation, shall be reported and the limit of quantitation shall be specified.

- For purposes of calculating NR 101 fees, the 2 mg/l lower reporting limits for BOD_5 and Total Suspended Solids shall be considered to be limits of quantitation

- For the purposes of reporting a calculated result, average or a mass discharge value, the permittee may substitute a 0 (zero) for any pollutant concentration that is less than the limit of detection. However, if the effluent limitation is less than the limit of detection, the department may substitute a value other than zero for results less than the limit of detection, after considering the number of monitoring results that are greater than the limit of detection and if warranted when applying appropriate statistical techniques.

6.1.6 Compliance Maintenance Annual Reports

Compliance Maintenance Annual Reports (CMAR) shall be completed using information obtained over each calendar year regarding the wastewater conveyance and treatment system. The CMAR shall be submitted by the permittee in accordance with ch. NR 208, Wis. Adm. Code, by June 30, each year on an electronic report form provided by the Department.

In the case of a publicly owned treatment works, a resolution shall be passed by the governing body and submitted as part of the CMAR, verifying its review of the report and providing responses as required. Private owners of wastewater treatment works are not required to pass a resolution; but they must provide an Owner Statement and responses as required, as part of the CMAR submittal.

A separate CMAR certification document, that is not part of the electronic report form, shall be mailed to the Department at the time of electronic submittal of the CMAR. The CMAR certification shall be signed and submitted by an authorized representative of the permittee. The certification shall be submitted by mail. The certification shall verify the electronic report is complete, accurate and contains information from the owner's treatment works.

6.1.7 Records Retention

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by the permit, and records of all data used to complete the application for the permit for a period of at least 3 years from the date of the sample, measurement, report or application. All pertinent sludge information, including permit application information and other documents specified in this permit or s. NR 204.06(9), Wis. Adm. Code shall be retained for a minimum of 5 years.

6.1.8 Other Information

Where the permittee becomes aware that it failed to submit any relevant facts in a permit application or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or correct information to the Department.

6.2 System Operating Requirements

6.2.1 Noncompliance Reporting

Sanitary sewer overflows and sewage treatment facility overflows shall be reported according to the 'Sanitary Sewer Overflows and Sewage Treatment Facility Overflows' section of this permit.

The permittee shall report the following types of noncompliance by a telephone call to the Department's regional office within 24 hours after becoming aware of the noncompliance:

- any noncompliance which may endanger health or the environment;
- any violation of an effluent limitation resulting from an unscheduled bypass;
- any violation of an effluent limitation resulting from an upset; and
- any violation of a maximum discharge limitation for any of the pollutants listed by the Department in the permit, either for effluent or sludge ceiling limits.

A written report describing the noncompliance shall also be submitted to the Department's regional office within 5 days after the permittee becomes aware of the noncompliance. On a case-by-case basis, the Department may waive the requirement for submittal of a written report within 5 days and instruct the permittee to submit the written report with the next regularly scheduled monitoring report. In either case, the written report shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times; the steps taken or planned to reduce, eliminate and prevent reoccurrence of the noncompliance; and if the noncompliance has not been corrected, the length of time it is expected to continue.

A scheduled bypass approved by the Department under the 'Scheduled Bypass' section of this permit shall not be subject to the reporting required under this section.

NOTE: Section 292.11(2)(a), Wisconsin Statutes, requires any person who possesses or controls a hazardous substance or who causes the discharge of a hazardous substance to notify the Department of Natural Resources **immediately** of any discharge not authorized by the permit. **The discharge of a hazardous substance that is not authorized by this permit or that violates this permit may be a hazardous substance spill**. **To report a hazardous substance spill, call DNR's 24-hour HOTLINE at 1-800-943-0003.**

6.2.2 Flow Meters

Flow meters shall be calibrated annually, as per s. NR 218.06, Wis. Adm. Code.

6.2.3 Raw Grit and Screenings

All raw grit and screenings shall be disposed of at a properly licensed solid waste facility or picked up by a licensed waste hauler. If the facility or hauler are located in Wisconsin, then they shall be licensed under chs. NR 500-536, Wis. Adm. Code.

6.2.4 Sludge Management

All sludge management activities shall be conducted in compliance with ch. NR 204 "Domestic Sewage Sludge Management", Wis. Adm. Code.

6.2.5 Prohibited Wastes

Under no circumstances may the introduction of wastes prohibited by s. NR 211.10, Wis. Adm. Code, be allowed into the waste treatment system. Prohibited wastes include those:

- which create a fire or explosion hazard in the treatment work;
- which will cause corrosive structural damage to the treatment work;
- solid or viscous substances in amounts which cause obstructions to the flow in sewers or interference with the proper operation of the treatment work;
- wastewaters at a flow rate or pollutant loading which are excessive over relatively short time periods so as to cause a loss of treatment efficiency; and
- changes in discharge volume or composition from contributing industries which overload the treatment works or cause a loss of treatment efficiency.

6.2.6 Bypass

This condition applies only to bypassing at a sewage treatment facility that is not a scheduled bypass, approved blending as a specific condition of this permit, a sewage treatment facility overflow or a controlled diversion as provided in the sections titled ‘Scheduled Bypass’, ‘Blending’ (if approved), ‘SSO’s and Sewage Treatment Facility Overflows’ and ‘Controlled Diversions’ of this permit. Any other bypass at the sewage treatment facility is prohibited and the Department may take enforcement action against a permittee for such occurrences under s. 283.89, Wis. Stats. The Department may approve an unscheduled bypass provided all the following conditions are met:

- The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
- There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities or adequate back-up equipment, retention of untreated wastes, reduction of inflow and infiltration, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance. When evaluating feasibility of alternatives, the department may consider factors such as technical achievability, costs and affordability of implementation and risks to public health, the environment and, where the permittee is a municipality, the welfare of the community served; and
- The bypass was reported in accordance with the Noncompliance Reporting section of this permit.

6.2.7 Scheduled Bypass

Whenever the permittee anticipates the need to bypass for purposes of efficient operations and maintenance and the permittee may not meet the conditions for controlled diversions in the ‘Controlled Diversions’ section of this permit, the permittee shall obtain prior written approval from the Department for the scheduled bypass. A permittee’s written request for Department approval of a scheduled bypass shall demonstrate that the conditions for unscheduled bypassing are met and include the proposed date and reason for the bypass, estimated volume and duration of the bypass, alternatives to bypassing and measures to mitigate environmental harm caused by the bypass. The department may require the permittee to provide public notification for a scheduled bypass if it is determined there is significant public interest in the proposed action and may recommend mitigation measures to minimize the impact of such bypass.

6.2.8 Controlled Diversions

Controlled diversions are allowed only when necessary for essential maintenance to assure efficient operation. Sewage treatment facilities that have multiple treatment units to treat variable or seasonal loading conditions may shut down redundant treatment units when necessary for efficient operation. The following requirements shall be met during controlled diversions:

- Effluent from the sewage treatment facility shall meet the effluent limitations established in the permit. Wastewater that is diverted around a treatment unit or treatment process during a controlled diversion shall be recombined with wastewater that is not diverted prior to the effluent sampling location and prior to effluent discharge;
- A controlled diversion may not occur during periods of excessive flow or other abnormal wastewater characteristics;
- A controlled diversion may not result in a wastewater treatment facility overflow; and
- All instances of controlled diversions shall be documented in sewage treatment facility records and such records shall be available to the department on request.

6.2.9 Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control which are installed or used by the permittee to achieve compliance with the conditions of this permit. The wastewater treatment facility shall be under the direct supervision of a state certified operator as required in s. NR 108.06(2), Wis. Adm. Code. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training as required in ch. NR 114, Wis. Adm. Code, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of the permit.

6.3 Sewage Collection Systems

6.3.1 Sanitary Sewage Overflows and Sewage Treatment Facility Overflows

6.3.1.1 Overflows Prohibited

Any overflow or discharge of wastewater from the sewage collection system or at the sewage treatment facility, other than from permitted outfalls, is prohibited. The permittee shall provide information on whether any of the following conditions existed when an overflow occurred:

- The sanitary sewer overflow or sewage treatment facility overflow was unavoidable to prevent loss of life, personal injury or severe property damage;
- There were no feasible alternatives to the sanitary sewer overflow or sewage treatment facility overflow such as the use of auxiliary treatment facilities or adequate back-up equipment, retention of untreated wastes, reduction of inflow and infiltration, or preventative maintenance activities;
- The sanitary sewer overflow or the sewage treatment facility overflow was caused by unusual or severe weather related conditions such as large or successive precipitation events, snowmelt, saturated soil conditions, or severe weather occurring in the area served by the sewage collection system or sewage treatment facility; and
- The sanitary sewer overflow or the sewage treatment facility overflow was unintentional, temporary, and caused by an accident or other factors beyond the reasonable control of the permittee.

6.3.1.2 Permittee Response to Overflows

Whenever a sanitary sewer overflow or sewage treatment facility overflow occurs, the permittee shall take all feasible steps to control or limit the volume of untreated or partially treated wastewater discharged, and terminate the discharge as soon as practicable. Remedial actions, including those in NR 210.21 (3), Wis. Adm. Code, shall be implemented consistent with an emergency response plan developed under the CMOM program.

6.3.1.3 Permittee Reporting

Permittees shall report all sanitary sewer overflows and sewage treatment overflows as follows:

- The permittee shall notify the department by telephone, fax or email as soon as practicable, but no later than 24 hours from the time the permittee becomes aware of the overflow;
- The permittee shall, no later than five days from the time the permittee becomes aware of the overflow, provide to the department the information identified in this paragraph using department form number 3400-184. If an overflow lasts for more than five days, an initial report shall be submitted within 5 days as required in this paragraph and an updated report submitted following cessation of the overflow. At a minimum, the following information shall be included in the report:

  ◦The date and location of the overflow;
  ◦The surface water to which the discharge occurred, if any;
  ◦The duration of the overflow and an estimate of the volume of the overflow;
  ◦A description of the sewer system or treatment facility component from which the discharge occurred such as manhole, lift station, constructed overflow pipe, or crack or other opening in a pipe;
  ◦The estimated date and time when the overflow began and stopped or will be stopped;
  ◦The cause or suspected cause of the overflow including, if appropriate, precipitation, runoff conditions, areas of flooding, soil moisture and other relevant information;
  ◦Steps taken or planned to reduce, eliminate and prevent reoccurrence of the overflow and a schedule of major milestones for those steps;
  ◦A description of the actual or potential for human exposure and contact with the wastewater from the overflow;
  ◦Steps taken or planned to mitigate the impacts of the overflow and a schedule of major milestones for those steps;
  ◦To the extent known at the time of reporting, the number and location of building backups caused by excessive flow or other hydraulic constraints in the sewage collection system that occurred concurrently with the sanitary sewer overflow and that were within the same area of the sewage collection system as the sanitary sewer overflow; and
  ◦The reason the overflow occurred or explanation of other contributing circumstances that resulted in the overflow event. This includes any information available including whether the overflow was unavoidable to prevent loss of life, personal injury, or severe property damage and whether there were feasible alternatives to the overflow.

  NOTE: A copy of form 3400-184 for reporting sanitary sewer overflows and sewage treatment facility overflows may be obtained from the department or accessed on the department's web site at http://dnr.wi.gov/topic/wastewater/SSOreport.html. As indicated on the form, additional information may be submitted to supplement the information required by the form.

- The permittee shall identify each specific location and each day on which a sanitary sewer overflow or sewage treatment facility overflow occurs as a discrete sanitary sewer overflow or sewage treatment facility overflow occurrence. An occurrence may be more than one day if the circumstances causing the sanitary sewer overflow or sewage treatment facility overflow results in a discharge duration of greater than 24 hours. If there is a stop and restart of the overflow at the same location within 24 hours and the overflow is caused by the same circumstance, it may be reported as one occurrence. Sanitary sewer overflow occurrences at a specific location that are separated by more than 24 hours shall be reported as separate occurrences; and
- A permittee that is required to submit wastewater discharge monitoring reports under NR 205.07 (1) (r) shall also report all sanitary sewer overflows and sewage treatment facility overflows on that report.

6.3.1.4 Public Notification

The permittee shall notify the public of any sanitary sewer and sewage treatment facility overflows consistent with its emergency response plan required under the CMOM (Capacity, Management, Operation and Maintenance) section of this permit and s. NR 210.23 (4) (f), Wis. Adm. Code. Such public notification shall occur promptly following any overflow event using the most effective and efficient communications available in the community. At minimum, a daily newspaper of general circulation in the county(s) and municipality whose waters may be affected by the overflow shall be notified by written or electronic communication.

6.3.2 Capacity, Management, Operation and Maintenance (CMOM) Program

- The permittee shall by August 1, 2016 submit to the Department verification that a CMOM program for the sewage collection system has been developed which is consistent with the requirements of NR 210.23, Wis. Adm. Code.
- The permittee shall develop and maintain written documentation of the CMOM program components, and shall verify each year with the submittal of the Compliance Maintenance Annual Report required under the 'Compliance Maintenance Annual Reports' section of this permit that the CMOM program documentation is current and meets the requirements in NR 210.23, Wis. Adm. Code.
- The permittee shall implement a CMOM program consistent with the permittee's program documentation and with the requirements of NR 210.23, Wis. Adm. Code.
- The permittee shall annually conduct a self-audit of activities to ensure the CMOM program is being implemented as necessary to meet the requirements contained in the CMOM program documentation.
- The permittee shall make available CMOM program documentation, a record of implementation activities and the results of the self-audit to the Department on request.

6.3.3 Sewer Cleaning Debris and Materials

All debris and material removed from cleaning sanitary sewers shall be managed to prevent nuisances, run-off, ground infiltration or prohibited discharges.

- Debris and solid waste shall be dewatered, dried and then disposed of at a licensed solid waste facility.
- Liquid waste from the cleaning and dewatering operations shall be collected and disposed of at a permitted wastewater treatment facility.
- Combination waste including liquid waste along with debris and solid waste may be disposed of at a licensed solid waste facility or wastewater treatment facility willing to accept the waste.

6.4 Surface Water Requirements

6.4.1 Permittee-Determined Limit of Quantitation Incorporated into this Permit

For pollutants with water quality-based effluent limits below the Limit of Quantitation (LOQ) in this permit, the LOQ calculated by the permittee and reported on the Discharge Monitoring Reports (DMRs) is incorporated by reference into this permit. The LOQ shall be reported on the DMRs, shall be the lowest quantifiable level practicable, and shall be no greater than the minimum level (ML) specified in or approved under 40 CFR Part 136 for the pollutant at the time this permit was issued, unless this permit specifies a higher LOQ.

6.4.2 Appropriate Formulas for Effluent Calculations

The permittee shall use the following formulas for calculating effluent results to determine compliance with average concentration limits and mass limits and total load limits:

Weekly/Monthly/Six-Month/Annual Average Concentration = the sum of all daily results for that week/month/six-month/year, divided by the number of results during that time period. [Note: When a six-month average effluent limit is specified for Total Phosphorus the applicable periods are May through October and November through April.]

Weekly Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the week.

Monthly Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the month.

Six-Month Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the six-month period. [Note: When a six-month average effluent limit is specified for Total Phosphorus the applicable periods are May through October and November through April.]

Annual Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the entire year.

Total Monthly Discharge: = monthly average concentration (mg/L) x total flow for the month (MG/month) x 8.34.

Total Annual Discharge: = sum of total monthly discharges for the calendar year.

12-Month Rolling Sum of Total Monthly Discharge: = the sum of the most recent 12 consecutive months of Total Monthly Discharges.

6.4.3 Effluent Temperature Requirements

Weekly Average Temperature – The permittee shall use the following formula for calculating effluent results to determine compliance with the weekly average temperature limit (as applicable): Weekly Average Temperature = the sum of all daily maximum results for that week divided by the number of daily maximum results during that time period.

Cold Shock Standard – Water temperatures of the discharge shall be controlled in a manner as to protect fish and aquatic life uses from the deleterious effects of cold shock. ‘Cold Shock’ means exposure of aquatic organisms to a rapid decrease in temperature and a sustained exposure to low temperature that induces abnormal behavior or physiological performance and may lead to death.

Rate of Temperature Change Standard – Temperature of a water of the state or discharge to a water of the state may not be artificially raised or lowered at such a rate that it causes detrimental health or reproductive effects to fish or aquatic life of the water of the state.

6.4.4 Visible Foam or Floating Solids

There shall be no discharge of floating solids or visible foam in other than trace amounts.

6.4.5 Surface Water Uses and Criteria

In accordance with NR 102.04, Wis. Adm. Code, surface water uses and criteria are established to govern water management decisions. Practices attributable to municipal, industrial, commercial, domestic, agricultural, land development or other activities shall be controlled so that all surface waters including the mixing zone meet the following conditions at all times and under all flow and water level conditions:

a) Substances that will cause objectionable deposits on the shore or in the bed of a body of water, shall not be present in such amounts as to interfere with public rights in waters of the state.

b) Floating or submerged debris, oil, scum or other material shall not be present in such amounts as to interfere with public rights in waters of the state.

c) Materials producing color, odor, taste or unsightliness shall not be present in such amounts as to interfere with public rights in waters of the state.

d) Substances in concentrations or in combinations which are toxic or harmful to humans shall not be present in amounts found to be of public health significance, nor shall substances be present in amounts which are acutely harmful to animal, plant or aquatic life.

6.4.6 Percent Removal

During any 30 consecutive days, the average effluent concentrations of BOD_5 and of total suspended solids shall not exceed 15% of the average influent concentrations, respectively. This requirement does not apply to removal of total suspended solids if the permittee operates a lagoon system and has received a variance for suspended solids granted under NR 210.07(2), Wis. Adm. Code.

6.4.7 Fecal Coliforms

The limit for fecal coliforms shall be expressed as a monthly geometric mean.

6.4.8 Seasonal Disinfection

Disinfection shall be provided from May 1 through September 30 of each year. Monitoring requirements and the limitation for fecal coliforms apply only during the period in which disinfection is required. Whenever chlorine is used for disinfection or other uses, the limitations and monitoring requirements for residual chlorine shall apply. A dechlorination process shall be in operation whenever chlorine is used.

6.4.9 Total Residual Chlorine Requirements (When De-Chlorinating Effluent)

Test methods for total residual chlorine, approved in ch. NR 219 - Table B, Wis. Adm. Code, normally achieve a limit of detection of about 20 to 50 micrograms per liter and a limit of quantitation of about 100 micrograms per liter. Reporting of test results and compliance with effluent limitations for chlorine residual and total residual halogens shall be as follows:

- Sample results which show no detectable levels are in compliance with the limit. These test results shall be reported on Wastewater Discharge Monitoring Report Forms as "< 100 µg/L". (Note: 0.1 mg/L converts to 100 µg/L)

- Samples showing detectable traces of chlorine are in compliance if measured at less than 100 µg/L, unless there is a consistent pattern of detectable values in this range. These values shall also be reported on Wastewater Discharge Monitoring Report Forms as "<100 µg/L." The facility operating staff shall record actual readings on logs maintained at the plant, shall take action to determine the reliability of detected results (such as re-sampling and/or calculating dosages), and shall adjust the chemical feed system if necessary to reduce the chances of detects.

- Samples showing detectable levels greater than 100 µg/L shall be considered as exceedances, and shall be reported as measured.

- To calculate average or mass discharge values, a "0" (zero) may be substituted for any test result less than 100 µg/L. Calculated values shall then be compared directly to the average or mass limitations to determine compliance.

6.4.10 Whole Effluent Toxicity (WET) Monitoring Requirements

In order to determine the potential impact of the discharge on aquatic organisms, static-renewal toxicity tests shall be performed on the effluent in accordance with the procedures specified in the *"State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, 2nd Edition" (PUB-WT-797*, November 2004) as required by NR 219.04, Table A, Wis. Adm. Code). All of the WET tests required in this permit, including any required retests, shall be conducted on the

Ceriodaphnia dubia and fathead minnow species. Receiving water samples shall not be collected from any point in contact with the permittee's mixing zone and every attempt shall be made to avoid contact with any other discharge's mixing zone.

6.4.11 Whole Effluent Toxicity (WET) Identification and Reduction

This standard requirement applies only to acute or chronic WET monitoring that is not accompanied by a WET limit. Within 60 days of a retest which showed positive results, the permittee shall submit a written report to the Biomonitoring Coordinator, Bureau of Water Quality, 101 S. Webster St., PO Box 7921, Madison, WI 53707-7921, which details the following:

- A description of actions the permittee has taken or will take to remove toxicity and to prevent the recurrence of toxicity;
- A description of toxicity reduction evaluation (TRE) investigations that have been or will be done to identify potential sources of toxicity, including some or all of the following actions:
  (a) Evaluate the performance of the treatment system to identify deficiencies contributing to effluent toxicity (e.g., operational problems, chemical additives, incomplete treatment)
  (b) Identify the compound(s) causing toxicity
  (c) Trace the compound(s) causing toxicity to their sources (e.g., industrial, commercial, domestic)
  (d) Evaluate, select, and implement methods or technologies to control effluent toxicity (e.g., in-plant or pretreatment controls, source reduction or removal)
- Where corrective actions including a TRE have not been completed, an expeditious schedule under which corrective actions will be implemented;
- If no actions have been taken, the reason for not taking action.

The permittee may also request approval from the Department to postpone additional retests in order to investigate the source(s) of toxicity. Postponed retests must be completed after toxicity is believed to have been removed.

6.5 Pretreatment Program Requirements

The permittee is required to operate an industrial pretreatment program as described in the program initially approved by the Department of Natural Resources including any subsequent program modifications approved by the Department, and including commitments to program implementation activities provided in the permittee's annual pretreatment program report, and that complies with the requirements set forth in 40 CFR Part 403 and ch. NR 211, Wis. Adm. Code. To ensure that the program is operated in accordance with these requirements, the following general conditions and requirements are hereby established:

6.5.1 Inventories

The permittee shall implement methods to maintain a current inventory of the general character and volume of wastewater that industrial users discharge to the treatment works and shall provide an updated industrial user listing annually and report any changes in the listing to the Department by March 31 of each year as part of the annual pretreatment program report required herein.

6.5.2 Regulation of Industrial Users

6.5.2.1 Limitations for Industrial Users:

The permittee shall develop, maintain, enforce and revise as necessary local limits to implement the general and specific prohibitions of the state and federal General Pretreatment Regulations. The permittee shall also provide to the Department a written, technical evaluation of the need to revise local limits within six months of permit reissuance.

6.5.2.2 Control Documents for Industrial Users (IUs)

The permittee shall control the discharge from each significant industrial user through individual discharge permits as required by s. NR 211.235, Wis. Adm. Code and in accordance with the approved pretreatment program procedures and the permittee's sewer use ordinance. The discharge permits shall be modified in a timely manner during the stated term of the discharge permits according to the sewer use ordinance as conditions warrant. The discharge permits shall include at a minimum the elements found in s. NR 211.235(1), Wis. Adm. Code and references to the approved pretreatment program procedures and the sewer use ordinance.

6.5.2.3 Review of Industrial User Reports, Inspections and Compliance Monitoring

The permittee shall require the submission of, receive, and review self-monitoring reports and other notices from industrial users in accordance with the approved pretreatment program procedures. The permittee shall randomly sample and analyze industrial user discharges and conduct surveillance activities to determine independent of information supplied by the industrial users, whether the industrial users are in compliance with pretreatment standards and requirements. The inspections and monitoring shall also be conducted to maintain accurate knowledge of local industrial processes, including changes in the discharge, pretreatment equipment operation, spill prevention control plans, slug control plans, and implementation of solvent management plans.

