TECHNICAL MEMORANDUM 2.5 – INFRASTRUCTURE GAP ANALYSIS

NEW Water Facility Plan

B&V PROJECT NO. 402658

PREPARED FOR

NEW Water
The brand of the Green Bay Metropolitan Sewerage District

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BLACK & VEATCH

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1 Purpose

The development of an overall understanding of the current treatment process in terms of capacity and infrastructure conditions is a critical step to every planning process for wastewater utilities. Without an agreed upon understanding of the treatment process, current capacity of the plant, and understanding of the current equipment condition, it is not possible to effectively develop infrastructure capital improvement plans. The purpose of Technical Memorandum 2.5 (TM 2.5) is to summarize the infrastructure capacity, overall treatment capacity, and major infrastructure gaps for the NEW Water Facility Plan through the development of the Infrastructure Gap Analysis Tool (Gap Analysis). TM 2.5 should be viewed as a companion to the Infrastructure Gap Analysis Tool. The specific objectives of TM 2.5 are to:

a. Assess the performance of the GBF and DPF facilities as well as individual unit processes under various future flow and loading conditions

b. Review and update process design capacities under current conditions for the GBF and DPF facilities considering unit process sizing, rated capacities, performance characteristics, mass balance calculations, and applicable code interpretations

c. Review and summarize condition assessment data from NEW Water's asset management program for the GBF and DPF facilities to assess the condition of the facilities

d. Review the findings from the process evaluation, design basis, and condition assessment reports to identify the infrastructure gaps in terms of a lack of needed capacity or equipment that will not be able to provide its expected service.

Subsequent analysis will then build on these gaps to identify needed improvements to the operation, maintenance, reliability, and efficiency for each unit process at the facilities. These recommended improvements will be made in the context of the 50-year vision being developed as part of this project.

TM 2.5 builds on and incorporates by reference findings from the previously completed Technical Memorandums:

- TM 2.1 – Projected Flows and Loads
- TM 2.2 – Future Regulatory Drivers
- TM 2.3 - Process Model Development
- TM 2.4 – Hydraulic Model Development

2 Approach to the Infrastructure Gap Assessment

This section describes how the infrastructure Gap Assessment Tool (Gap Analysis) was completed and the information in it used in TM 2.5. Section 3 describes the Infrastructure Gaps for the De Pere Facility and Section 4 describes the gaps for the Green Bay Facility.

2.1 INFORMATION USED FOR THE INFRASTRUCTURE GAP ASSESSMENT

The Gap Analysis was built on the following analysis.

- Establishing current and future flows and loads (TM 2.1)
- Consideration of future regulatory drivers (TM 2.2)
- Assessing process limitations through the application of the plant process model (TM 2.3)
- Evaluation of hydraulic limitations through application of the plant hydraulic model (TM 2.4)
- Other known information about the equipment based on a review of reports describing recent plant upgrades, visual observations of the equipment done as part of this project and conclusions from NEW Water's previous condition assessment efforts.

The goal is that the Gap Analysis will be a long-term tool for NEW Water to track future asset and capacity improvements and gaps.

2.2 INFRASTRUCTURE GAP ANALYSIS TOOL (GAP ANALYSIS) DEVELOPMENT

The Gap Analysis was prepared in a Microsoft Excel spreadsheet. The tabs are ordered by summary tabs (flow and load capacity summary GBF/DPF plant schematic), and influent effluent parameter summary. The summary tabs are then followed by each unit process tab. The unit process evaluations (which the unit process tabs within the spreadsheet) at the DPF include:

- Influent Pump Station (Influent pumps, GBF transfer pumps, and screens)
- Mill Waste Transfer
- Preliminary Treatment Units
- Aeration Basins
- Intermediate Clarifiers
- 2nd Stage Aeration
- Final Clarifiers
- Tertiary Filters
- Disinfection

The unit process evaluations (which match the unit process tabs within the spreadsheet) at the GBF include:

- Influent Pump Station
- Headworks
- Primary Clarifiers
- NP Aeration Basin and Clarifier
- SP Aeration Basin and Clarifier

- Disinfection
- Thickening
- Anaerobic Digestion
- Solids Handling
- P-Release (NOT IN USE)
- Nutrient Recovery (NOT IN USE)

Each unit process summary includes a design basis capacity analysis, an asset management gap analysis, the asset management system output for major equipment related to unit process, and the design basis (equipment summary and calculations).

Design Basis Capacity Analysis

The design basis capacity analysis is the first section within each unit process tab. This section summarizes the utilization of each component for either equipment or process. The percent utilization was calculated based on either equipment capabilities or process limitations. The percent utilization for the process and volumetric requirements were determined in the *Design Basis Calculations* provided after the asset management data in each tab.

Asset Management Gap Analysis

The asset management gap analysis provides a summary of the major gaps in the system provided by the asset management system output and by operator infrastructure gap identification. The figure provided in this section is a summary of the probability of failure (PoF) and the consequence of failure (CoF) for all equipment for each unit process and the number of items represented for each rating. All of these ratings are based on "desktop" analysis ratings developed in a previous asset management evaluation. The asset management data were provided by NEW Water from the asset management system. The PoF rating was estimated during an asset management evaluation and represents the asset's age, condition, failure history, historical knowledge, maintenance records, and applied stresses. The ratings for the PoF range from 1 to 5, with 1 being improbable likelihood of failure and 5 being imminent failure likely with continuous failure experienced. The PoF is typically used to calculate the asset's risk level of failure and the remaining life of the asset.