The permittee shall inspect and sample the discharge from each significant industrial user as specified in the permittee's approved pretreatment program or as specified in NR 211.235(3). The permittee shall evaluate whether industrial users identified as significant need a slug control plan according to the requirements of NR 211.235(4). If a slug control plan is needed, the plan shall contain at a minimum the elements specified in s. NR 211.235(4)(b), Wis. Adm. Code.

6.5.2.4 Enforcement and Industrial User Compliance Evaluation & Violation Reports

The permittee shall enforce the industrial pretreatment requirements including the industrial user discharge limitations of the permittee's sewer use ordinance. The permittee shall investigate instances of noncompliance by collecting and analyzing samples and collecting other information with sufficient care to produce evidence admissible in enforcement proceedings or in judicial actions. Investigation and response to instances of noncompliance shall be in accordance with the permittee's sewer use ordinance and approved Enforcement Response Plan.

The permittee shall make a semiannual report on forms provided or approved by the Department. The semiannual report shall include an analysis of industrial user significant noncompliance (i.e. the Industrial User Compliance Evaluation, also known as the SNC Analysis) as outlined in s.NR 211.23(1)(j), Wis. Adm. Code, and a summary of the permittee's response to all industrial noncompliance (i.e. the Industrial User Violation Report). The Industrial User Compliance Evaluation Report shall include monitoring results received from industrial users pursuant to s. NR 211.15(1)-(5), Wis. Adm. Code. The Industrial User Violation Report shall include copies of all notices of noncompliance, notices of violation and other enforcement correspondence sent by the permittee to industrial users, together with the industrial user's response. The Industrial User Compliance Evaluation and Violation Reports for the period January through June shall be provided to the Department by September 30 of each year and for the period July through December shall be provided to the Department by March 31 of the succeeding year, unless alternate submittal dates are approved.

6.5.2.5 Publication of Violations

The permittee shall publish a list of industrial users that have significantly violated the municipal sewer use ordinance during the calendar year, in the largest daily newspaper in the area by March 31 of the following year pursuant to s. NR 211.23(1)(j), Wis. Adm. Code. A copy of the newspaper publication shall be provided as part of the annual pretreatment report specified herein.

6.5.2.6 Multijurisdictional Agreements

The permittee shall establish agreements with all contributing jurisdictions as necessary to ensure compliance with pretreatment standards and requirements by all industrial users discharging to the permittee's wastewater treatment system. Any such agreement shall identify who will be responsible for maintaining the industrial user inventory, issuance of industrial user control mechanisms, inspections and sampling, pretreatment program implementation, and enforcement.

6.5.3 Annual Pretreatment Program Report

The permittee shall evaluate the pretreatment program, and submit the Pretreatment Program Report to the Department on forms provided or approved by the Department by March 31 annually, unless an alternate submittal date is approved. The report shall include a brief summary of the work performed during the preceding calendar year, including the numbers of discharge permits issued and in effect, pollution prevention activities, number of inspections and monitoring surveys conducted, budget and personnel assigned to the program, a general discussion of program progress in meeting the objectives of the permittee's pretreatment program together with summary comments and recommendations.

6.5.4 Pretreatment Program Modifications

- Future Modifications: The permittee shall within one year of any revisions to federal or state General Pretreatment Regulations submit an application to the Department in duplicate to modify and update its approved pretreatment program to incorporate such regulatory changes as applicable to the permittee. Additionally, the Department or the permittee may request an application for program modification at any time where necessary to improve program effectiveness based on program experience to date.

- Modifications Subject to Department Approval: The permittee shall submit all proposed pretreatment program modifications to the Department for determination of significance and opportunity for comment in accordance with the requirements and conditions of s. NR 211.27, Wis. Adm. Code. Any substantial proposed program modification shall be subject to Department public noticing and formal approval prior to implementation. A substantial program modification includes, but is not limited to, changes in enabling legal authority to administer and enforce pretreatment conditions and requirements; significant changes in program administrative or operational procedures; significant reductions in monitoring frequencies; significant reductions in program resources including personnel commitments, equipment, and funding levels; changes (including any relaxation) in the local limitations for substances enforced and applied to users of the sewerage treatment works; changes in treatment works sludge disposal or management practices which impact the pretreatment program; or program modifications which increase pollutant loadings to the treatment works. The Department shall use the procedures outlined in s. NR 211.30, Wis. Adm. Code for review and approval/denial of proposed pretreatment program modifications. The permittee shall comply with local public participation requirements when implementing the pretreatment program.

6.5.5 Program Resources

The permittee shall have sufficient resources and qualified personnel to carry out the pretreatment program responsibilities as listed in ss. NR 211.22 and NR 211.23, Wis. Adm. Code.

6.6 Land Application Requirements

6.6.1 Sludge Management Program Standards And Requirements Based Upon Federally Promulgated Regulations

In the event that new federal sludge standards or regulations are promulgated, the permittee shall comply with the new sludge requirements by the dates established in the regulations, if required by federal law, even if the permit has not yet been modified to incorporate the new federal regulations.

6.6.2 General Sludge Management Information

The General Sludge Management Form 3400-48 shall be completed and submitted prior to any significant sludge management changes.

6.6.3 Sludge Samples

All sludge samples shall be collected at a point and in a manner which will yield sample results which are representative of the sludge being tested, and collected at the time which is appropriate for the specific test.

6.6.4 Land Application Characteristic Report

Each report shall consist of a Characteristic Form 3400-49 and Lab Report. The Characteristic Report Form 3400-49 shall be submitted electronically by January 31 following each year of analysis.

Following submittal of the electronic Characteristic Report Form 3400-49, this form shall be certified electronically via the 'eReport Certify' page by a principal executive officer, ranking elected official or duly authorized representative. The 'eReport Certify' page certifies that the electronic report is true, accurate and complete. The Lab Report must be sent directly to the facility's DNR sludge representative or basin engineer unless approval for not submitting the lab reports has been given.

The permittee shall use the following convention when reporting sludge monitoring results: Pollutant concentrations less than the limit of detection shall be reported as < (less than) the value of the limit of detection. For example, if a substance is not detected at a detection limit of 1.0 mg/kg, report the pollutant concentration as < 1.0 mg/kg .

All results shall be reported on a dry weight basis.

6.6.5 Calculation of Water Extractable Phosphorus

When sludge analysis for Water Extractable Phosphorus is required by this permit, the permittee shall use the following formula to calculate and report Water Extractable Phosphorus:
Water Extractable Phosphorus (% of Total P) =
[Water Extractable Phosphorus (mg/kg, dry wt) ÷ Total Phosphorus (mg/kg, dry wt)] x 100

6.6.6 Monitoring and Calculating PCB Concentrations in Sludge

When sludge analysis for "PCB, Total Dry Wt" is required by this permit, the PCB concentration in the sludge shall be determined as follows.

Either congener-specific analysis or Aroclor analysis shall be used to determine the PCB concentration. The permittee may determine whether Aroclor or congener specific analysis is performed. Analyses shall be performed in accordance with the following provisions and Table EM in s. NR 219.04, Wis. Adm. Code.

- EPA Method 1668 may be used to test for all PCB congeners. If this method is employed, all PCB congeners shall be delineated. Non-detects shall be treated as zero. The values that are between the limit of detection and the limit of quantitation shall be used when calculating the total value of all congeners.

All results shall be added together and the total PCB concentration by dry weight reported. **Note**: It is recognized that a number of the congeners will co-elute with others, so there will not be 209 results to sum.

- EPA Method 8082A shall be used for PCB-Aroclor analysis and may be used for congener specific analysis as well. If congener specific analysis is performed using Method 8082A, the list of congeners tested shall include at least congener numbers 5, 18, 31, 44, 52, 66, 87, 101, 110, 138, 141, 151, 153, 170, 180, 183, 187, and 206 plus any other additional congeners which might be reasonably expected to occur in the particular sample. For either type of analysis, the sample shall be extracted using the Soxhlet extraction (EPA Method 3540C) (or the Soxhlet Dean-Stark modification) or the pressurized fluid extraction (EPA Method 3545A). If Aroclor analysis is performed using Method 8082A, clean up steps of the extract shall be performed as necessary to remove interference and to achieve as close to a limit of detection of 0.11 mg/kg as possible. Reporting protocol, consistent with s. NR 106.07(6)(e), should be as follows: If all Aroclors are less than the LOD, then the Total PCB Dry Wt result should be reported as less than the highest LOD. If a single Aroclor is detected then that is what should be reported for the Total PCB result. If multiple Aroclors are detected, they should be summed and reported as Total PCBs. If congener specific analysis is done using Method 8082A, clean up steps of the extract shall be performed as necessary to remove interference and to achieve as close to a limit of detection of 0.003 mg/kg as possible for each congener. If the aforementioned limits of detection cannot be achieved after using the appropriate clean up techniques, a reporting limit that is achievable for the Aroclors or each congener for the sample shall be determined. This reporting limit shall be reported and qualified indicating the presence of an interference. The lab conducting the analysis shall perform as many of the following methods as necessary to remove interference:

3620C – Florisil	3611B - Alumina
3640A - Gel Permeation	3660B - Sulfur Clean Up (using copper shot instead of powder)
3630C - Silica Gel	3665A - Sulfuric Acid Clean Up

6.6.7 Annual Land Application Report

Land Application Report Form 3400-55 shall be submitted electronically by January 31, each year whether or not non-exceptional quality sludge is land applied. Non-exceptional quality sludge is defined in s. NR 204.07(4), Wis. Adm. Code. Following submittal of the electronic Annual Land Application Report Form 3400-55, this form shall be certified electronically via the 'eReport Certify' page by a principal executive officer, ranking elected official or duly authorized representative. The 'eReport Certify' page certifies that the electronic report form is true, accurate and complete.

6.6.8 Other Methods of Disposal or Distribution Report

The permittee shall submit electronically the Other Methods of Disposal or Distribution Report Form 3400-52 by January 31, each year whether or not sludge is hauled, landfilled, incinerated, or exceptional quality sludge is distributed or land applied. Following submittal of the electronic Report Form 3400-52, this form shall be certified electronically via the 'eReport Certify' page by a principal executive officer, ranking elected official or duly authorized representative. The 'eReport Certify' page certifies that the electronic report form is true, accurate and complete.

6.6.9 Approval to Land Apply

Bulk non-exceptional quality sludge as defined in s. NR 204.07(4), Wis. Adm. Code, may not be applied to land without a written approval letter or Form 3400-122 from the Department unless the Permittee has obtained permission from the Department to self approve sites in accordance with s. NR 204.06 (6), Wis. Adm. Code. Analysis of sludge characteristics is required prior to land application. Application on frozen or snow covered ground is restricted to the extent specified in s. NR 204.07(3) (l), Wis. Adm. Code.

6.6.10 Soil Analysis Requirements

Each site requested for approval for land application must have the soil tested prior to use. Each approved site used for land application must subsequently be soil tested such that there is at least one valid soil test in the four years prior to land application. All soil sampling and submittal of information to the testing laboratory shall be done in accordance with UW Extension Bulletin A-2100. The testing shall be done by the UW Soils Lab in Madison or Marshfield, WI or at a lab approved by UW. The test results including the crop recommendations shall be submitted to the DNR contact listed for this permit, as they are available. Application rates shall be determined based on the crop nitrogen recommendations and with consideration for other sources of nitrogen applied to the site.

6.6.11 Land Application Site Evaluation

For non-exceptional quality sludge, as defined in s. NR 204.07(4), Wis. Adm. Code, a Land Application Site Request Form 3400-053 shall be submitted to the Department for the proposed land application site. The Department will evaluate the proposed site for acceptability and will either approve or deny use of the proposed site. The permittee may obtain permission to approve their own sites in accordance with s. NR 204.06(6), Wis. Adm. Code.

6.6.12 Class B Sludge: Fecal Coliform Limitation

Compliance with the fecal coliform limitation for Class B sludge shall be demonstrated by calculating the geometric mean of at least 7 separate samples. (Note that a Total Solids analysis must be done on each sample). The geometric mean shall be less than 2,000,000 MPN or CFU/g TS. Calculation of the geometric mean can be done using one of the following 2 methods.
Method 1:
Geometric Mean = $(X_1 \text{ x } X_2 \text{ x } X_3 \ldots \text{x } X_n)^{1/n}$
Where X = Coliform Density value of the sludge sample, and where n = number of samples (at least 7)

Method 2:
Geometric Mean = antilog$[(X_1 + X_2 + X_3 \ldots + X_n) \div n]$
Where X = $\log_{10}$ of Coliform Density value of the sludge sample, and where n = number of samples (at least 7)
Example for Method 2

Sample Number	Coliform Density of Sludge Sample	$\log_{10}$
1	6.0×10^5	5.78
2	4.2×10^6	6.62
3	1.6×10^6	6.20
4	9.0×10^5	5.95
5	4.0×10^5	5.60
6	1.0×10^6	6.00
7	5.1×10^5	5.71

The geometric mean for the seven samples is determined by averaging the $\log_{10}$ values of the coliform density and taking the antilog of that value.
(5.78 + 6.62 + 6.20 + 5.95 + 5.60 + 6.00 + 5.71) ÷ 7 = 5.98
The antilog of 5.98 = 9.5×10^5

6.6.13 Class B Sludge: Anaerobic Digestion

Treat the sludge in the absence of air for a specific mean cell residence time at a specific temperature. Values for the mean cell residence time and temperature shall be between 15 days at 35° C to 55° C and 60 days at 20° C. Straight-line interpolation to calculate mean cell residence time is allowable when the temperature falls between 35° C and 20° C.

6.6.14 Class B Sludge - Vector Control: Injection

No significant amount of the sewage sludge shall be present on the land surface within one hour after the sludge is injected.

6.6.15 Class A Sludge - Vector Control: Incorporation

Class A sludge shall be surface applied within 8 hours after being discharged from a pathogen treatment process and then be incorporated within 6 hours of surface application.

6.6.16 Landfilling of Sludge

General: Sewage sludge may not be disposed of in a municipal solid waste landfill unless the landfill meets the requirements of chs. NR 500 to 536, Wis. Adm. Code, and is an approved facility as defined in s. 289.01(3), Wis. Stats. Any facility accepting sewage sludge shall be approved by the Department in writing to accept sewage sludge. Disposal of sewage sludge in a municipal solid waste landfill shall be in accordance with ss. NR 506.13 and 506.14. Sewage sludge may not be disposed of in a surface disposal unit as defined in s. NR 204.03(62).

Approval: The permittee shall obtain approval from the Department prior to the disposal of sludge at a Wisconsin licensed landfill.

6.6.17 Sludge Landfilling Reports

The permittee shall report the volume of sludge disposed of at any landfill facility on Form 3400-52. The permittee shall include the name and address of the landfill, the Department license number or other state's designation or license number for all landfills used during the report period and a letter of acceptability from the landfill owner. In addition, any permittee utilizing landfills as a disposal method shall submit to the Department any test results used to indicate acceptability of the sludge at a landfill. Form 3400-52 shall be submitted annually by January 31, following each year sludge is landfilled.

7 Summary of Reports Due

FOR INFORMATIONAL PURPOSES ONLY

Description	Date	Page
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Operational Evaluation Report	June 30, 2016	16
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Compliance Alternatives, Source Reduction, Improvements and Modifications Status	June 30, 2017	16
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Preliminary Compliance Alternatives Plan	June 30, 2018	16
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Final Compliance Alternatives Plan	June 30, 2019	17
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Progress Report on Plans & Specifications	June 30, 2020	17
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Final Plans and Specifications	June 30, 2021	17
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Treatment Plant Upgrade to Meet WQBELs	September 30, 2021	17
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Construction Upgrade Progress Report #1	September 30, 2022	17
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Construction Upgrade Progress Report #2	September 30, 2023	17
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Complete Construction	May 31, 2024	18
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Achieve Compliance	July 1, 2024	18
Mercury Pollutant Minimization Program -Implement the Mercury Pollutant Minimization Program	July 1, 2015	18
Mercury Pollutant Minimization Program -Submit Annual Status Reports	March 31, 2016	18
Mercury Pollutant Minimization Program -Submit Annual Status Report #2	March 31, 2017	18
Mercury Pollutant Minimization Program -Submit Annual Status Report #3	March 31, 2018	18
Mercury Pollutant Minimization Program -Submit Annual Status Report #4	March 31, 2019	18
Mercury Pollutant Minimization Program -Submit Annual Status Report #5	March 31, 2020	18
Mercury Pollutant Minimization Program -Submittal of Annual PMP Status Reports After Permit Expiration	See Permit	18
CMOM (Capacity, Management, Operation and Maintenance) Program Development -Complete Program Development	August 1, 2016	19
Compliance Maintenance Annual Reports (CMAR)	by June 30, each year	21

Industrial User Compliance Evaluation and Violation Reports	Semiannual	30
Pretreatment Program Report	Annually	31
General Sludge Management Form 3400-48	prior to any significant sludge management changes	32
Characteristic Form 3400-49 and Lab Report	by January 31 following each year of analysis	32
Land Application Report Form 3400-55	by January 31, each year whether or not non-exceptional quality sludge is land applied	33
Report Form 3400-52	by January 31, each year whether or not sludge is hauled, landfilled, incinerated, or exceptional quality sludge is distributed or land applied	33
Wastewater Discharge Monitoring Report	no later than the date indicated on the form	20

Report forms shall be submitted electronically in accordance with the reporting requirements herein. Any facility plans or plans and specifications for municipal, industrial, industrial pretreatment and non industrial wastewater systems shall be submitted to the Bureau of Water Quality, P.O. Box 7921, Madison, WI 53707-7921. All other submittals required by this permit shall be submitted to:
South Central Region, 3911 Fish Hatchery Road, Fitchburg, WI 53711-5397

APPENDIX C
HO-CHUNK CASINO LETTER

City of
BELOIT, Wisconsin

DEPARTMENT OF PUBLIC WORKS
UTILITIES AND ENGINEERING FACILITY
2400 Springbrook Court, Beloit, WI 53511
www.ci.beloit.wi.us

Ms. Ryan Lee
Analytical Environmental Services
1801 7th Street Suite 100
Sacramento, CA 95811

September 25, 2012

Dear Ryan,

Please allow this letter to serve as confirmation as to the City of Beloit, Wisconsin wastewater treatment facility's BOD and TSS capacity.

The City of Beloit Water Resources Division (WRD) owns and operates an 11.3 million gallons/day (MGD) advanced activated sludge wastewater treatment facility. On an average day the facility treats 4.0 MGD and meets all National Pollution Discharge Elimination System permit criteria. The facility routinely receives a grade of "A" on its Wisconsin DNR Compliance Maintenance Annual Report. The WRD also developed and manages an aggressive collection system maintenance program along with an award winning EPA mandated industrial pre-treatment program.

The most recent allocation study reveals an available BOD capacity of 5689 pounds per day or the equivalent of 12,642 single family residences. For a better perspective, a recent study looked at the flows and strength of discharge from two -200,000 square foot casinos. The averaged results are as follows:

- Flow: 107,000 gallons per day
- BOD discharge: 494 pounds per day
- TSS discharge: 253 pounds per day NOTE: TSS capacity is a non-factor.

As you can see, the City of Beloit's wastewater treatment facility is well-positioned for future growth and expansion. We look forward to working with you and forwarding the casino initiative. If you have any questions please call me at 608 364 5721 or e-mail me at mathosh@ci.beloit.wi.us. Thank you!

Respectfully,

HMathos

Harry C. Mathos, Director of Water Resources

Cc: Larry Arft
File

APPENDIX D
SUI PROJECTIONS AND PAST FLOWS

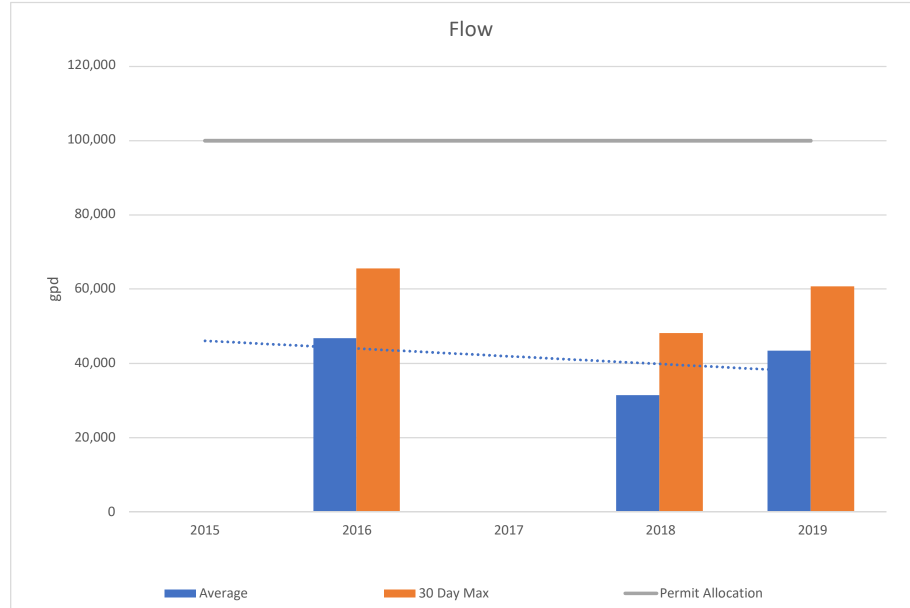
SIU A

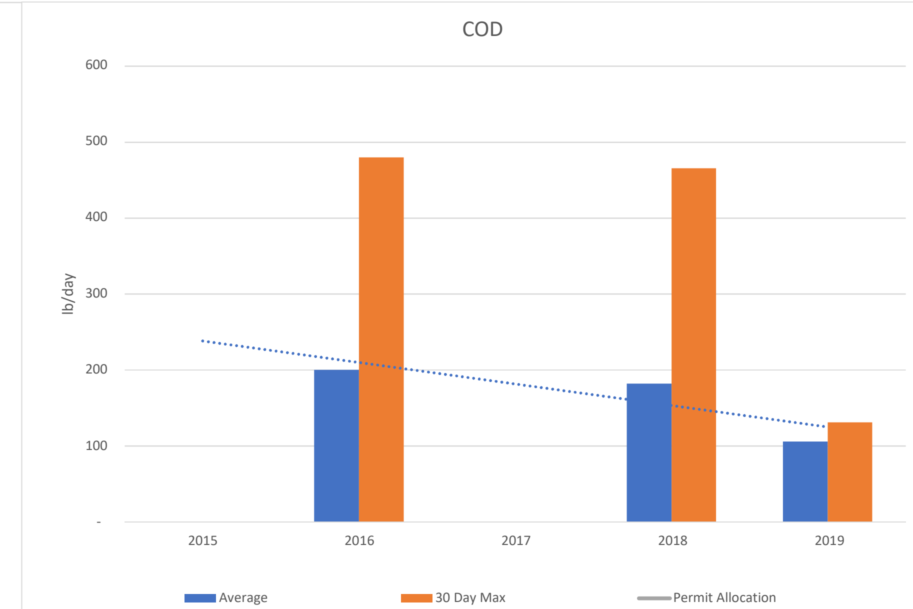
DRAFT-(08.19.20)

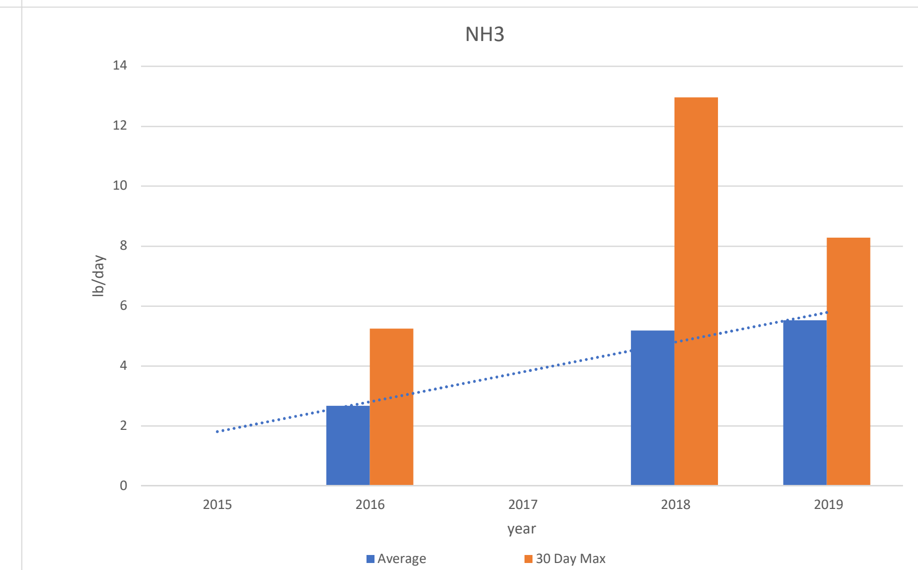
SIU A

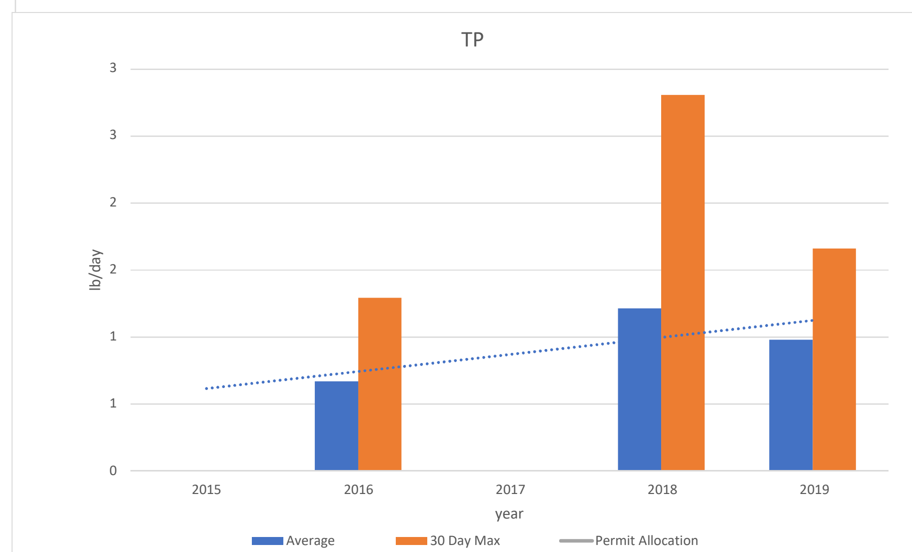
	Year	Flow gpd	COD lb/day	TSS lb/day	NH3 lb/day	P lb/day
Permit Allocation		100,000	N/A	N/A	N/A	N/A
2015 Average	2015					
2016 Average	2016	46,800	200	52	3	1
2017 Average	2017					
2018 Average	2018	31,374	182	63	5	1
2019 Average	2019	43,381	106	22	6	1
2018-19 Average		34,385	163	53	5	1
2015 30 Day Max:	2015					
2016 30 Day Max:	2016	65,614	480	96	5	1
2017 30 Day Max:	2017					
2018 30 Day Max:	2018	48,145	466	197	13	3
2019 30 Day Max:	2019	60,718	131	30	8	2

Note: No Data available for 2015 and 2017.



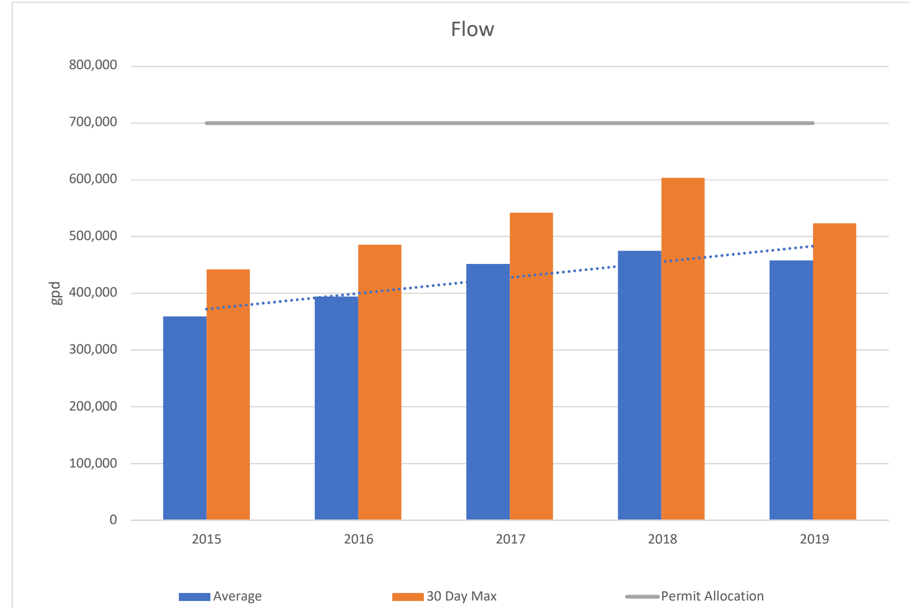


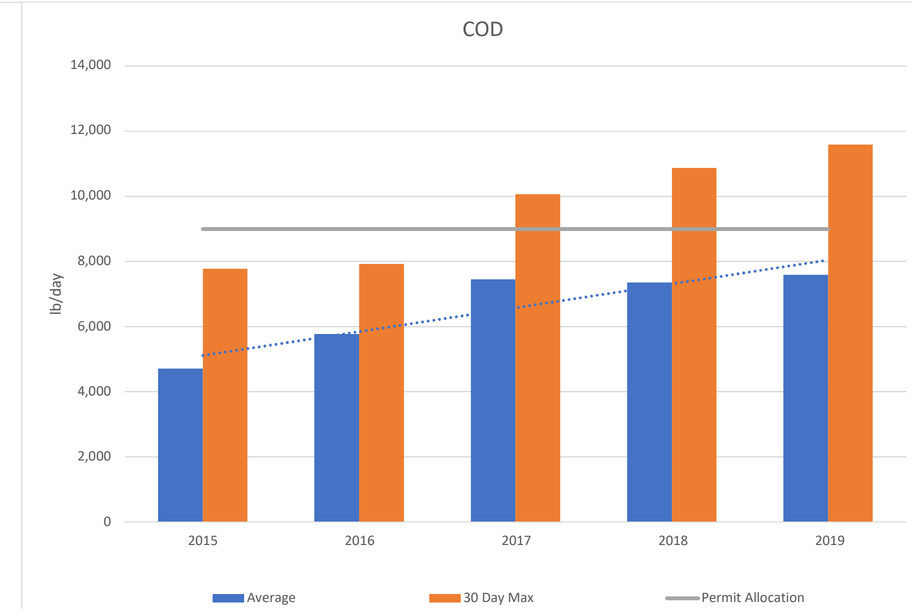


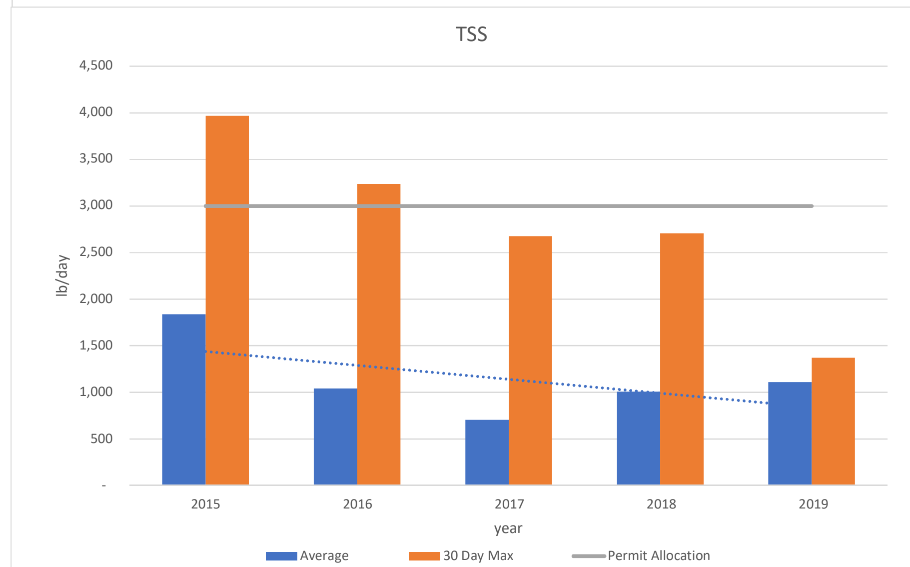


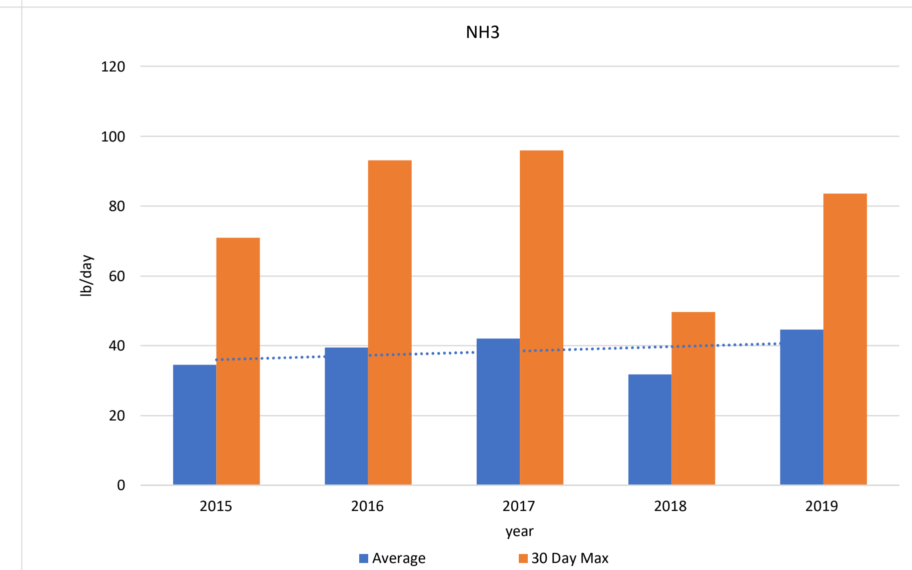
SIU B

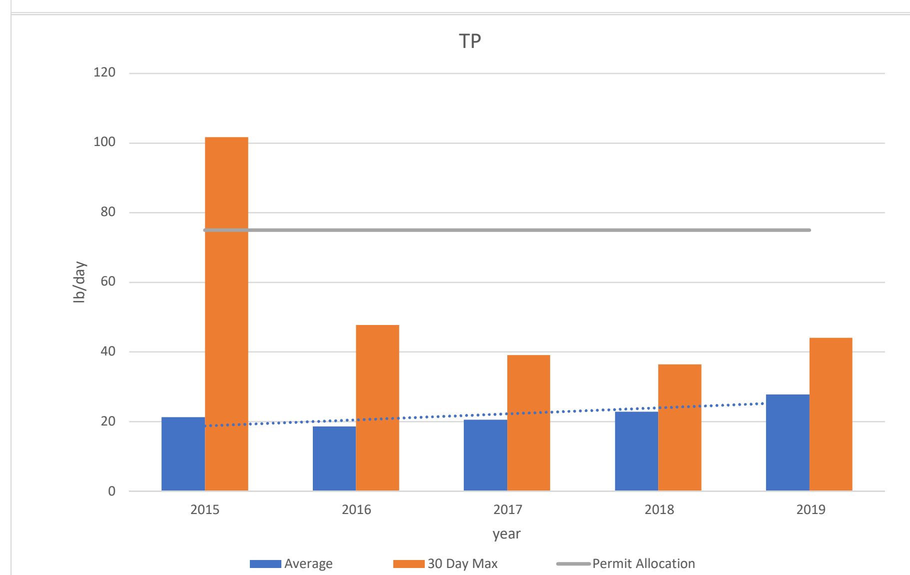
	Year	Flow gpd	COD lb/day	TSS lb/day	NH3 lb/day	P lb/day
Permit Allocation		700,000	9,000	3,000	N/A	75
2015 Average	2015	359,216	4,719	1,839	35	21
2016 Average	2016	394,669	5,779	1,041	39	19
2017 Average	2017	451,503	7,457	707	42	21
2018 Average	2018	475,099	7,352	1,006	32	23
2019 Average	2019	457,931	7,597	1,109	45	28
2018-19 Average		470,924	7,415	1,032	35	24
2015 30 Day Max:	2015	442,165	7,778	3,970	71	102
2016 30 Day Max:	2016	485,790	7,922	3,237	93	48
2017 30 Day Max:	2017	541,987	10,070	2,678	96	39
2018 30 Day Max:	2018	603,840	10,877	2,707	50	36
2019 30 Day Max:	2019	523,716	11,593	1,370	84	44











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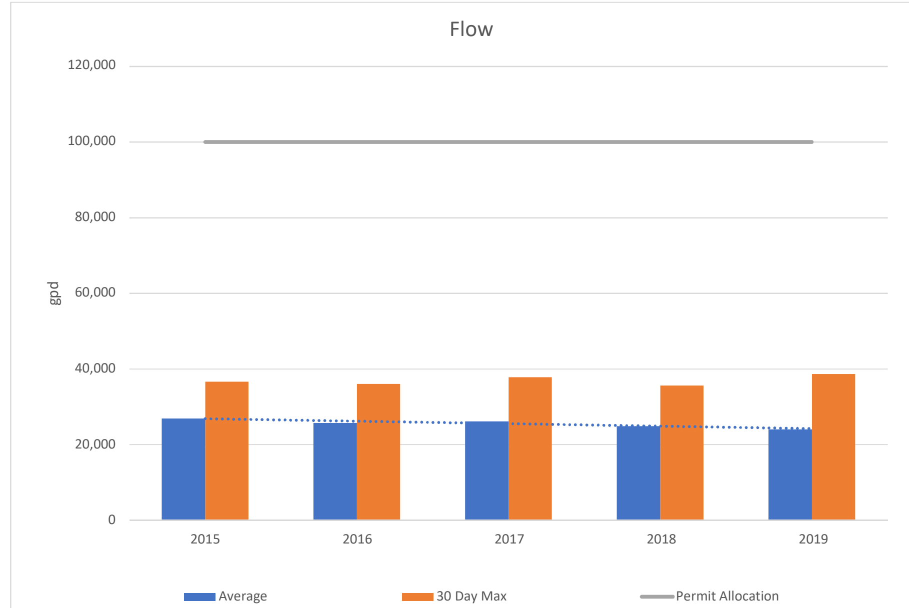
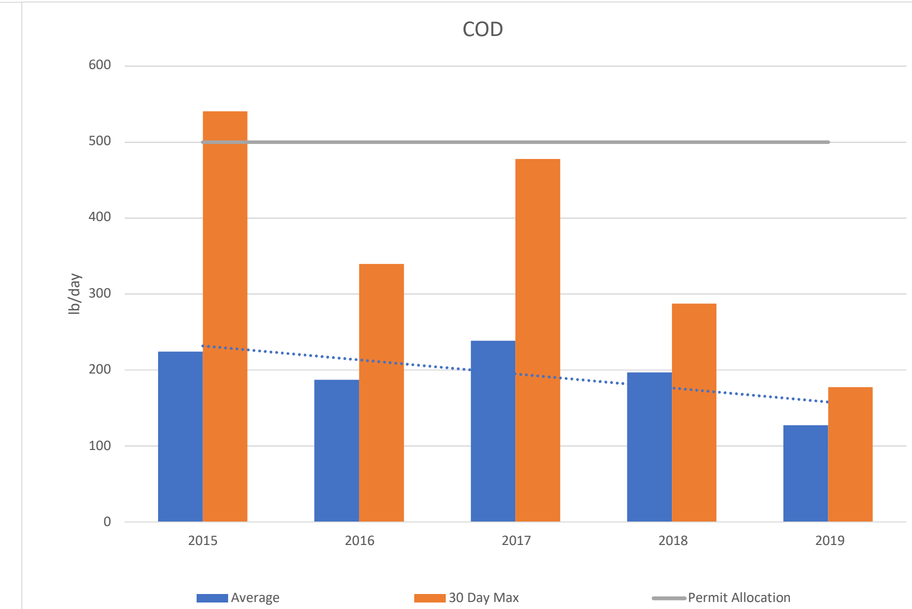
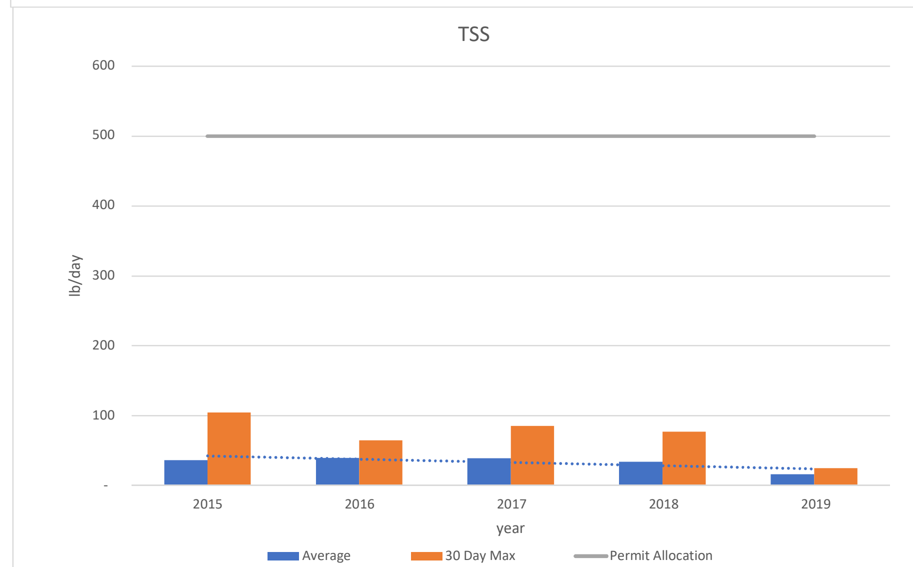
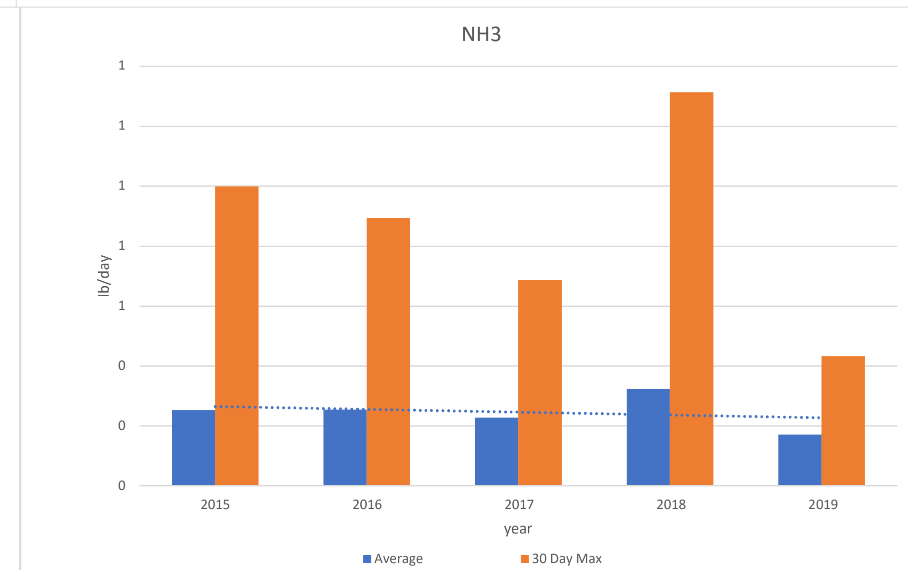
SIU C

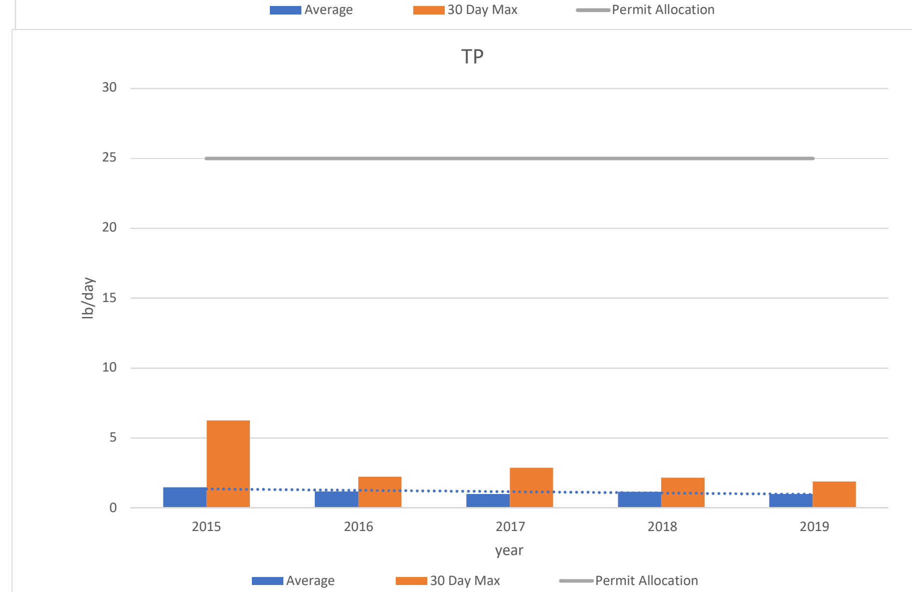
	Year	Flow gpd	COD lb/day	TSS lb/day	NH3 lb/day	P lb/day
Permit Allocation		100,000	500	500	N/A	25
2015 Average	2015	26,915	225	37	0	1
2016 Average	2016	25,704	187	39	0	1
2017 Average	2017	26,134	239	39	0	1
2018 Average	2018	24,899	197	34	0	1
2019 Average	2019	24,041	128	16	0	1
2018-19 Average		24,690	179	30	0	1
2015 30 Day Max:	2015	36,685	541	105	1	6
2016 30 Day Max:	2016	36,036	340	65	1	2
2017 30 Day Max:	2017	37,811	478	85	1	3
2018 30 Day Max:	2018	35,617	288	77	1	2
2019 30 Day Max:	2019	38,649	178	25	0	2











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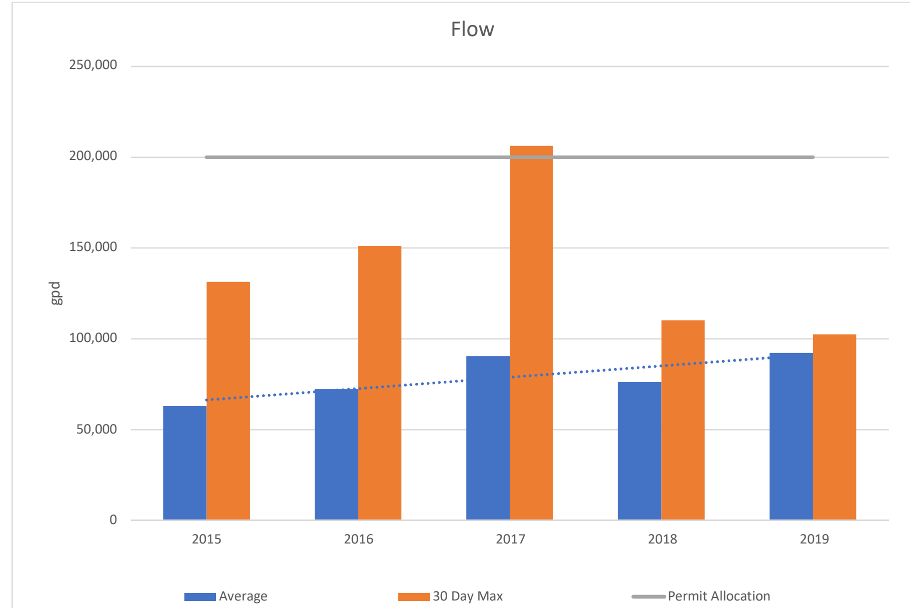
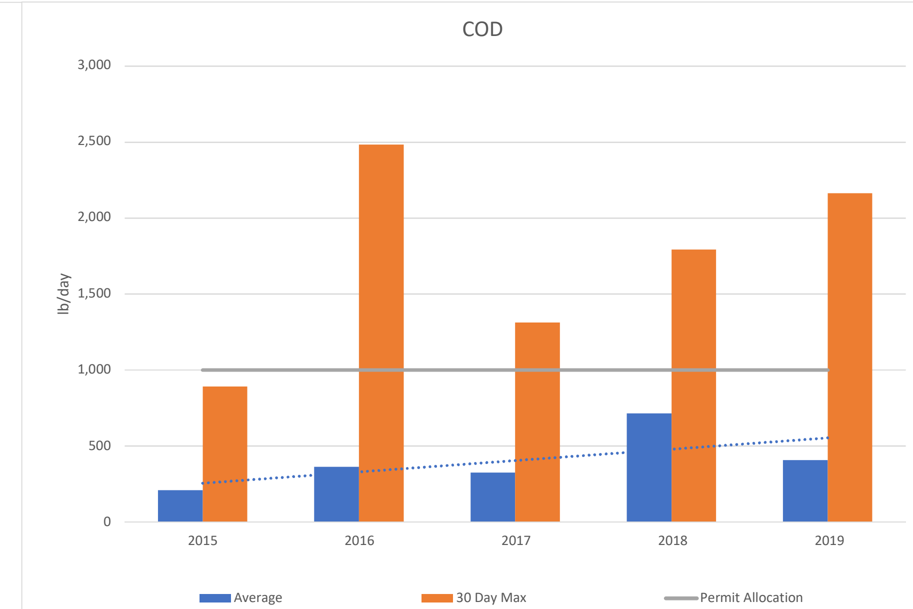
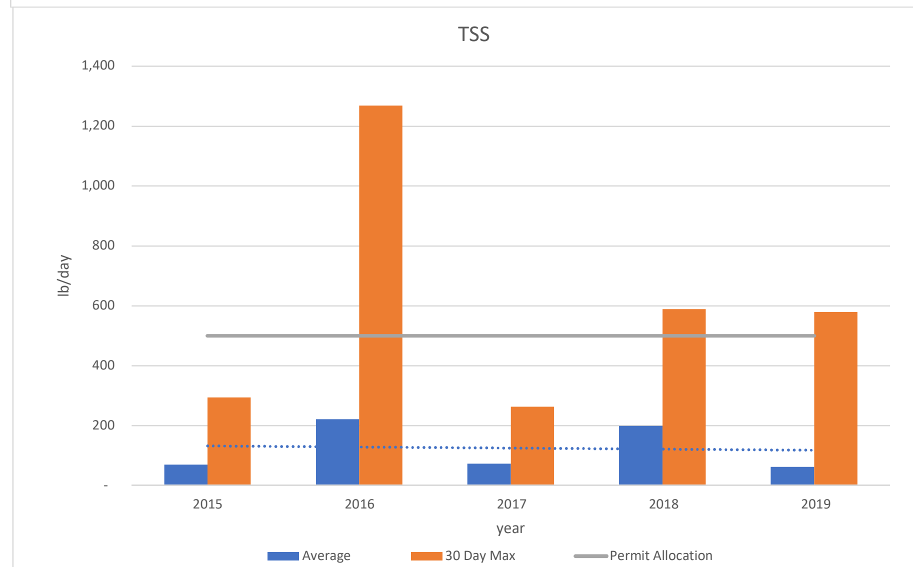
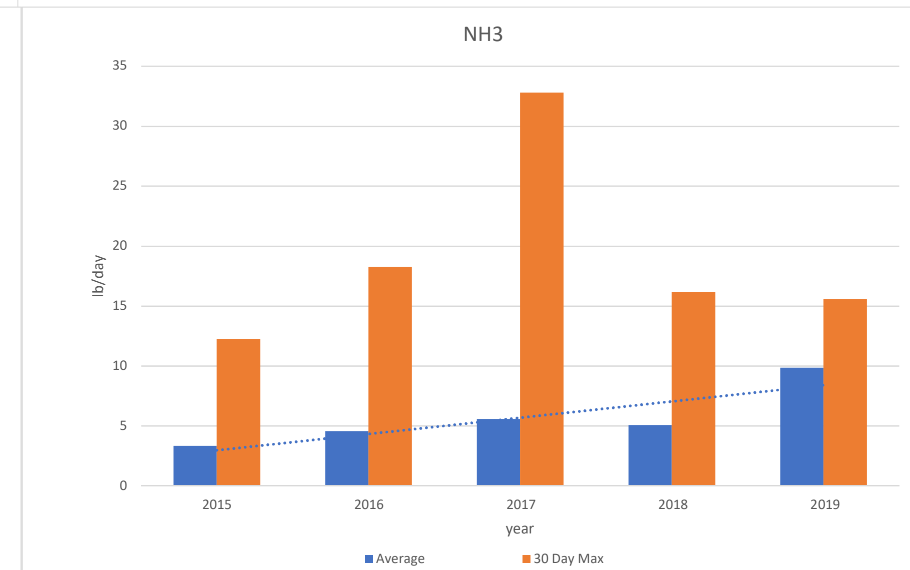
SIU D

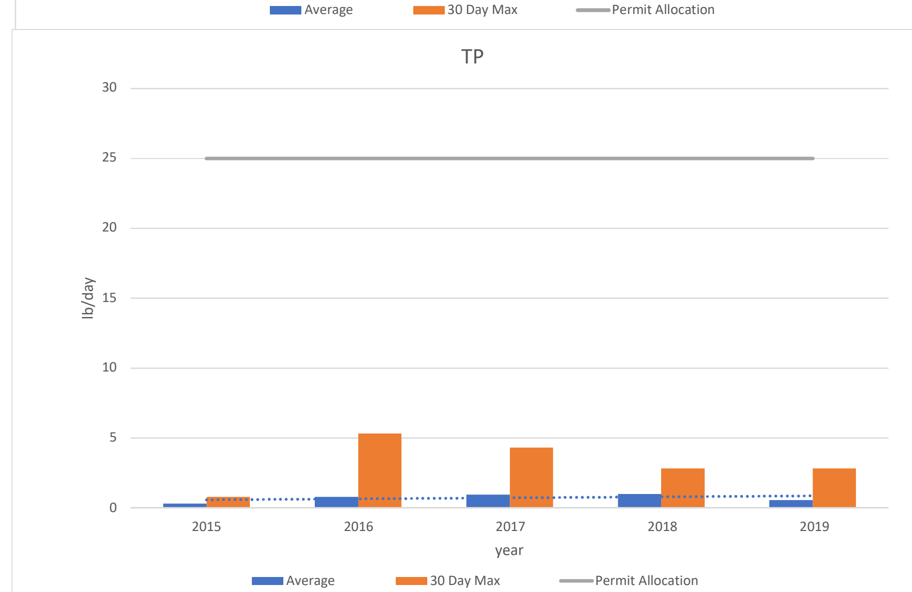
	Year	Flow gpd	COD lb/day	TSS lb/day	NH3 lb/day	P lb/day
Permit Allocation		200,000	1,000	500	N/A	25
2015 Average	2015	62,867	210	69	3	0
2016 Average	2016	72,289	363	222	5	1
2017 Average	2017	90,337	326	72	6	1
2018 Average	2018	76,115	715	199	5	1
2019 Average	2019	92,228	407	63	10	1
2018-19 Average		80,164	638	165	6	1
2015 30 Day Max:	2015	131,380	891	294	12	1
2016 30 Day Max:	2016	151,157	2,485	1,269	18	5
2017 30 Day Max:	2017	206,207	1,313	264	33	4
2018 30 Day Max:	2018	110,182	1,794	589	16	3
2019 30 Day Max:	2019	102,482	2,164	579	16	3











SIU E

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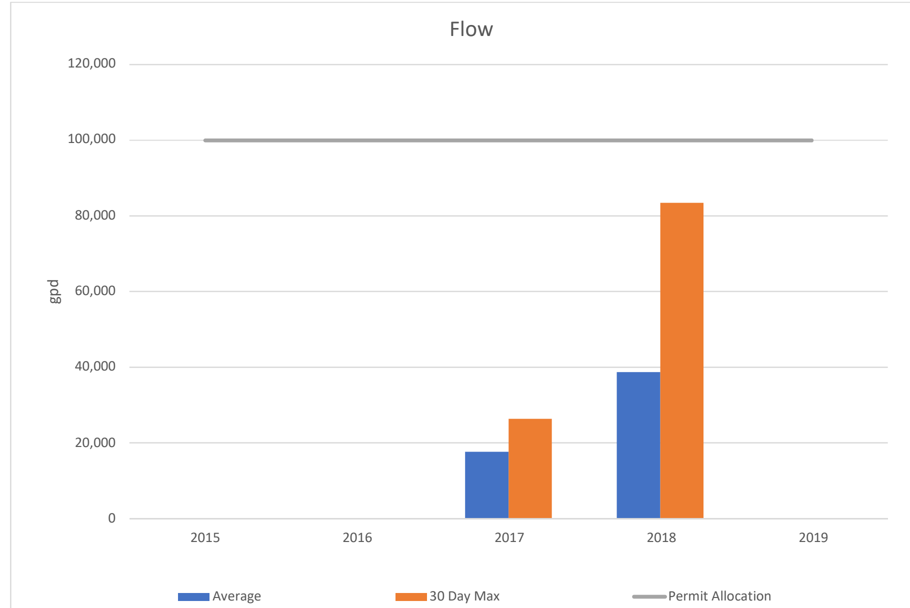
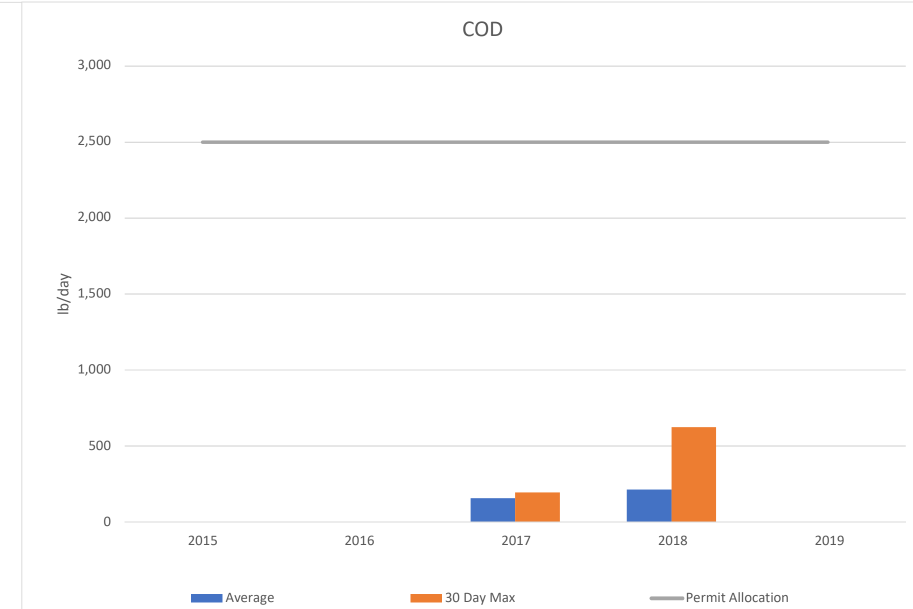
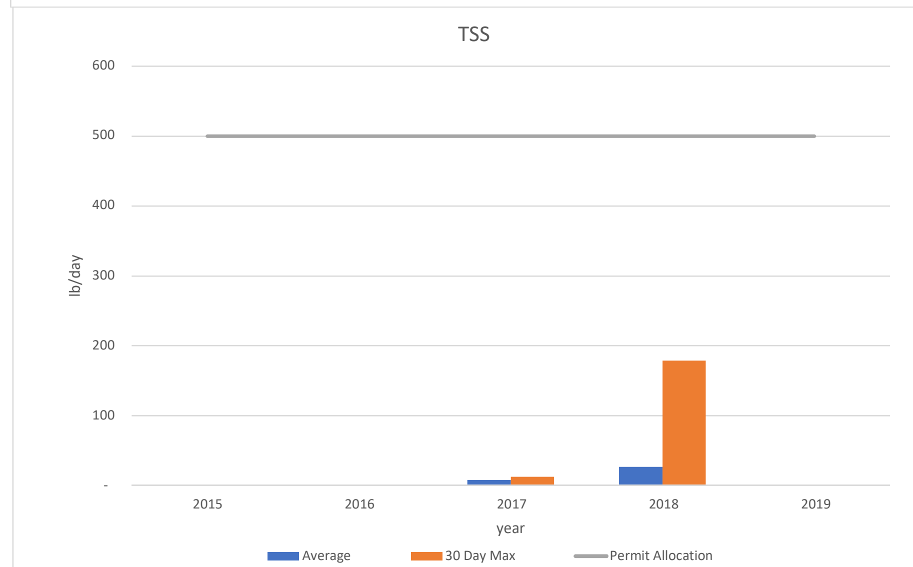
SIU E

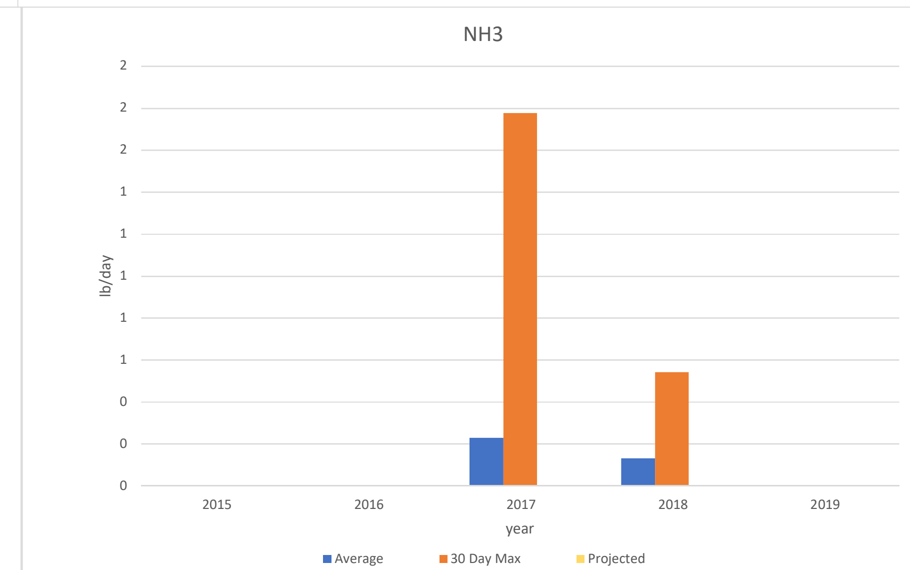
	Year	Flow gpd	COD lb/day	TSS lb/day	NH3 lb/day	P lb/day
Permit Allocation		100,000	2,500	500	N/A	50
2015 Average	2015	-	-	-	-	-
2016 Average	2016	-	-	-	-	-
2017 Average	2017	17,684	157	8	0	1
2018 Average	2018	38,687	213	27	0	2
2019 Average	2019	-	-	-	-	-
2018-19 Average		29,023	159	20	0	1
2015 30 Day Max:	2015	-	-	-	-	-
2016 30 Day Max:	2016	-	-	-	-	-
2017 30 Day Max:	2017	26,380	194	13	2	1
2018 30 Day Max:	2018	83,516	624	179	1	4
2019 30 Day Max:	2019	-	-	-	-	-

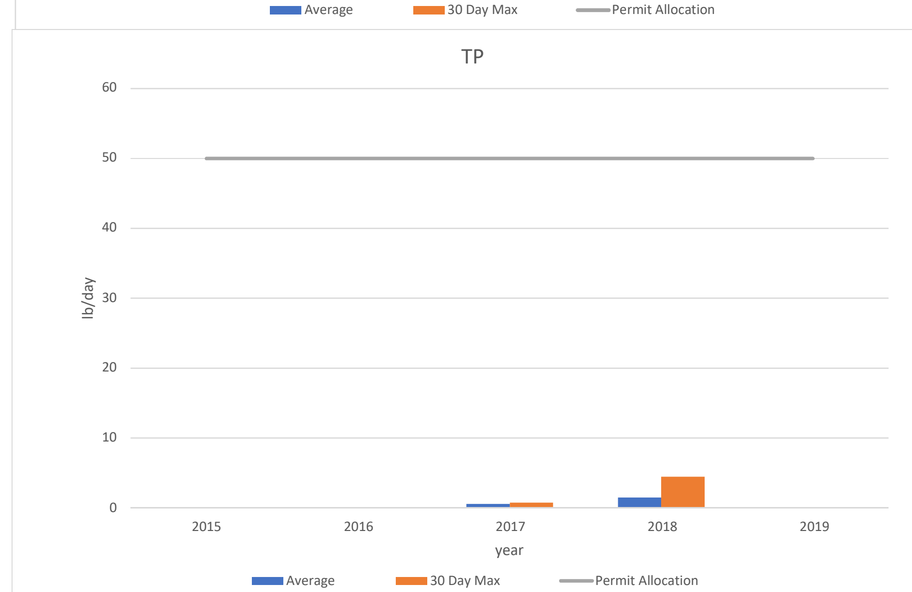
**SIU E did not start till 2017 and shut down plant to switch processes in late 2018.











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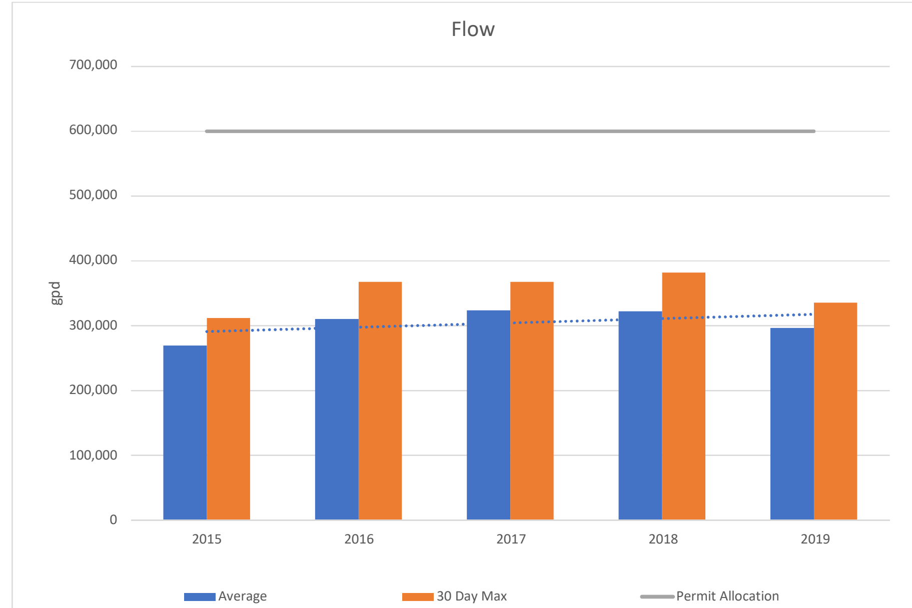
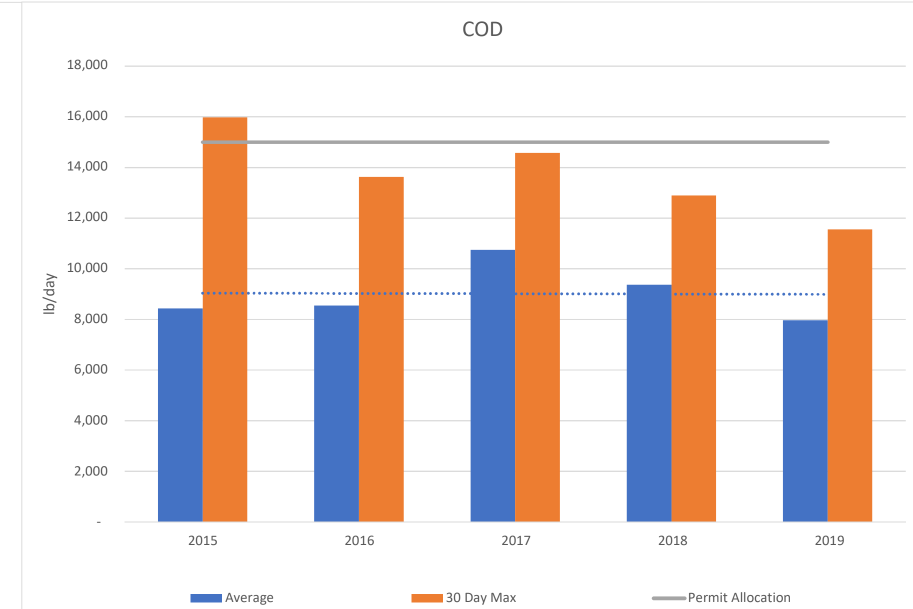
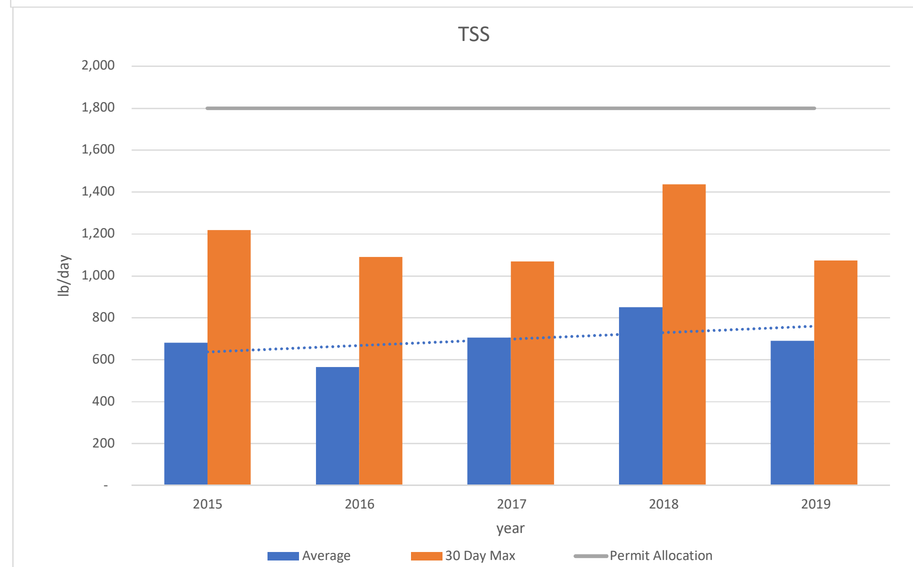
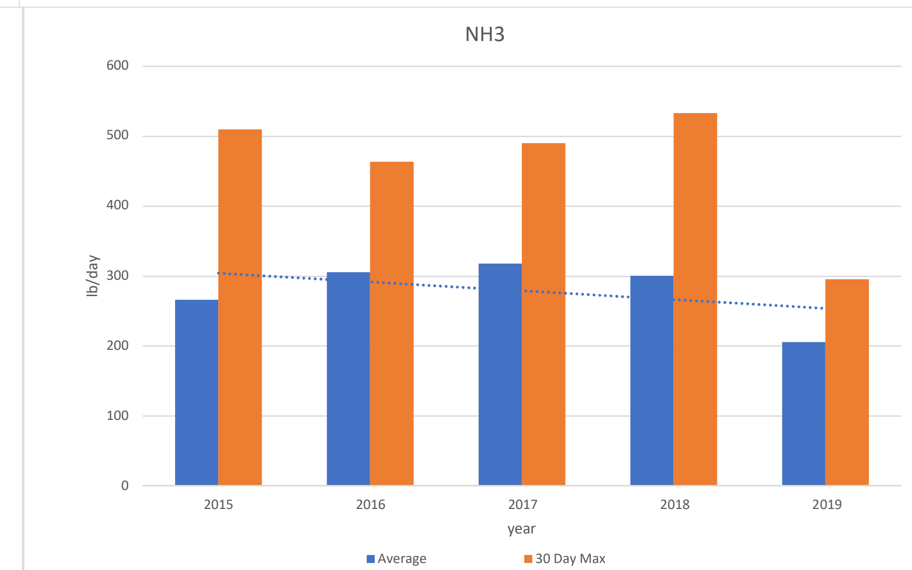
SIU F

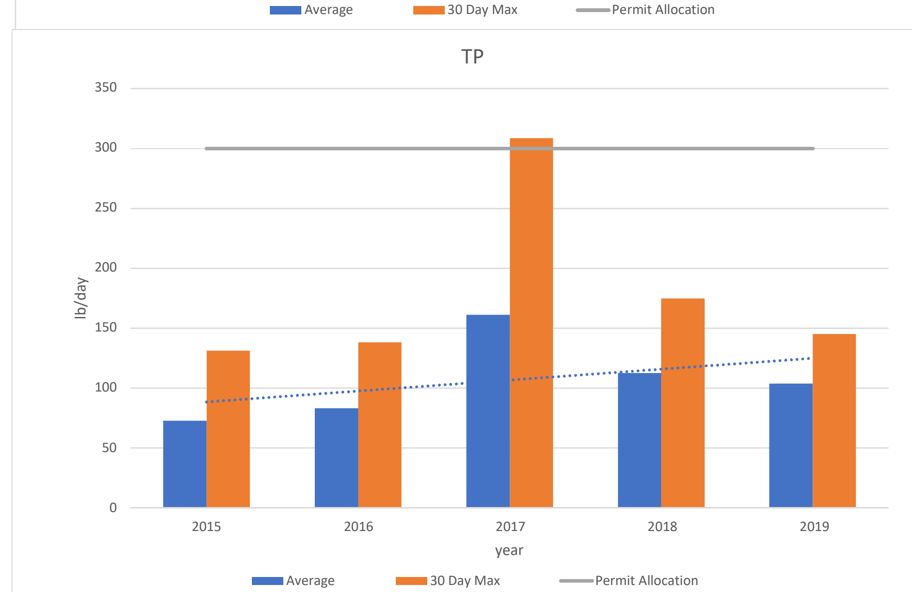
	Year	Flow gpd	COD lb/day	TSS lb/day	NH3 lb/day	P lb/day
Permit Allocation		600,000	15,000	1,800	N/A	300
2015 Average	2015	269,206	8,440	681	266	73
2016 Average	2016	310,202	8,550	564	305	83
2017 Average	2017	323,506	10,742	706	318	161
2018 Average	2018	322,292	9,372	851	300	113
2019 Average	2019	296,451	7,969	691	206	104
2018-19 Average		315,911	9,024	811	277	110
2015 30 Day Max:	2015	311,651	15,981	1,220	510	131
2016 30 Day Max:	2016	367,924	13,626	1,089	464	138
2017 30 Day Max:	2017	367,809	14,573	1,069	490	309
2018 30 Day Max:	2018	382,355	12,894	1,437	533	175
2019 30 Day Max:	2019	335,662	11,564	1,074	296	145











SIU G

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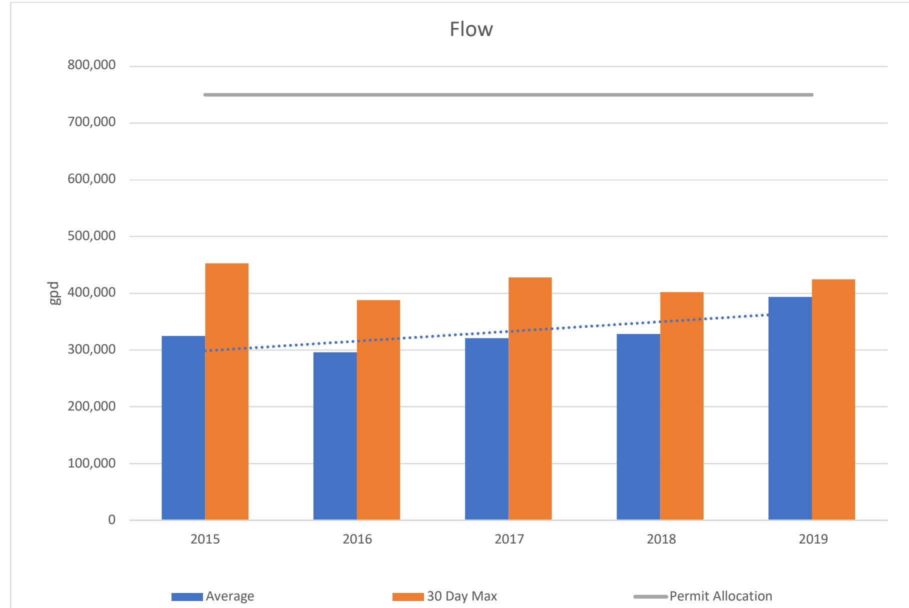
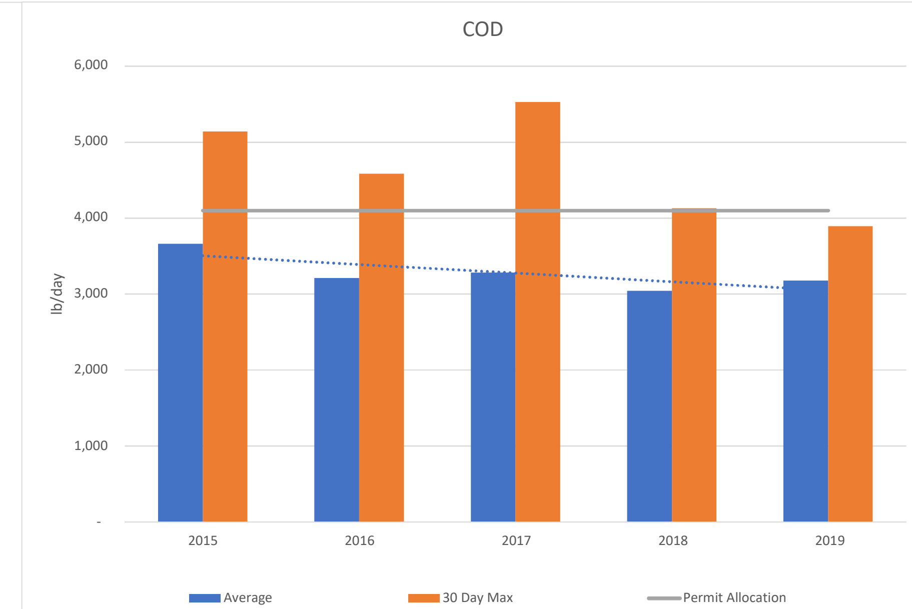
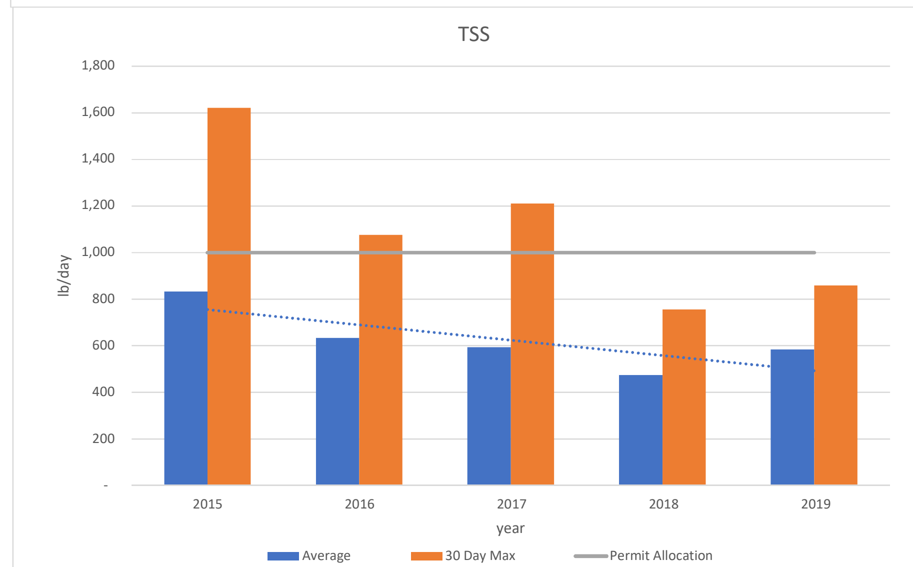
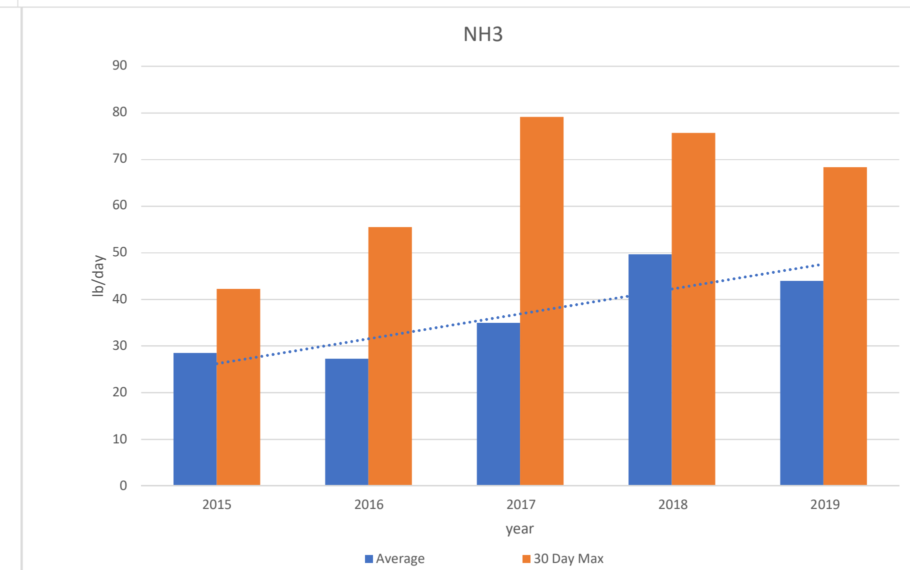
SIU G

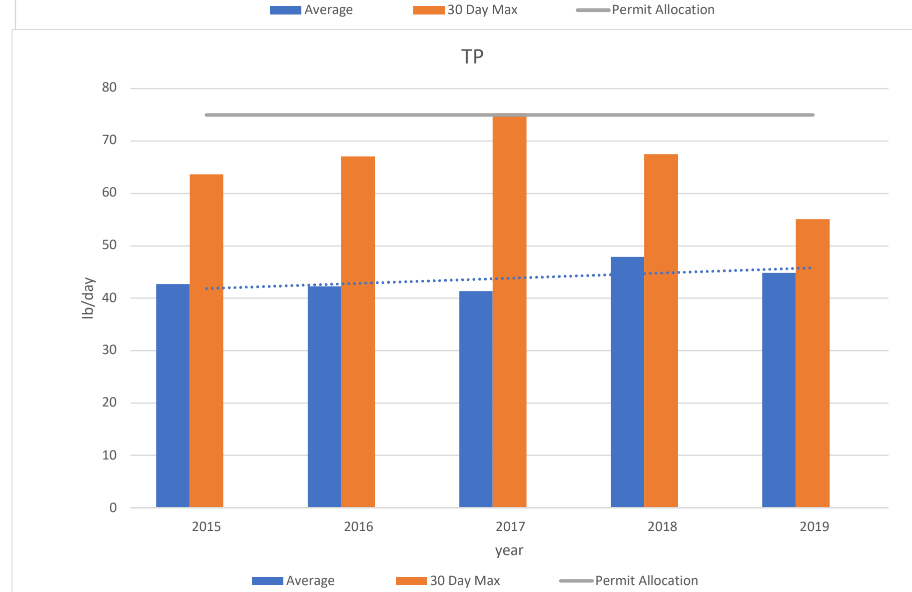
	Year	Flow gpd	COD lb/day	TSS lb/day	NH3 lb/day	P lb/day
Permit Allocation		750,000	4,100	1,000	N/A	75
2015 Average	2015	324,564	3,661	833	29	43
2016 Average	2016	296,126	3,214	634	27	42
2017 Average	2017	321,102	3,285	593	35	41
2018 Average	2018	328,294	3,044	474	50	48
2019 Average	2019	393,879	3,179	585	44	45
2018-19 Average		344,777	3,079	502	48	47
2015 30 Day Max:	2015	452,987	5,141	1,621	42	64
2016 30 Day Max:	2016	388,481	4,583	1,077	56	67
2017 30 Day Max:	2017	428,059	5,530	1,211	79	75
2018 30 Day Max:	2018	402,218	4,130	756	76	67
2019 30 Day Max:	2019	424,852	3,893	859	68	55





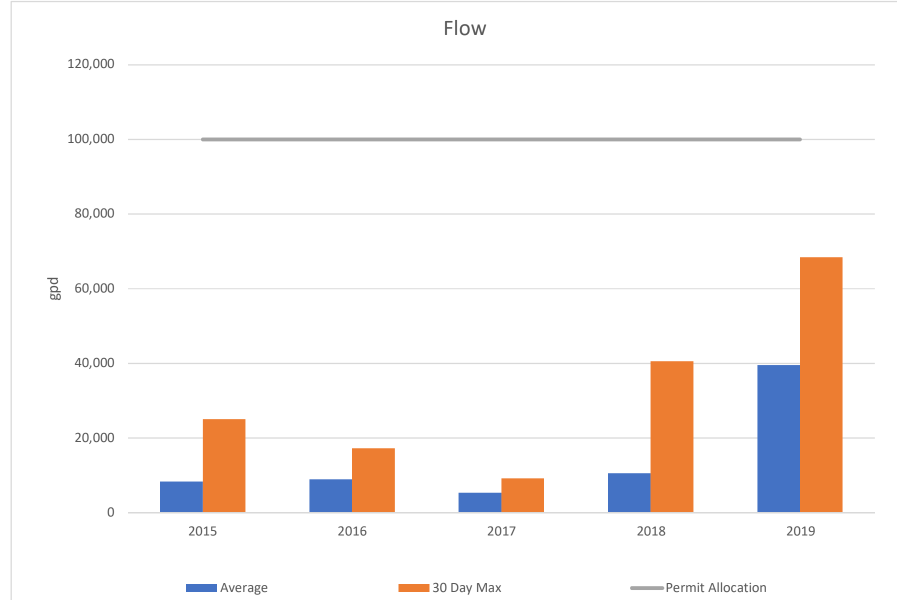


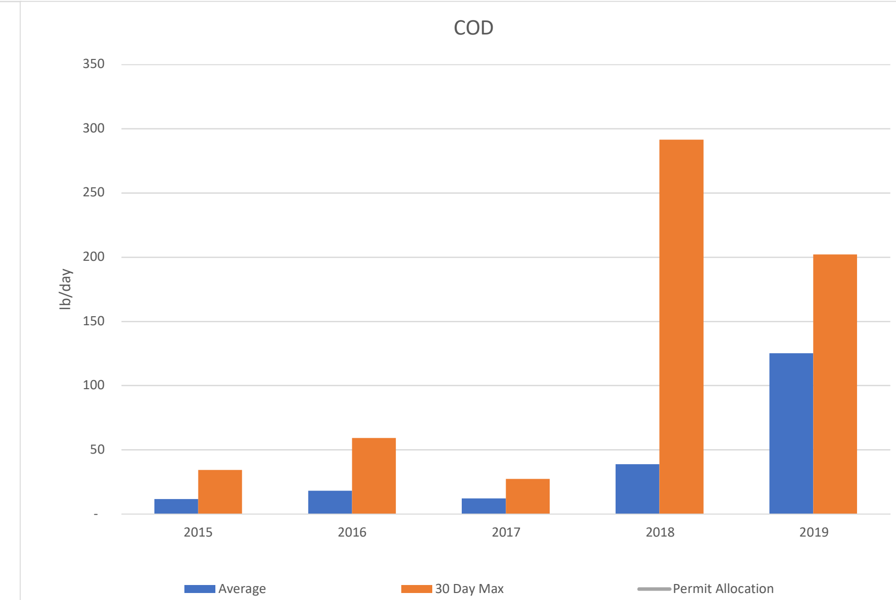


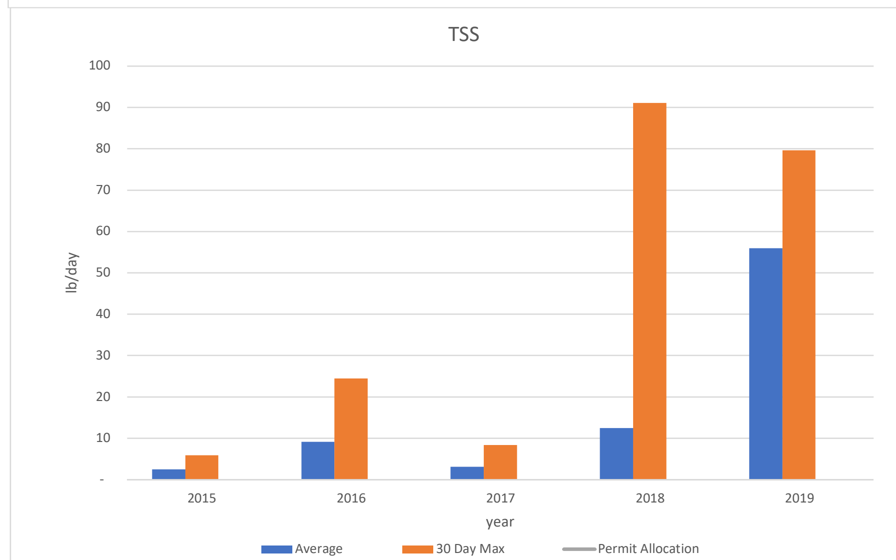


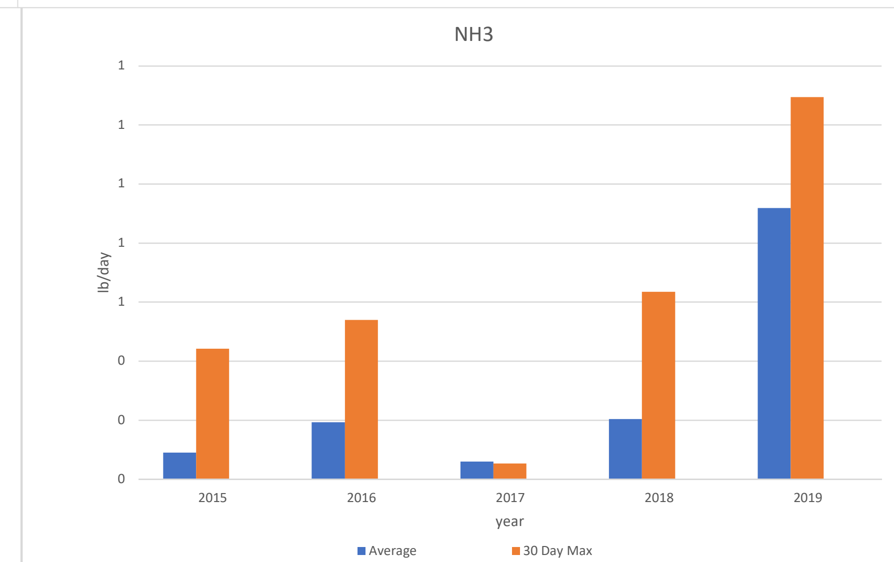
SIU H

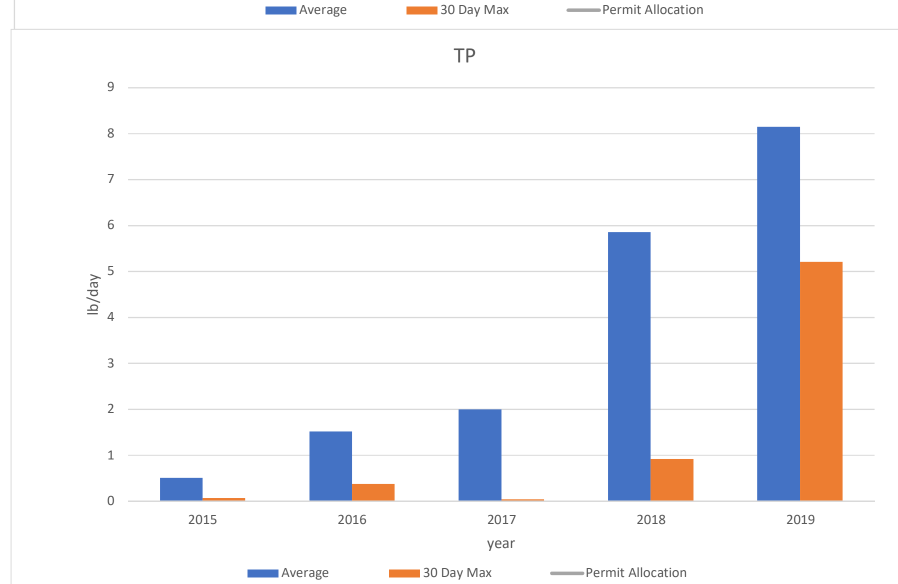
	Year	Flow gpd	COD lb/day	TSS lb/day	NH3 lb/day	P lb/day
		100,000	N/A	N/A	N/A	N/A
2015 Average	2015	8,263	12	3	0	1
2016 Average	2016	8,899	18	9	0	2
2017 Average	2017	5,379	12	3	0	2
2018 Average	2018	10,531	39	12	0	6
2019 Average	2019	39,513	125	56	1	8
2018-19 Average		17,781	60	23	0	6
2015 30 Day Max:	2015	25,063	34	6	0	0
2016 30 Day Max:	2016	17,219	59	24	1	0
2017 30 Day Max:	2017	9,231	27	8	0	0
2018 30 Day Max:	2018	40,582	291	91	1	1
2019 30 Day Max:	2019	68,459	202	80	1	5











APPENDIX E
DAILY FLOW GRAPHS

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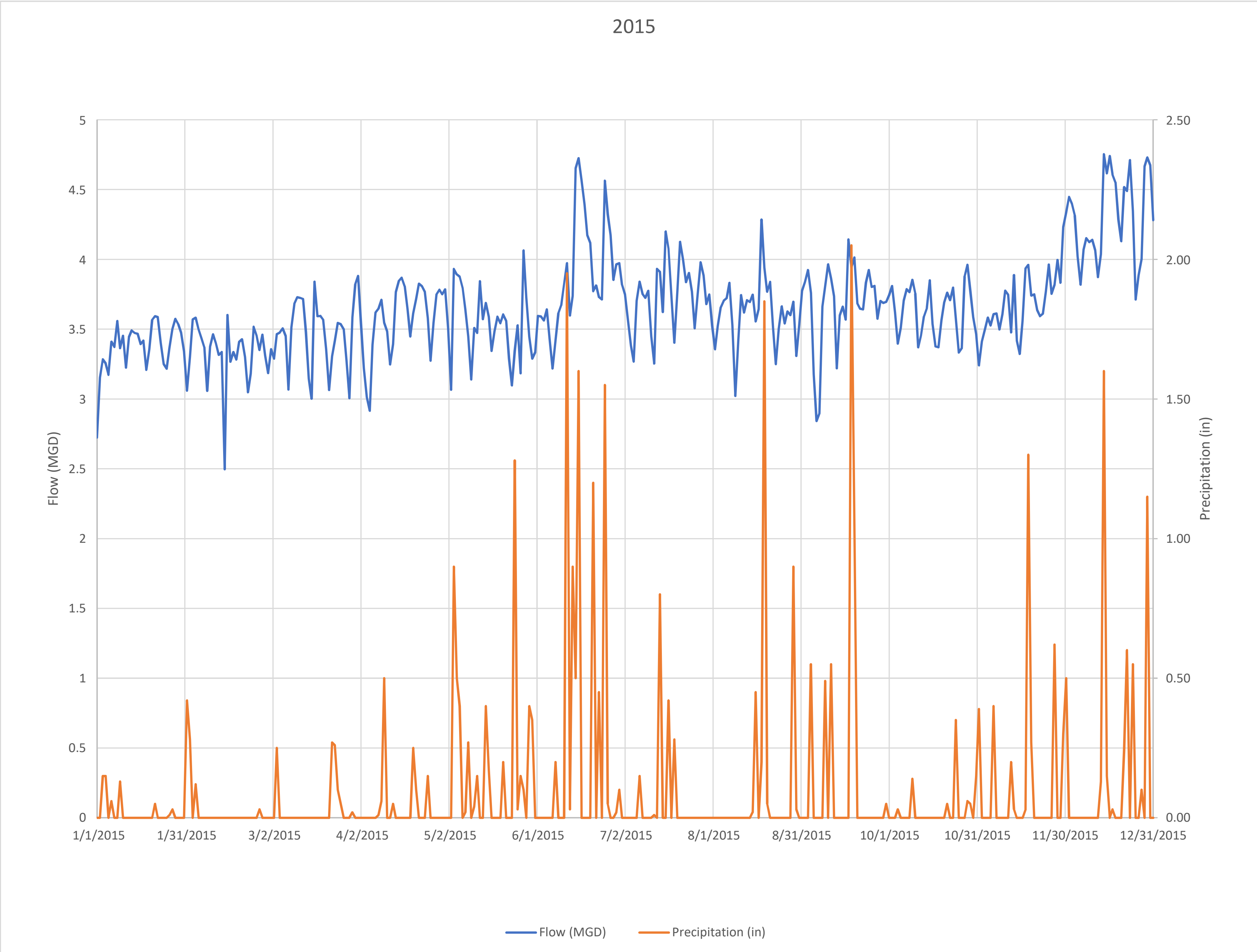

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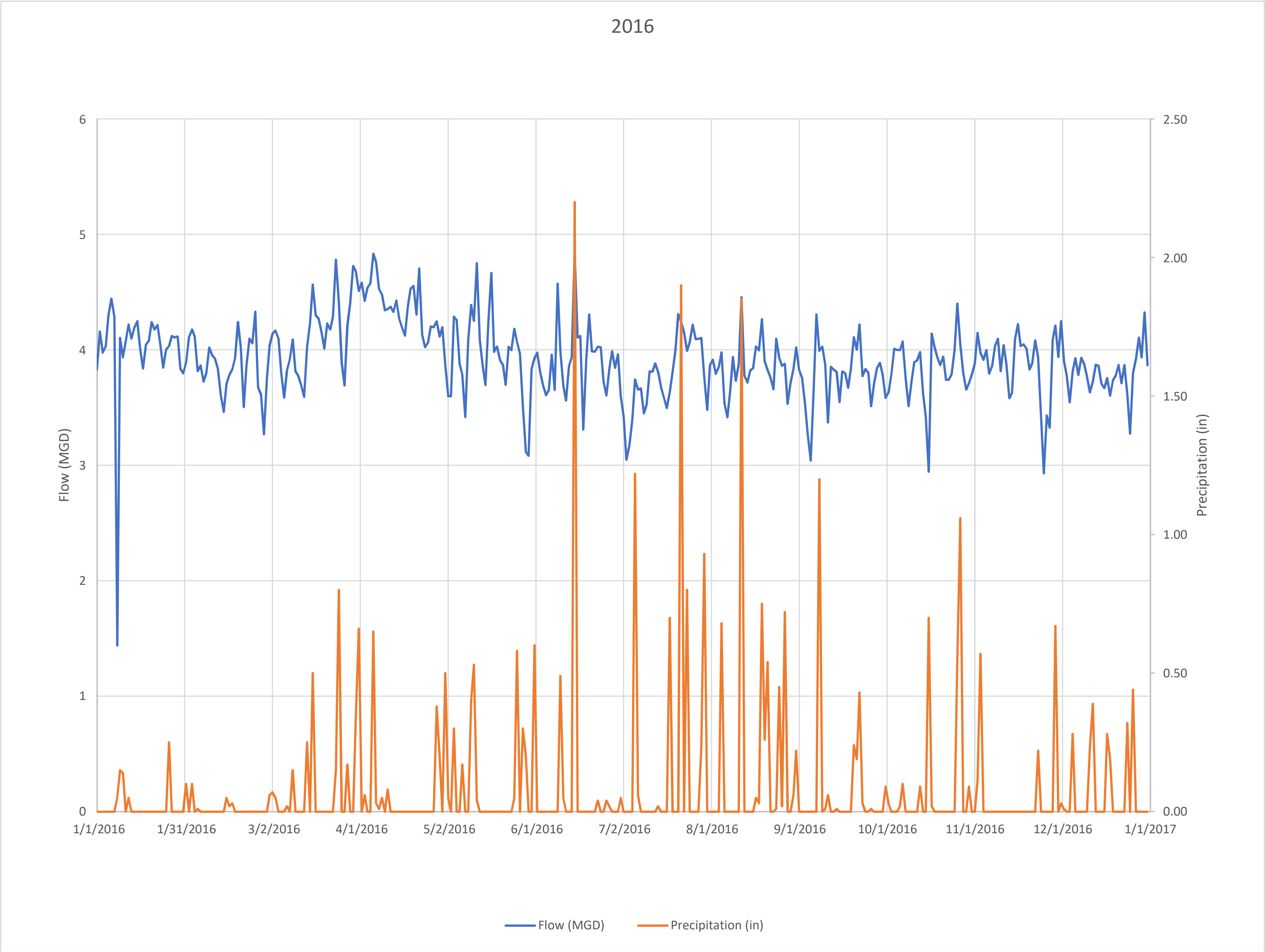
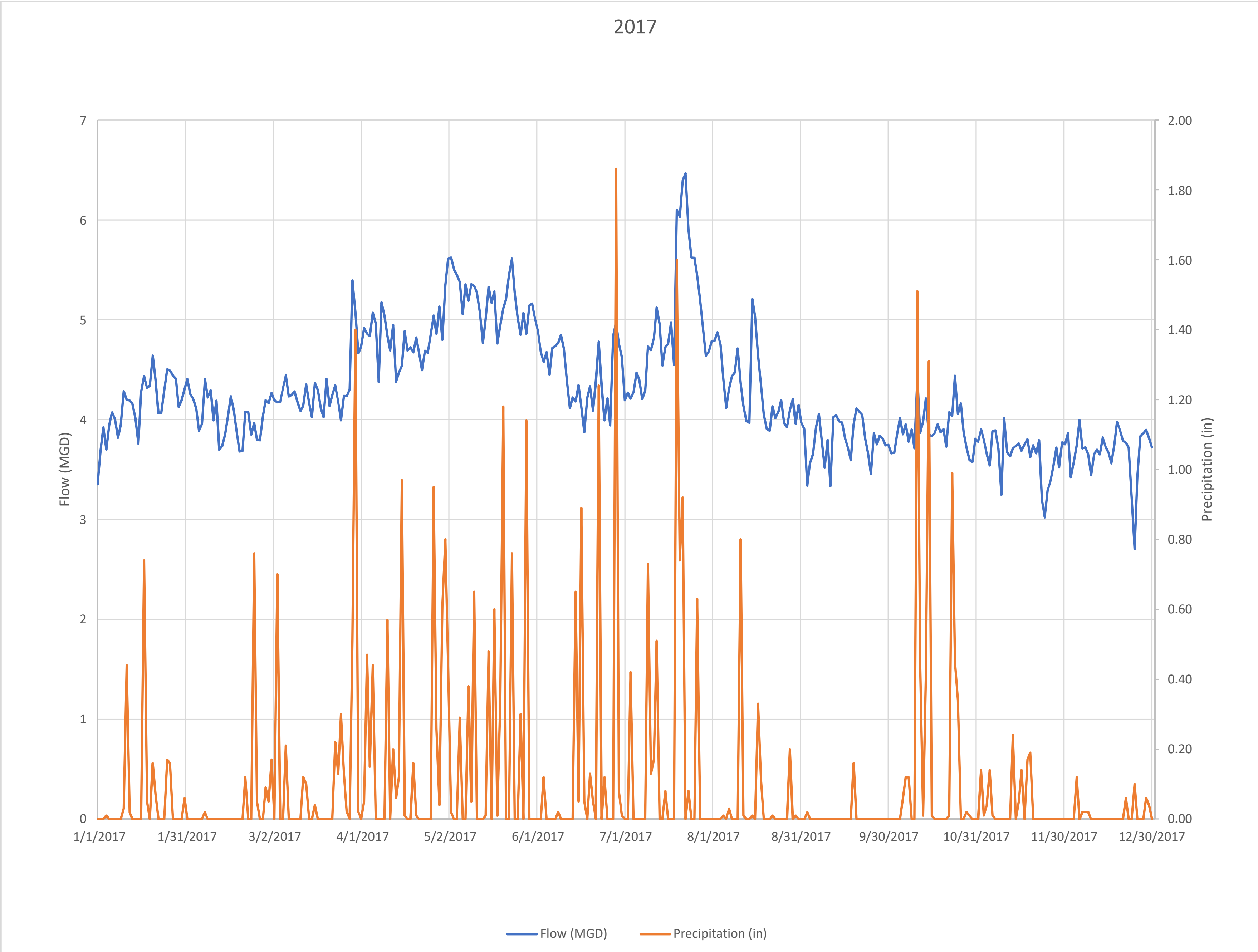
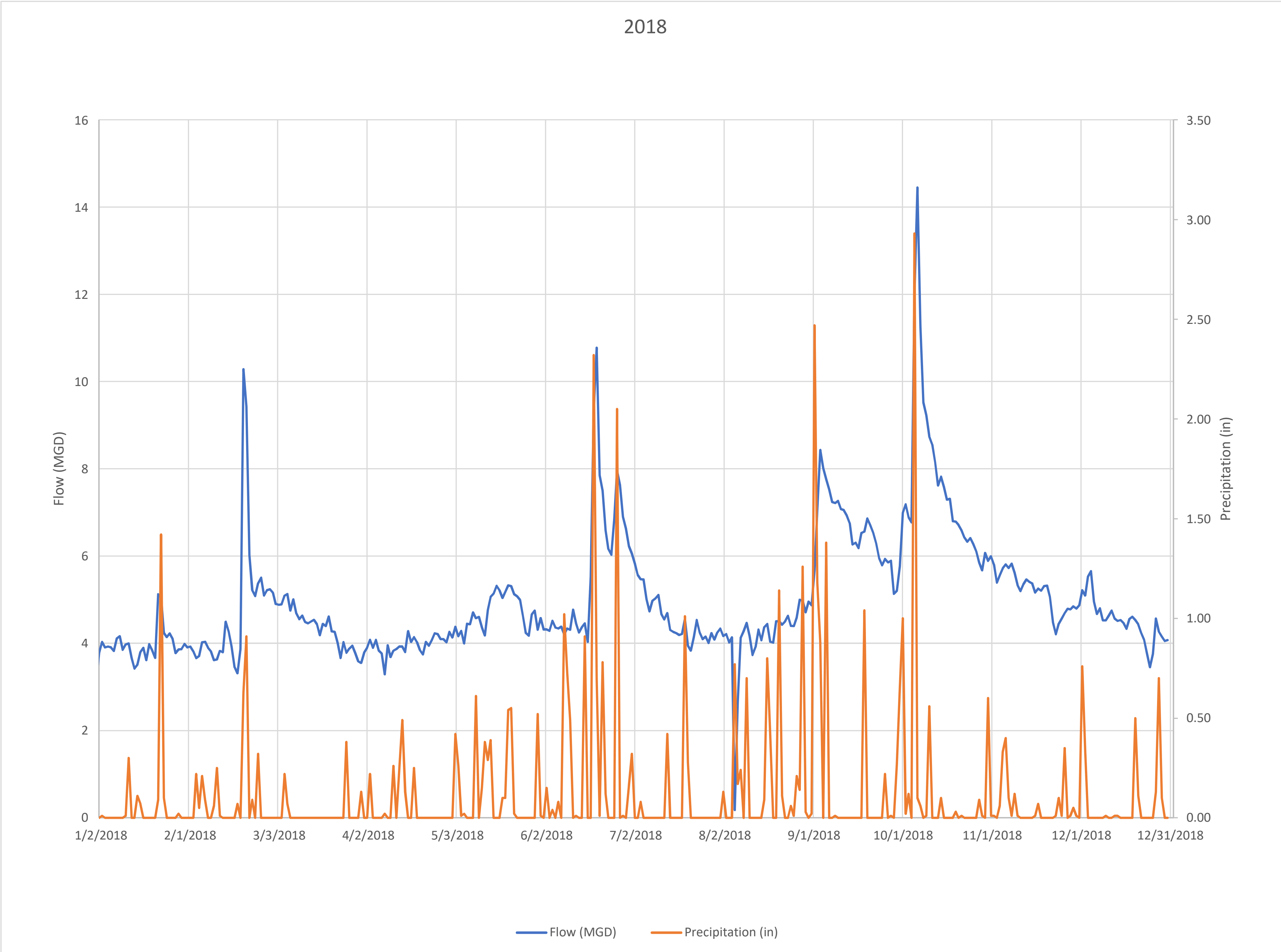
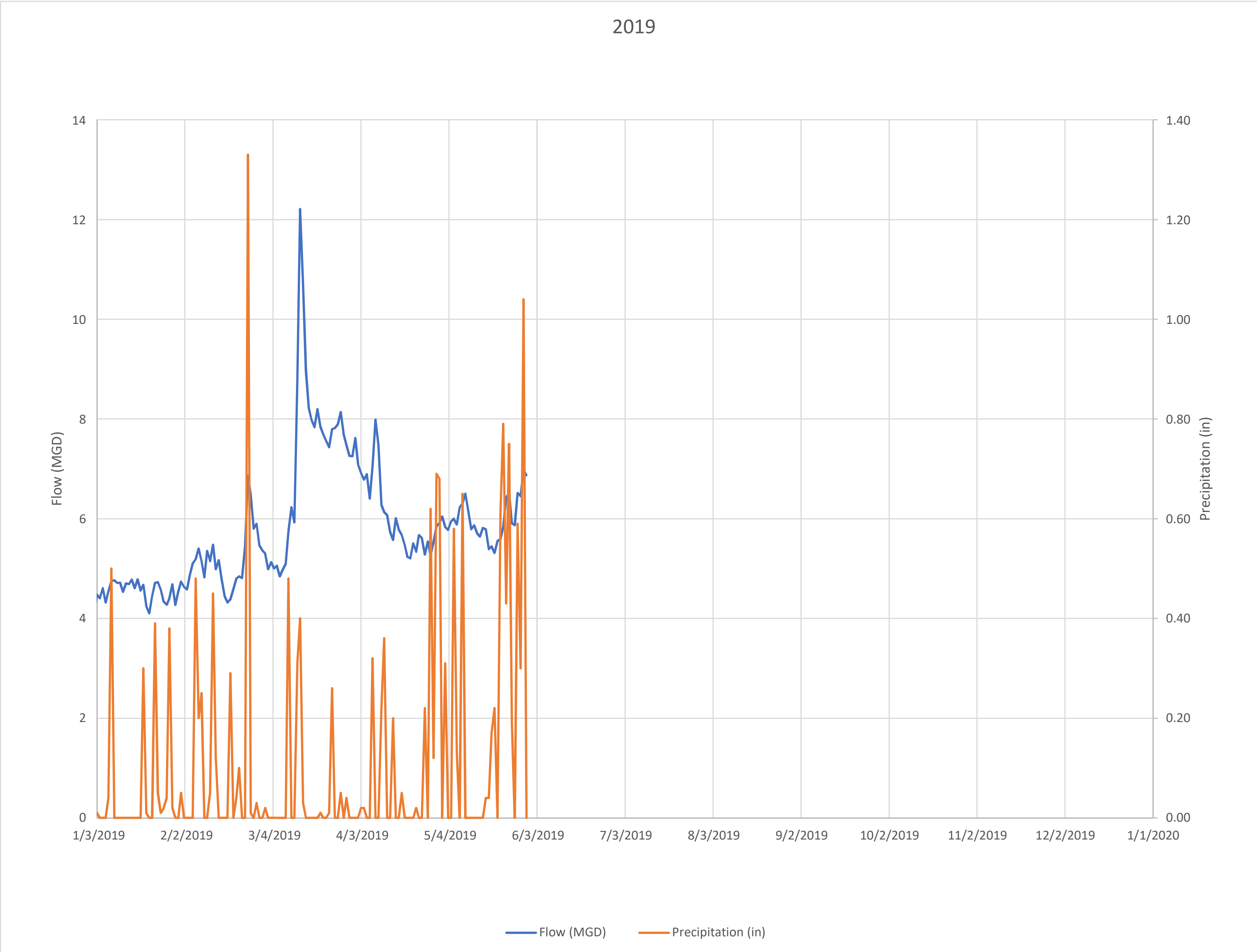



2017
Flow (MGD)
Precipitation (in)
7
6
5
4
3
2
1
0
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1/1/2017
1/31/2017
3/2/2017
4/1/2017
5/2/2017
6/1/2017
7/1/2017
8/1/2017
8/31/2017
9/30/2017
10/31/2017
11/30/2017
12/30/2017
Flow (MGD)
Precipitation (in)

DRAFT-(08.19.20)




2019
Flow (MGD)
Precipitation (in)
14
12
10
8
6
4
2
0
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1/3/2019
2/2/2019
3/4/2019
4/3/2019
5/4/2019
6/3/2019
7/3/2019
8/3/2019
9/2/2019
10/2/2019
11/2/2019
12/2/2019
1/1/2020
Flow (MGD)
Precipitation (in)

APPENDIX F
WPCF EQUIPMENT SUMMARY

Evaluation Date	Evaluated By	Equipment Name	Equipment No.	Manufacturer	Year Installed	Modifications Since Install	Importance	Overall Condition	Overall Criticality	Comments
2019	RJL	Aeration Diffusors		Sanitaire	1989	Original piping. Diffusors have been replaced. Original diffusors were ceramic.	5	3	15	DO Control throttles inlet for each tank. Basin 5 was replaced in 2018. Piping is due to be replaced. Basin 2 was replaced over 10 years ago. Basins 3 and 4 were replaced ~5 years ago.
2019	RJL	Aeration Piping / Valves			1989		5	2	10	Expansion valves are deteriorated.
2019	RJL	Aeration Splitter Structure & Gates			1989		5	4	20	Bad corrosion on concrete. 3-4" of corrosion in some areas. Odor control was plugged, gates in structure are ok. Some drain Valves in splitter areas are frozen up. Used to have diffused air but this was removed.
2019	RJL	Aeration tank structure and gates			1989		5	2	10	Concrete is in good condition and gates are functional. Several mud drain valves have been replaced.
2019	RJL	Air Compressors		Ingersoll	2001		4	3	12	50 HP Compressor typically runs. 100 HP compressor typically only runs when mixing old biosolids storage tank. Motors overheat, drying system is antequated. Air reservoir tanks have oil in them.
2019	RJL	Air Compressor System - Compressors			1997		5	3	15	compressors installed in 1997, dryers installed in 1992. oil is in the system. Pneumatic valves, compressors, and dryers need replacement.
2019	RJL	Air Compressor System - Dryers			1992		5	3	15	compressors installed in 1997, dryers installed in 1992. oil is in the system. Pneumatic valves, compressors, and dryers need replacement.
2019	RJL	Air activated flow control valves for RAS/WAS			1989		3.5	4	14	Oil in compressed air lines has caused significant issues
2019	RJL	Anoxic Zone Mixers		Flygt	~2006		5	3	15	2 mixers per tank originally, there is now just 1. Mixers are expensive to repair and one or 2 per year needs to be rebuilt. 1 is kept on the shelf.
2019	RJL	Bisulfite Pumps		B&T	1989		5	4	20	Pumps are old. Hard to get parts. 2 pumps and 1 skid.
2019	RJL	Chemical Containment Area			1989		4	4	16	Many leaks in containment area. If there is a spill of 1,000 gallons, likely only 1,000 gallons would be contained.
2019	RJL	Chlorine contact Tank			1989		5	2	10	Replaced approx. 1/2 of mud drain valves. Concrete in good condition.
2019	RJL	Chlorine Pump 1			2018		5	1	5	Chlorine pumps are not flow proportionate.
2019	RJL	Chlorine Pump 2			1989		5	3	15	Chlorine pumps are not flow proportionate.
2019		Disinfection tank, gates, and valves			1989				0	
2019	RJL	Disinfection system			1989		5	3.5	17.5	only one hydrochloride pump (5 yrs old). 3 other pumps can't be controlled based on flow rate. Flow paces control of system. It is hard to find pumps for bisulfite pumps. Fiberglass tanks were relined once in the 1990's. Chemical feed lines going to contact tanks with plug need to be acid cleaned annually. Only using one tank; filled 3-4 times per summer.
2019	RJL	DO Controls			1989		4	3.5	14	1 probe in each basin. 2 tanks have DO probes at tail end of tank for monitoring only. DO probes in each tank throttle tank flow to each tank. Least valve open controls blower air.
2019	RJL	Fiberglass tanks			1989	relined inside 10-15 years ago.	5	4	20	Redundancy for chlorine, no redundancy for bisulfite. 2 chlorine and 1 bisulfite tank. No known leaks.
2019	RJL	Final clarifier tanks			1989		5	2	10	No corrosion on structure. Grout popping in places.
2019	RJL	Clarifier mechanisms			1989	Some minor repairs.	3.5	2.5	8.75	stop logs don't work anymore. Gates are ok. Mud valves are deteriorated with several repairs over the last several years.
2019	RJL	flow control gates at chlorine contact tank			1989		4	3	12	still operable. Likely replace w/ UV Project.
2019	RJL	WAS/Primary Mixer	M-10-10-1-1		2010		2	3	6	Mixers are not typically used.
2019	RJL	WAS/Primary Mixer	M-10-10-1-2		2010		2	3	6	Mixers are not typically used
2019	RJL	Gravity belt thickener	M-10-6-2	Ashbrook Simon Hartley	1989	gearboxes, rollers	4	4	16	Remaining useful life depends on part availability. WAS Only. Old. Coatings have fallen off rollers. Filtrate pan gets plugged with struvite.
2019	RJL	Gravity belt thickener	M-10-6-3	Ashbrook Simon Hartley	1989	gearboxes, rollers	4	4	16	Remaining useful life depends on part availability. Not used often. When used, it is used for either WAS or Digested Sludge. Old. Coatings have fallen off rollers. Filtrate pan gets plugged w/ struvite.
2019	RJL	Gravity belt thickener	M-10-6-4	Ashbrook Simon Hartley	1987	refurbished in 1991, came from old plant	4	4	16	Old. Coatings have fallen off rollers. Filtrate pan get plugged w/ struvite. Can do Digester or WAS
2019	RJL	polymer mixer	M-11-10		1989	valve and actuator have been replaced	5	4	20	mechanicals could be updated. Tank is fine. Better technology possibly available? Feed line upstream of polymer wetting head is plugged.
2019	RJL	Polymer conveyance blower	M-11-6-1		1989		5	4	20	There is a backup blower on the shelf

Evaluation Date	Evaluated By	Equipment Name	Equipment No.	Manufacturer	Year Installed	Modifications Since Install	Importance	Overall Condition	Overall Criticality	Comments
2019	RJL	Gravimetric Feeder	M-11-6-2		1989		5	4	20	system works fine. Need to better control humidity in this space.
2019	RJL	Digested Sludge Grinder	M-12-8-1	Muffin Monster	1989	Rebuilt/replaced multiple times	5	4	20	
2019	RJL	Digested Sludge Grinder	M-12-8-2	Muffin Monster	1989	Rebuilt/replaced multiple times.	5	4	20	
2019	RJL	Waste Gas Incinerator	M-14-3		1989		4	5	20	Ignition issues
2019	RJL	Boiler #1	M-15-18-1	Cleaver Brooks	1989	Retubed and controls were recently upgraded	4	3	12	Primary boiler, this and Boiler 2 run in winter, only 1 runs in the summer. Can run on natural gas or digester gas.
2019	RJL	Boiler #2	M-15-18-2	Cleaver Brooks	1989	Retubed and controls were recently upgraded	4	3	12	primary boilers. Both Boiler 1 and 2 run in the winter, only 1 runs In the summer. Can run on natural gas or digester gas.
2019	RJL	boiler #3	M-15-18-3	PK	2009		3	2	6	only run on natural gas and only used in extreme cold conditions.
2019	RJL	Boiler #4	M-15-18-4	PK	2009		3	2	6	See M-15-18-3 for comments.
2019	RJL	Boiler #5	M-15-18-5	PK	2009		3	2	6	See M-15-18-3 for comments.
2019	RJL	Sludge Heat Exchanger	M-15-4-1		1989		5	4	20	undersized. Difficulty maintaining temps. High priority item, needs replacement
2019	RJL	Sludge heat exchanger	M-15-4-2		1989		5	4	20	undersized. Difficulty maintaining temps. High priority item, needs replacement.
2019	RJL	Submersible Mixer	M-16-11-1	Flygt	2007		5	3	15	occasional high amp draw. Motors appear undersized, they are tripping out on high amps.
2019	RJL	Submersible Mixer	M-16-11-2	Flygt	2007		5	3	15	occasional high amp draw. Motors appear undersized, they are tripping out on high amps.
2019	RJL	Submersible Mixer	M-16-11-3	Flygt	2007		5	3	15	occasional high amp draw. Motors appear undersized, they are tripping out on high amps.
2019	RJL	Submersible Mixers	M-16-11-4	Flygt	2007		5	3	15	occasional high amp draw. Motors appear undersized, they are tripping out on high amps.
2019	RJL	belt filter press	M-21-3	Ashbrook	2010		4	3	12	12-13% cake. Cannot pump cake w/ higher concentration. Main problem w/ system is conveyance of cake. Only runs seasonally in the summer.
2019	RJL	Mechanical step screen	M-2-4-1	Parkson	1989	Wear guides were replaced. Replaced motor.	3	2	6	Minor oil leaks. No major failures since new.
2019	RJL	Screening wash press	M-2-6-1	Huber	2011	None.	3	2	6	Screen uses city water. Solenoid valves cause water hammer
2019	RJL	Vortex Grit Tanks	M-3-1-1	Smith & Loveless	1989	Air scour piping has been replaced w/ PVC.	3	4	12	Mostly original. One blade set fell off, rebuilt in house. Motor sounds rough
2019	RJL	Vortex Grit Tanks	M-3-1-2	Smith & Loveless	1989	Air scour piping has been replaced w/ PVC.	3	4	12	Mostly Original. One blade set fell off and was rebuilt in house. Motor sounds rough.
2019	RJL	Grit Washer	M-3-5-1	Wemco	1989	None.	3	4	12	They don't use a spray nozzle at the top of clarifiers because it would fill the truck with water. Grit out of machine is dry. Replace auger plates. Motors and gearboxes are original. Noticed minor odors when grit pump was running.
2019	RJL	Grit Washer	M-3-5-2	Wemco	1989	None.	3	4	12	Same comments and pictures as M-3-5-1
2019	RJL	Primary Scum Grinder	M-4-9-1	JWC Muffin Monster	1989		4	4	16	There is a unit on the shelf to replace the original grinder. Partial redundancy because it is possible to pump out of the scum pit w/ ODS pumps. Possible to change clarifiers when out of service too. Controls need work, they stop occasionally.
2019	RJL	Primary Scum Grinder	M-4-9-2	JWC Muffin Monster	1989	Pump has been replaced since initial installation	4	4	16	Overall condition is a 3, controls are a 4. Partial redundancy, can pump out of the sump pit w/ ODS pumps. See M-4-9-1 for additional comments and photos.
2019	RJL	Blower	M-6-3-2	Lamson	1989	parts used to rebuild M-6-3-4	5	5	25	Hasn't run for several years but could with some work. Parts from 2 were used to rebuild #4. Starting to become expensive and hard to get parts. Partial redundancy.
2019	RJL	Blower	M-6-3-3	Lamson	1989	Parts used to rebuild M-6-3-4	5	5	25	3 hasn't been run for several years but could run with some work. Parts from 3 were used to rebuild 4. Starting to become expensive to run and hard to get parts for.

Evaluation Date	Evaluated By	Equipment Name	Equipment No.	Manufacturer	Year Installed	Modifications Since Install	Importance	Overall Condition	Overall Criticality	Comments
2019	RJL	Blower with VFD	M-6-3-4	Lamson	1989	VFD installed in 2010. Motor replaced in 1997	5	4	20	Blower has VFD. Starting to become expensive to run and hard to find parts.
2019	RJL	Aeration Blower	M-6-3-5	Lamson	1989	VFD added in 2010. Replaced bearings on blower as well.	5	4	20	Partial redundancy for blower.
2019	RJL	Aeration Blowers	M-6-3-6	Lamson	1989	VFD added in 2010. Motor and bearings replaced as well.	5	4	20	Partial redundancy for blower.
2019	RJL	Thickened Sludge Pump	P-10-10-2		1989	Rebuilt. Motor Replaced in 1 pump	4	3	12	Level controls are associated w/ specific tank. If sludge gets over 5%, it becomes difficult to pump. When pumping TWAS to digester, they mix digested sludge with it to minimize pressures in pipe line, this messes up the digester feed flow measurement.
2019	RJL	Thickened Sludge Pump	P-10-10-3		1989	Rebuilt.	4	3	12	Level controls are associated w/ specific tank. If sludge gets over 5%, it becomes difficult to pump. When pumping TWAS to digester, they mix digested sludge with it to minimize pressures in pipe line, this messes up the digester feed flow measurement.
2019	RJL	Thickened Sludge Pump	P-10-10-4		1989	Rebuilt.	4	3	12	Level controls are associated w/ specific tank. If sludge gets over 5%, it becomes difficult to pump. When pumping TWAS to digester, they mix digested sludge with it to minimize pressures in pipe line, this messes up the digester feed flow measurement.
2019	RJL	Thickening Feed Pump	P-10-12-1	Wemco	2010		2	2	4	Only used when pumping primary sludge to GBTs. Not needed for WAS
2019	RJL	Thickening Feed Pump	P-10-12-2	Wemco	2010		2	2	4	Only used when pumping primary sludge to GBTs. Not needed for WAS
2019	RJL	Filtrate Pump	P-10-7-1		2010		1	2	2	Pump is not used.
2019	RJL	Filtrate Pump	P-10-7-2		2010		1	1	1	Pump is not used.
2019	RJL	Filtrate Recirculation pump	P-10-7-3		2010		1	2	2	Pump is not used.
2019	RJL	Polymer transfer pump	P-11-11-1	Moyno	1989		5	2	10	They have a spare pump and motor on the shelf. Air actuated valves on discharge are showing a lot of corrosion.
2019	RJL	Polymer Feed Pump	P-11-16-5		1989		5	2	10	Critical pumps. Can't pump cake without them.
2019	RJL	Polymer Feed Pump	P-11-16-6		1989		5	2	10	Critical pumps. Can't pump cake without them.
2019	RJL	Polymer feed Pump	P-11-16-1		2010		3	3	9	limited pressure (70 psi)
2019	RJL	Polymer feed Pump	P-11-16-2	Moyno	1989	1 motor has been replaced between 2, 3, and 4. pump has been rebuilt	4	3	12	pumps to GBT
2019	RJL	Polymer Feed Pump	P-11-16-3	Moyno	1989	pump has been rebuilt	4	3	12	to GBT
2019	RJL	Polymer Feed Pump	P-11-16-4	Moyno	1989	Pump has been rebuilt	4	3	12	to GBT
2019	RJL	DS Thickener Feed Pump	P-12-5-1		1989		4	4	16	
2019	RJL	DS Thickener Feed Pump	P-12-5-2		2011		4	3	12	previous pump was replaced with larger pump to increase pressure through static mixing system.
2019	RJL	Digester Drain / Transfer Pump	P-12-6		2017		4	2	8	Can pump to other digester, storage, or BFP. Can be used to clean primary & WAS feed lines.
2019	RJL	Digester sludge recirculation pump	P-15-2-1		1991		5	4	20	Occasionally gas bind causing loss of flow. Pumps are too far away from suction of digesters.
2019	RJL	Digester sludge recirculation pump	P-15-2-2		1991		5	4	20	Occasionally gas bind causing loss of flow. Pumps are too far away from suction of digesters.
2019	RJL	Digester Sludge Recirculation Pump	P-15-2-3		1991		5	4	20	Occasionally gas bind causing loss of flow. Pumps are too far away from suction of digesters.
2019	RJL	Truck Loading Pump	P-16-10-1	Flygt	2007	Originally installed 1987, new flygt pump installed 2007	5	3	15	Unknown condition. Adding VFD would be a good enhancement for this pump. Mounting rails broke due to torque during pump start up. Tripping out on overtemp.
2019	RJL	Sludge Loading/Recirculation Pump	P-16-3-1		1989	has been rebuilt	4	3	12	
2019	RJL	Sludge Loading/Recirculation Pump	P-16-3-2		1989	has been rebuilt	4	3	12	
2019	RJL	Plant Drain Pump	P-17-3-1		1992	rebuilt	5	3	15	
2019	RJL	Plant Drain Pump	P-17-3-2		1992		5	3	15	
2019	RJL	Concentrated Scum Transfer Pump	P-18-4	Moyno	1989	Stator replaced twice.	4	3	12	some corrosion. Minimal run time; runs once every couple of days.
2019	RJL	Digested sludge Transfer Pump	P-2-12	Moyno	1997		3	5	15	Infrequently used
2019	RJL	Septage Pump	P-2-13	Vaughn	1997		3	3	9	Can pump to plant influent or plant.

Evaluation Date	Evaluated By	Equipment Name	Equipment No.	Manufacturer	Year Installed	Modifications Since Install	Importance	Overall Condition	Overall Criticality	Comments
2019	RJL	Digester Sludge Cake Pump	P-21-6		2010	rebuilt. 3rd stator	5	3	15	manual controls. Auto controls didn't work. High pressure @ pump if cake is over 13%. Major issues w/ conveyance of cake sludge.
2019	RJL	Grit Slurry Pumps	P-3-3-1	Wemco	1989	None.	3	4	12	Difficult to maintain. Impellor wore hole through volute.
2019	RJL	Grit Slurry Pump	P-3-3-2	Wemco	1989	None.	3	4	12	Difficult to maintain. Impellor wore hole through volute.
2019	RJL	Primary Scum Pumps	P-4-10-1	Moyno	1989	Pump	3	3	9	No redundant pumps but the pump can be bypassed by pumping scum directly to the digester. The rotors and stators have been replaced several times. There is life left for these pumps due to the parts available for maintenance at the plant.
2019	RJL	Primary Scum Pump	P-4-10-2	Moyno	1989		3	3	9	No redundant pumps but can be bypassed by pumping scum directly into the digester. Rotors and stators have been replaced several times. There is life left in these pumps due to the plant having parts available for maintenance.
2019	RJL	Primary sludge Pump	P-4-6-1	Dorr Oliver	1989	None.	4	3	12	Several parts replaced.
2019	RJL	Primary Sludge Pump	P-4-6-2	Dorr Oliver	1989	None.	4	3	12	Several Parts Replaced.
2019	RJL	Primary Sludge Transfer Pump	P-4-6-3	Wemco	2010	None.	4	2	8	Can't pump to digester with these pumps. These pumps are used to pump to GBT to blending tank to blend with WAS. They are run when blanket depths are too high in primaries and they can't keep up.
2019	RJL	Primary Sludge Transfer Pump	P-4-6-4	Wemco	2010	None.	4	2	8	Can't pump to digester with these pumps. These pumps are used to pump to GBT to blending tank to blend with WAS. They are run when blanket depths are too high in primaries and they can't keep up.
2019	RJL	Secondary Scum Pump	P-7-3-1	Moyno	2019		2	1	2	No redundant pump but can drain scum to plant drain. Typically pumps secondary scum to channel downstream of grit.
2019	RJL	Secondary Scum Pump	P-7-3-2	Moyno	1989	pump was rebuilt.	2	3	6	No redundant pipe but can drain scum to plant drain. Equipment typically pumps secondary scum to channel downstream of grit.
2019	RJL	Secondary Scum Pump	P-7-3-3	Moyno	1989	Pump was rebuilt.	2	3	6	No redundant pump but can drain scum to plant drain.
2019	RJL	RAS Pump	P-7-5-1	Wemco	1989	typical maintenance (seals, wear rings)	4	3	12	impellors are bad. 1 new pump on shelf. Capacity is 1500 GPM @ 8' TDH
2019	RJL	RAS pump	P-7-5-2	Wemco	1989	Typical maintenance (seals and wear rings)	4	3	12	impellors are bad. 1 new pump on shelf. Capacity is 1500 GPM @ 8' TDH
2019	RJL	RAS Pump	P-7-5-3	Wemco	1989	Typical maintenance.	4	3	12	impellors are bad. 1 new pump on shelf. Capacity is 1500 GPM @ 8' TDH
2019	RJL	RAS Pump	P-7-5-4	Wemco	1989	Typical maintenance.	4	3	12	impellors are bad. 1 new pump on shelf. Capacity is 1500 GPM @ 8' TDH
2019	RJL	RAS pump	P-7-5-5	Wemco	1989	Typical Maintenance	4	3	12	impellors are bad. 1 new pump on shelf. Capacity is 1500 GPM @ 8' TDH
2019	RJL	WAS Pump	P-7-7-1	Wemco	1989	New impellor	4	3	12	1200 GPM @ 36' TDH 1250 RPM. Corrosion damage.
2019	RJL	WAS Pump	P-7-7-2	Wemco	1989		4	3	12	1200 GPM @ 36' TDH 1250 RPM. Pump has corrosion damage.
2019	RJL	Booster Pump	P-8-10-1		1989	bearing replacement, new VFD 2-3 years ago.	3	3	9	Have redundancy, can get parts. Never have to run more than 2 of 4 pumps. Can run to failure. Isolation valves have pneumatic actuators that stick and cause leave.
2019	RJL	Booster Pump	P-8-10-2		1989	bearing replacement, new VFD 2-3 years ago.	3	3	9	Have redundancy, can get parts. Never have to run more than 2 of 4 pumps. Can run to failure. Isolation valves have pneumatic actuators that stick and cause leave.
2019	RJL	Booster Pump	P-8-10-3		1989	bearing replacement, new VFD 2-3 years ago.	3	3	9	Have redundancy, can get parts. Never have to run more than 2 of 4 pumps. Can run to failure. Isolation valves have pneumatic actuators that stick and cause leave.
2019	RJL	Booster Pump	P-8-10-4		1989	bearing replacement, new VFD 2-3 years ago.	3	3	9	Have redundancy, can get parts. Never have to run more than 2 of 4 pumps. Can run to failure. Isolation valves have pneumatic actuators that stick and cause leave.
2019	RJL	South Primary Clarifier (#1)		ENVIREX	1989	None. Changed anodes on Cathodic protection.	4	5	20	Repainted 10-15 years ago. Grout needs to be re-done. Hot water to scum pit is no longer used, was originally used to heat the scum pit. Steel weirs are shot. Very corroded and need replacement. Corrosion on tank as well. In CIP to redo this clarifier next year. Summary for both T-4-2-2 and M-4-2-2/
2019	RJL	North Primary clarifier (#2)		ENVIREX	1989	Rehabbed.	4	4	16	Redid mechanism and paint. Grout needs redone. Corrosion on concrete. This was coated in 2008. Summary for both T-4-2-2 and M-4-2-2

Evaluation Date	Evaluated By	Equipment Name	Equipment No.	Manufacturer	Year Installed	Modifications Since Install	Importance	Overall Condition	Overall Criticality	Comments
2019	RJL	Primary Splitter Box and Gates			1989		5	5	25	Located upstream of Clarifiers. Box and gates have major corrosion with reinforcing steel showing. Frames on the gates are in bad condition and need to bypass pump to repair them. This summary is for FG-4-1-1 and FG-4-1-2 as well as the splitter box.
2019	RJL	Screening Auger/Conveyor			2010		4	2	8	Trouble free so far. No redundancy but the auger/conveyor can be bypassed.
2019	RJL	Sludge Storage tank 1 and mixing system			1989		4	5	20	Poor mixing. Old. Gas mixing system is used w/ compressed air. Mixing at sludge draw off is critical for pumping. The cover leaks so it cant store gas as originally designed. Never were able to store gas in this tank. Tank was only emptied 1 time in 30 years and the internal condition is unknown. Large columns supporting cover could hinder mixing.
2019	RJL	Sludge storage tank 2 and mixing system			1997		5	2	10	Cranes for removing pump & mixers needs to be replaced. Sidewalk, fill around tank is settling causing issues on conduit. Odor bed has been removed. Odors can be an issue when tank is mixed.
2019	RJL	Sumps and Pumps			1989		5	2	10	Many sump pumps have been replaced.
2019	RJL	Thickened Sludge Wet wells	T-10-10-1		1989		5	2	10	Not originally used, was set up for future. It was converted to a WAS/Primary Sludge Blending tank
2019	RJL	Thickened Sludge Wet wells	T-10-10-2		1989		5	2	10	No mixing in tank.
2019	RJL	Thickened Sludge Wet wells	T-10-10-3		1989		5	2	10	No mixing in tank. 1 Tank per GBT
2019	RJL	Filtrate Sump	T-10-7		2010	Lined w/ Epoxy in 2010.	1	2	2	Not typically used. Filtrate is now sent directly to plant drain system.
2019	RJL	Polymer Feed Tank	T-11-13-1		1989		5	3	15	fiberglass tanks, decent condition. No mixers. Air operated valves are corroded.
2019	RJL	Polymer Feed Tank	T-11-13-2		1989		5	3	15	see T-11-13-1 for comments.
2019	RJL	Dry Polymer Hopper	T-11-6		1989		5	4	20	system works fine. Need to better control humidity in this space.
2019	RJL	Digester #1	T-12-4-1		1989		5	2	10	New mixing sytem installed. Gas seal at cover/wall was broken and repaired shortly after original construction. Flame arrestors have been replaced.
2019	RJL	Digester #2	T-12-4-2		1989		5	2	10	Coatings were added 15 yrs ago to again repair gas seal. See T-12-4-1 for more comments.
2019	RJL	Plant Drain Wet well	T-17-3		1989		5	2	10	
2019	RJL	Scum Concentrator	T-18-1	Tenco Hydro Inc.	1989	Filaments, chain, sprockets replaced.	4	4	16	Thickened scum goes to 400 gallon heated thickened scum tank. No redundancy but this equipment can be bypassed directly to the digester. Can this equipment be eliminated?
2019	RJL	Scum Storage Tank	T-18-2	Mueller	1989	None.	4	2	8	Minimal damage. No bypass for the scum but can be routed directly to the digester.
2019	RJL	Mist Scrubber	T-19-12-1		1989		5	3	15	Scrubber has issues in the winter. Shut off in winter. Chemical storage tanks have been replaced.
2019	RJL	Septage Receiving Pit	T-2-10-1		1989		3	3	9	tanks don't take much septage. 1 pit goes to plant influent. 1 pit goes to digesters or sludge thickening.
2019	RJL	Septage Receiving Pit	T-2-10-2		1989		3	3	9	see T-2-10-1 for comments.
2019	RJL	Digested Sludge Cake Loadout Bin	T-21-10		1989		3	2	6	Works ok once cake gets to it. Odors are an issue in summer, NH4 smell.
2019	RJL	Septage Tanks, 2 units	T-2-11-1		1989		3	2	6	
2019	RJL	Waste Gas Incinerator		Link Ladder	1989		5	5	25	Needs replacement. High Priority

APPENDIX G
COST BREAKDOWNS

City of Beloit, Wisconsin
Wastewater Facilities Plan
Opinion of Present Worth Cost **Discount Rate** 3.375%

Alternative AS1 - Expansion of Activated Sludge System with Current A/O Configuration

ITEM	Initial Capital Cost	Future Capital Cost	Replacement Year	Replacement Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Demolition (Blowers, Piping, Diffusers, Mixers)	$ 50,000	$ -	20	$ -	$ -	$ -
Two Additional Activated Sludge Trains - 3.9 MG	$ 3,900,000	$ -	40	$ -	$ 1,950,000	$ 1,000,000
Anaerobic Mixers	$ 300,000	$ -	20	$ -	$ -	$ -
Fine Bubble Diffusers	$ 880,000	$ 880,000	15	$ 530,000	$ 590,000	$ 300,000
Blowers	$ 1,140,000	$ -	20	$ -	$ -	$ -
Subtotal	$ 6,270,000	$ 880,000				
Piping and Mechanical (20%)	$ 1,260,000	$ -	40	$ -	$ 630,000	$ 320,000
HVAC (7%)	$ 440,000	$ -	20	$ -	$ -	$ -
Electrical (25%)	$ 1,570,000	$ -	20	$ -	$ -	$ -
Sitework (5%)	$ 320,000					
Subtotal	$ 9,860,000					
Contractor GCs (10%)	$ 990,000					
Total Construction Costs	$ 10,850,000					
Contingencies and Engineering Services (40%)	$ 4,340,000					
Total Capital Costs	$ 15,190,000			$ 530,000	$ 3,170,000	$ 1,620,000
Present Worth of Capital Costs	**$ 15,190,000**			$ 530,000		$ 1,620,000

	Current	Year 2045	Average
Relative Labor ($40/hr)	$ -	$ -	$ -
Maintenance (~2% of equipment)	$ 46,000	$ 46,000	$ 46,000
Power ($0.08/kWh)	$ 277,000	$ 486,000	$ 381,500
Total O&M Costs	$ 323,000	$ 532,000	$ 427,500
Present Worth of O&M			**$ 6,150,000**

Summary of Present Worth Costs

Capital Cost	$ 15,190,000
Replacement	$ 530,000
O&M Cost	$ 6,150,000
Salvage Value	$ (1,620,000)
Total Present Worth	**$ 20,250,000**

Notes:
All costs are second quarter, 2020 dollars.
Present worth is calculated on a 20-year basis at discount rate shown.

DRAFT-(08.19.20)

City of Beloit, Wisconsin
Wastewater Facilities Plan
Opinion of Present Worth Cost **Discount Rate** 3.375%

Alternative AS2 - Expansion of Activated Sludge System with A2O Configuration

ITEM	Initial Capital Cost	Future Capital Cost	Replacement Year	Replacement Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Demolition (Blowers, Piping, Diffusers, Mixers)	$ 50,000	$ -	20	$ -	$ -	$ -
Two Additional Activated Sludge Trains - 3.9 MG	$ 3,900,000	$ -	40	$ -	$ 1,950,000	$ 1,000,000
Baffle Walls in Existing Tanks - Anoxic Zones	$ 70,000	$ -	40	$ -	$ 40,000	$ 20,000
Anaerobic Mixers	$ 300,000	$ -	20	$ -	$ -	$ -
Anoxic Mixers	$ 300,000	$ -	20	$ -	$ -	$ -
Fine Bubble Diffusers	$ 700,000	$ 700,000	15	$ 430,000	$ 470,000	$ 240,000
Nitrate Recycle Pumps	$ 240,000	$ -	20	$ -	$ -	$ -
Blowers	$ 1,140,000	$ -	20	$ -	$ -	$ -
Subtotal	$ 6,700,000	$ 700,000				
Piping and Mechanical (20%)	$ 1,340,000	$ -	40	$ -	$ 670,000	$ 340,000
HVAC (7%)	$ 470,000	$ -	20	$ -	$ -	$ -
Electrical (25%)	$ 1,680,000	$ -	20	$ -	$ -	$ -
Sitework (5%)	$ 340,000					
Subtotal	$ 10,530,000					
Contractor GCs (10%)	$ 1,060,000					
Total Construction Costs	$ 11,590,000					
Contingencies and Engineering Services (40%)	$ 4,640,000					
Total Capital Costs	$ 16,230,000			$ 430,000	$ 3,130,000	$ 1,600,000
Present Worth of Capital Costs	**$ 16,230,000**			$ 430,000		$ 1,600,000

	Current	Year 2045	Average
Relative Labor ($40/hr)	$ -	$ -	$ -
Maintenance (~2% of equipment)	$ 54,000	$ 54,000	$ 54,000
Power ($0.08/kWh)	$ 286,000	$ 491,000	$ 388,500
Total O&M Costs	$ 340,000	$ 545,000	$ 442,500
Present Worth of O&M			**$ 6,360,000**

Summary of Present Worth Costs	
Capital Cost	$ 16,230,000
Replacement	$ 430,000
O&M Cost	$ 6,360,000
Salvage Value	$ (1,600,000)
Total Present Worth	**$ 21,420,000**

Notes:
All costs are second quarter, 2020 dollars.
Present worth is calculated on a 20-year basis at discount rate shown.

DRAFT-(08.19.20)

City of Beloit, Wisconsin
Wastewater Facilities Plan
Opinion of Present Worth Cost — **Discount Rate** 3.375%

Alternative D1 - Expand Chlorination/ Dechlorination

ITEM	Initial Capital Cost	Future Capital Cost	Future Capital Cost Year	Replacement Cost	Service Life	Replacement Cost (P.W.)	Future Capital Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Demolition	$ 25,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Chlorine Contact Tank Expansion	$ 200,000	$ -		$ -	40	$ -	$ -	$ 100,000	$ 50,000
Containment Area Rehabilitation	$ 20,000	$ -		$ -	20	$ -	$ -	$ -	$ -
New Stop Logs and Frame	$ 20,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Liquid Chlorination Chemical Bulk Storage Tanks (2)	$ 90,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Liquid Chlorination Chemical Feed Pumps (5)	$ 110,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Liquid Dechlorination Chemical Bulk Storage Tank	$ 45,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Liquid Dechlorination Chemical Feed Pumps (2)	$ 44,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Subtotal	$ 554,000	$ -		$ -					
Piping and Mechanical (20%)	$ 120,000	$ -			40	$ -		$ 60,000	$ 30,000
Electrical (20%)	$ 120,000	$ -			20	$ -		$ -	$ -
HVAC (8%)	$ 50,000	$ -			20	$ -		$ -	$ -
Sitework (5%)	$ 30,000								
Subtotal	$ 874,000								
Contractor GCs (10%)	$ 90,000								
Total Construction Costs	$ 964,000								
Contingencies and Engineering Services (40%)	$ 390,000								
Total Capital Costs	$ 1,354,000					$ -	$ -	$ 160,000	$ 80,000
Present Worth of Capital Costs	**$ 1,354,000**					$ -	$ -		$ 80,000

	Current	Year 2045	Average
Relative Labor ($40/hr)	$ -	$ -	$ -
Maintenance (~2% of equipment)	$ 3,000	$ 3,000	$ 3,000
Power ($0.08/kWh)	$ 1,000	$ 1,000	$ 1,000
Chemical Use	$ 29,000	$ 43,000	$ 36,000
Total O&M Costs	$ 33,000	$ 47,000	$ 40,000
Present Worth of O&M			**$ 570,000**

Summary of Present Worth Costs

Capital Cost	$ 1,354,000
Future Capital Costs/Replacement	$ -
O&M Cost	$ 570,000
Salvage Value	$ (80,000)
Total Present Worth	**$ 1,844,000**

Notes:
All costs are second quarter, 2020 dollars.
Present worth is calculated on a 20-year basis at discount rate shown.

City of Beloit, Wisconsin
Wastewater Facilities Plan
Opinion of Present Worth Cost — **Discount Rate** 3.375%

Alternative D2 - Ultraviolet Disinfection

ITEM	Initial Capital Cost	Future Capital Cost	Future Capital Cost Year	Replacement Cost	Service Life	Replacement Cost (P.W.)	Future Capital Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Demolition	$ 50,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Tank Modifications	$ 600,000	$ -		$ -	40	$ -	$ -	$ 300,000	$ 150,000
Fixed Weir Troughs	$ 95,000	$ -		$ -	20	$ -	$ -	$ -	$ -
UV Equipment	$ 500,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Slide Gates (5)	$ 115,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Metal Canopy	$ 70,000	$ -		$ -	40	$ -	$ -	$ 40,000	$ 20,000
Subtotal	$ 1,430,000	$ -		$ -					
Piping and Mechanical (5%)	$ 80,000	$ -			40	$ -		$ 40,000	$ 20,000
Electrical (25%)	$ 360,000	$ -			20	$ -		$ -	$ -
HVAC (5%)	$ 80,000	$ -			20	$ -		$ -	$ -
Sitework (5%)	$ 80,000								
Subtotal	$ 2,030,000								
Contractor GCs (10%)	$ 210,000								
Total Construction Costs	$ 2,240,000								
Contingencies and Engineering Services (40%)	$ 900,000								
Total Capital Costs	$ 3,140,000					$ -	$ -	$ 380,000	$ 190,000
Present Worth of Capital Costs	**$ 3,140,000**					$ -	$ -		$ 190,000

	Current	Year 2045	Average
Relative Labor ($40/hr)	$ -	$ -	$ -
Maintenance (~2% of equipment)	$ 4,000	$ 4,000	$ 4,000
Power ($0.08/kWh)	$ 5,000	$ 5,000	$ 5,000
Lamp Replacement	$ 3,000	$ 3,000	$ 3,000
Total O&M Costs	$ 12,000	$ 12,000	$ 12,000
Present Worth of O&M			**$ 170,000**

Summary of Present Worth Costs

Capital Cost	$ 3,140,000
Future Capital Costs/Replacement	$ -
O&M Cost	$ 170,000
Salvage Value	$ (190,000)
Total Present Worth	**$ 3,120,000**

Notes:
All costs are second quarter, 2020 dollars.
Present worth is calculated on a 20-year basis at discount rate shown.

City of Beloit, Wisconsin
Wastewater Facilities Plan
Opinion of Present Worth Cost **Discount Rate**

Alternative OC1 - Chemical Scrubber

ITEM	Initial Capital Cost	Future Capital Cost	Replacement Year	Replacement Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Demolition	$ 50,000	$ -	20	$ -	$ -	$ -
Chemical Scrubber Replacement	$ 370,000	$ -	20	$ -	$ -	$ -
Chemical Storage Tank Replacement	$ 50,000	$ -	20	$ -	$ -	$ -
Chemical Feed System Replacement	$ 30,000	$ 20,000	15	$ 10,000	$ 20,000	$ 10,000
Subtotal	$ 500,000	$ 20,000				
Piping and Mechanical (25%)	$ 130,000	$ -	40	$ -	$ 50,000	$ 30,000
Electrical (20%)	$ 100,000	$ -	20	$ -	$ -	$ -
HVAC (0%)	$ -	$ -	20	$ -	$ -	$ -
Sitework (5%)	$ 30,000					
Subtotal	$ 760,000					
Contractor GCs (10%)	$ 80,000					
Total Construction Costs	$ 840,000					
Contingencies and Engineering Services (40%)	$ 340,000					
Total Capital Costs	$ 1,180,000			$ 10,000	$ 70,000	$ 40,000
Present Worth of Capital Costs	**$ 1,180,000**			$ 10,000		$ 40,000
Relative Labor ($40/hr)	$ -					
Maintenance (~2% of equipment)	$ 10,000					
Power ($0.08/kWh)	$ 11,000					
Chemical Use	$ 20,000					
Total O&M Costs	$ 41,000					
Present Worth of O&M	**$ 590,000**					

Summary of Present Worth Costs

Capital Cost	$ 1,180,000
Future Capital Costs/Replacement	$ 10,000
O&M Cost	$ 590,000
Salvage Value	$ (40,000)
Total Present Worth	**$ 1,740,000**

Notes:
All costs are second quarter, 2020 dollars.
Present worth is calculated on a 20-year basis at discount rate shown.

City of Beloit, Wisconsin
Wastewater Facilities Plan
Opinion of Present Worth Cost **Discount Rate**

Alternative OC2 - Biofilter

ITEM	Initial Capital Cost	Future Capital Cost	Replacement Year	Replacement Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Demolition	$ 50,000	$ -	20	$ -	$ -	$ -
Biofilter System	$ 640,000	$ -	20	$ -	$ -	$ -
Subtotal	$ 690,000	$ -				
Piping and Mechanical (15%)	$ 110,000	$ -	40	$ -	$ 20,000	$ 10,000
Electrical (20%)	$ 110,000	$ -	20	$ -	$ -	$ -
HVAC (0%)	$ -	$ -	20	$ -	$ -	$ -
Sitework (5%)	$ 40,000					
Subtotal	$ 950,000					
Contractor GCs (10%)	$ 100,000					
Total Construction Costs	$ 1,050,000					
Contingencies and Engineering Services (40%)	$ 420,000					
Total Capital Costs	$ 1,470,000			$ -	$ 20,000	$ 10,000
Present Worth of Capital Costs	**$ 1,470,000**			$ -		$ 10,000
Relative Labor ($40/hr)	$ -					
Maintenance (~2% of equipment)	$ 10,000					
Power ($0.08/kWh)	$ 11,000					
Chemical Use	$ -					
Total O&M Costs	$ 21,000					
Present Worth of O&M	**$ 300,000**					

Summary of Present Worth Costs

Capital Cost	$ 1,470,000
Future Capital Costs/Replacement	$ -
O&M Cost	$ 300,000
Salvage Value	$ (10,000)
Total Present Worth	**$ 1,760,000**

Notes:
All costs are second quarter, 2020 dollars.
Present worth is calculated on a 20-year basis at discount rate shown.

City of Beloit, Wisconsin
Wastewater Facilities Plan
Opinion of Present Worth Cost

Discount Rate 3.375%

Alternative B1 - Liquid Biosolids Storage, Additional Land Application Equipment

ITEM	Initial Capital Cost	Future Capital Cost	Future Capital Cost Year	Replacement Cost	Service Life	Replacement Cost (P.W.)	Future Capital Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Demolition	$ 100,000								
Additional liquid storage tank - 4.8 MG	$ -	$ 3,040,000	10	$ -	40	$ -	$ 2,180,000	$ 2,280,000	$ 1,170,000
New Storage Tank Cover	$ -	$ 600,000	10	$ -	20	$ -	$ 430,000	$ 300,000	$ 150,000
Storage Tank Mixing System	$ -	$ 300,000	10	$ -	20	$ -	$ 220,000	$ 150,000	$ 80,000
Storage Tank Loadout Pump	$ -	$ 60,000	10	$ -	20	$ -	$ 40,000	$ 30,000	$ 20,000
Storage Tank No. 1 Cover Repair	$ -	$ 200,000	10	$ -	20	$ -	$ 140,000	$ 100,000	$ 50,000
Storage Tank No. 1 Mixing System	$ 300,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Storage Tank No. 1 Loadout Pump	$ 60,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Gravity Belt Thickener (1)	$ 400,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Biosolids Conveyors	$ 320,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Thickened Sludge Pump (1)	$ 70,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Additional Truck Loadout Area	$ 770,000	$ -		$ -	40	$ -	$ -	$ 390,000	$ 200,000
Subtotal	$ 2,020,000	$ 4,200,000		$ -			$ 3,010,000		
Piping and Mechanical (15%)	$ 310,000	$ 630,000	10		40	$ -	$ 450,000	$ 630,000	$ 320,000
Electrical (15%)	$ 310,000	$ 630,000	10		20	$ -	$ 450,000	$ 320,000	$ 165,000
HVAC (7%)	$ 150,000	$ 130,000	10		20	$ -	$ 90,000	$ 70,000	$ 36,000
Sitework (10%)	$ 210,000	$ 210,000	10				$ 150,000		
Subtotal	$ 3,000,000	$ 5,800,000					$ 4,150,000		
Contractor GCs (10%)	$ 300,000	$ 580,000					$ 420,000		
Total Construction Costs	$ 3,300,000	$ 6,380,000					$ 4,570,000		
Contingencies and Engineering Services (40%)	$ 1,320,000	$ 2,560,000					$ 1,830,000		
Additional Transportation and Land Application Equipment	$ 600,000	$ 800,000	10	$ -	20	$ -	$ 570,000	$ 400,000	$ 210,000
Total Capital Costs	$ 5,220,000	$ 9,740,000				$ -	$ 6,970,000	$ 4,670,000	$ 2,401,000
Present Worth of Capital Costs	**$ 5,220,000**					$ -	$ 6,970,000		$ 2,401,000

	Current	Year 2045	Average
Relative Labor ($40/hr)	$ 180,000	$ 280,000	$ 230,000
Maintenance (~2% of equipment)	$ 20,000	$ 30,000	$ 25,000
Power ($0.08/kWh)	$ 8,000	$ 11,000	$ 10,000
Polymer Use (at 10 lbs/DT)	$ 40,000	$ 60,000	$ 50,000
Biosolids Disposal (Truck Maintenance, Gas, Fees)	$ 180,000	$ 340,000	$ 260,000
Total O&M Costs	$ 428,000	$ 721,000	$ 575,000
Present Worth of O&M			**$ 8,270,000**

Summary of Present Worth Costs

Capital Cost	$ 5,220,000
Future Capital Costs/Replacement	$ 6,970,000
O&M Cost	$ 8,270,000
Salvage Value	$ (2,401,000)
Total Present Worth	**$ 18,059,000**

Notes:
All costs are second quarter, 2020 dollars.
Present worth is calculated on a 20-year basis at discount rate shown.

City of Beloit, Wisconsin
Wastewater Facilities Plan
Opinion of Present Worth Cost

Discount Rate 3.375%

Alternative B2 - Dewatering and Off-Site Storage

ITEM	Initial Capital Cost	Future Capital Cost	Future Capital Cost Year	Replacement Cost	Service Life	Replacement Cost (P.W.)	Future Capital Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Demolition	$ 50,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Dewatering Centrifuge (1)	$ 750,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Centrifuge Feed Pumps (2)	$ 120,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Biosolids Conveyors	$ 320,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Additional Truck Loadout Area	$ 770,000	$ -		$ -	40	$ -	$ -	$ 390,000	$ 200,000
Off-Site Cake Storage Building	$ 3,220,000	$ 1,610,000	10	$ -	40	$ -	$ 1,160,000	$ 2,820,000	$ 1,450,000
Subtotal	$ 5,230,000	$ 1,610,000					$ 1,160,000		
Piping and Mechanical (5%)	$ 270,000	$ 90,000	10		40	$ -	$ 60,000	$ 210,000	$ 110,000
Electrical (20%)	$ 1,050,000	$ 330,000	10		20	$ -	$ 240,000	$ 170,000	$ 88,000
HVAC (3%)	$ 160,000	$ -	10		20	$ -	$ -	$ -	$ -
Sitework (20%)	$ 1,050,000	$ 330,000	10				$ 240,000	$ -	$ -
Subtotal	$ 7,760,000	$ 2,360,000					$ 1,700,000		
Contractor GCs (10%)	$ 780,000	$ 240,000					$ 170,000		
Total Construction Costs	$ 8,540,000	$ 2,600,000					$ 1,870,000		
Land Acquisition (20 Acres at $25,000/Ac)	$ 500,000	$ -					$ -		
Contingencies and Engineering Services (40%)	$ 3,420,000	$ 1,040,000					$ 750,000		
Land Application Equipment	$ 1,000,000	$ -			20	$ -	$ -	$ -	$ -
Total Capital Costs	$ 13,460,000	$ 3,880,000				$ -	$ 2,790,000	$ 3,590,000	$ 1,848,000
Present Worth of Capital Costs	**$ 13,460,000**					$ -	$ 2,790,000		$ 1,848,000

	Current	Year 2045	Average
Relative Labor ($40/hr)	$ 180,000	$ 280,000	$ 230,000
Maintenance (~2% of equipment)	$ 20,000	$ 20,000	$ 20,000
Power ($0.08/kWh)	$ 10,000	$ 20,000	$ 15,000
Polymer Use (at 25 lbs/DT)	$ 90,000	$ 140,000	$ 115,000
Biosolids Disposal (Truck Maintenance, Gas, Fees)	$ 90,000	$ 170,000	$ 130,000
Total O&M Costs	$ 390,000	$ 630,000	$ 510,000
Present Worth of O&M			**$ 7,330,000**

Summary of Present Worth Costs

Capital Cost	$ 13,460,000
Future Capital Costs/Replacement	$ 2,790,000
O&M Cost	$ 7,330,000
Salvage Value	$ (1,848,000)
Total Present Worth	**$ 21,732,000**

Notes:
All costs are second quarter, 2020 dollars.
Present worth is calculated on a 20-year basis at discount rate shown.

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City of Beloit, Wisconsin
Wastewater Facilities Plan
Opinion of Present Worth Cost

Discount Rate 3.375%

Alternative B3 - Drying

ITEM	Initial Capital Cost	Future Capital Cost	Future Capital Cost Year	Replacement Cost	Service Life	Replacement Cost (P.W.)	Future Capital Cost (P.W.)	20-Year Salvage Value	Salvage Value (P.W.)
Demolition	$ 50,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Dewatering Centrifuge (1)	$ 670,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Centrifuge Feed Pumps (2)	$ 120,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Biosolids Conveyors	$ 320,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Process Building Expansion - Dryer and Truck Loadout/Storage Area	$ 1,910,000	$ -		$ -	40	$ -	$ -	$ 960,000	$ 490,000
Drying Equipment	$ 3,300,000	$ -		$ -	20	$ -	$ -	$ -	$ -
Subtotal	$ 6,370,000	$ -							
Piping and Mechanical (10%)	$ 640,000	$ -			40	$ -	$ -	$ 320,000	$ 160,000
Electrical (20%)	$ 1,280,000	$ -			20	$ -	$ -	$ -	$ -
HVAC (5%)	$ 320,000	$ -			20	$ -	$ -	$ -	$ -
Sitework (5%)	$ 320,000	$ -					$ -		
Subtotal	$ 8,930,000	$ -							
Contractor GCs (10%)	$ 900,000								
Total Construction Costs	$ 9,830,000								
Contingencies and Engineering Services (40%)	$ 3,940,000								
Total Capital Costs	$ 13,770,000	$ -				$ -	$ -	$ 1,280,000	$ 650,000
Present Worth of Capital Costs	**$ 13,770,000**	$ -				$ -	$ -		$ 650,000

Notes:
All costs are second quarter, 2020 dollars.
Present worth is calculated on a 20-year basis at discount rate shown.

	Current	Year 2045	Average
Relative Labor ($40/hr)	$ 80,000	$ 120,000	$ 100,000
Maintenance (~2% of equipment)	$ 90,000	$ 90,000	$ 90,000
Power ($0.08/kWh)	$ 60,000	$ 90,000	$ 75,000
Gas Use ($0.50/therm)	$ 70,000	$ 100,000	$ 85,000
Polymer Use (at 30 lbs/DT)	$ 90,000	$ 140,000	$ 115,000
Biosolids Disposal	$ -	$ -	$ -
Total O&M Costs	$ 390,000	$ 540,000	$ 465,000
Present Worth of O&M	**$ 5,610,000**	**$ 7,760,000**	**$ 6,680,000**

Summary of Present Worth Costs	
Capital Cost	$ 13,770,000
Future Capital Costs/Replacement	$ -
O&M Cost	$ 6,680,000
Salvage Value	$ (650,000)
Total Present Worth	**$ 19,800,000**

Notes:
All costs are second quarter, 2020 dollars.
Present worth is calculated on a 20-year basis at discount rate shown.