The CoF rating is assigned to evaluate the importance of a piece of equipment to the process and includes the overall repair, social, environmental, collateral damage, legal, loss of business revenue, and any other relevant costs associated with the failure. The range of ratings is from 1 (insignificant disruption) to 5 (catastrophic disruption). For this analysis, critical equipment was considered those with a PoF and CoF rating of 3.0 or greater.

Asset Management System Output for Major Equipment Related to Unit Process

The asset management analysis input listed was provided by NEW Water from their asset management database developed for each facility. Within each database, the PoF and CoF ratings were used for critical equipment identification. The list in this section was taken directly from the asset management database and can easily be updated with new system input, including new or improved equipment through copy and pasting new equipment into this spreadsheet from the asset management system to keep the tabs up to date. Other notes provided via the process site assessment and meetings with NEW Water are provided under the *Operation Infrastructure Gap*

Identification. Following the asset management summary is the *Asset Management System Output for Major Equipment Related to Unit Processes* which includes each piece of major equipment and its related scoring from the related previously conducted site assessment.

The associated cost from the asset management system is also called out in this section with a total costs summary estimate to update these assets. These costs will be updated in the evaluation phase if they are deemed necessary to replace.

Equipment and Capacity Analysis

After the asset management data output the *Equipment and Capacity Analysis* is presented. Within this section the current equipment, original design parameters, and the applicable flow and process calculations are provided. The data used to develop process and flow/volumetric limitations were provided in TM 2.1 *Flows and Loads*.

For equipment capacity and volumetric utilization, the size of the tankage and equipment was compared to the flows and loads for each unit process and a percent utilization was calculated. For regulatory compliance, the process calculations were compared to the recommended standards from the *Recommended Standards for Wastewater Facilities (2014)* also known as the *10 States Standards*.

The Gap Analysis was developed to understand the process and equipment gaps at the facility and develop recommended facility upgrades to meet future operational requirements as well as improve the ease of operation. The overall updates will provide data for the development of a new vision for each facility in which the treatment may be low operator requirements, reliable, with low operation and maintenance.

2.3 OTHER TOOLS USED FOR THE INFRASTRUCTURE GAP

While not formally part of the Gap Analysis spreadsheet, two other tools were used to help evaluate process and hydraulic capacity and these are described below.

Process Model Capacity Summary

As part of the Process Model Calibration and Capacity Analysis TM (TM 2.3), several areas of process capacity were further explored. The results of the process model evaluation do no change the process design capacity but help to identify the root cause of process limitations. Where applicable, the process model results will be referenced in this TM, with details provided in TM 2.3.

Hydraulic Model Capacity Summary

The hydraulic model was developed for the Facility Plan and summarized in TM 2.2. The hydraulic model is a mathematical model of the surface water elevation of wastewater discharged at various flow rates into the GBF and DPF. The primary objective of TM 2.2 was to develop, calibrate, and validate plant hydraulic models that replicate actual hydraulic performance from the plant headworks to the plant discharge for each facility. The hydraulic models were used to identify process bottlenecks and assess future infrastructure improvements. The hydraulic model will be used as a tool to predict water surface elevations at various flow scenarios based on previous collected elevations during high flow events. Within each unit process a summary of any bottlenecks, freeboard issues, or submergence issues will be identified.

Additional hydraulic analyses were completed to identify the overall hydraulic capacity at the GBF. These analyses identified areas with velocity and freeboard limitation as critical criteria and submerged flumes, weirs and gates as non-critical. The criteria are identified in Table 2-1.

Table 2-1. Hydraulic Impact Bottleneck Criteria

	FLAGGED	
Critical Criteria		
Channel/Pipe Velocity	< 6 fps	> 6 fps
Freeboard Limitations	NO *More than 6" freeboard to top of channel*	FLOOD *Less than 6" freeboard to top of channel*
Non-Critical Criteria		
Submerged Flumes	NO *Flume in free flow*	SUBMERGED *Flume submerged*
Submerged Weirs	NO *Weir unsubmerged*	SUBMERGED *Weir submerged*
Submerged Gates	NO *Gate unsubmerged*	SUBMERGED *Gate submerged*

Additional analyses were completed for the GBF pump station and the GBF gravity system hydraulics under current and future peak flow conditions for the 10-year and the 25-year recurrence intervals. The range of peak flows evaluated ranged from 128 million gallons per day (mgd) (current condition at a 10-year recurrence interval) to 175 mgd (50 year projection at a 25-year recurrence interval) (Table 2-2). The flow rates evaluated were presented in the Interceptor System Master Plan (ISMP).

Table 2-2 Six flow scenarios in which the GBF Pump Station and gravity system hydraulics were analyzed

	RECURRENCE INTERVAL PEAK FLOW (MGD)	
	10-Year	**25-Year**
Current Conditions	128	151
20-Year Future	135	159
50-Year Future	148	175

3 De Pere Facility Infrastructure Gap Results

The DPF treatment facility includes screening, influent pumping, grit removal, first stage aeration, intermediate clarifiers, second stage aeration, final clarifiers, tertiary filters, and disinfection as detailed on Figure 3-1.

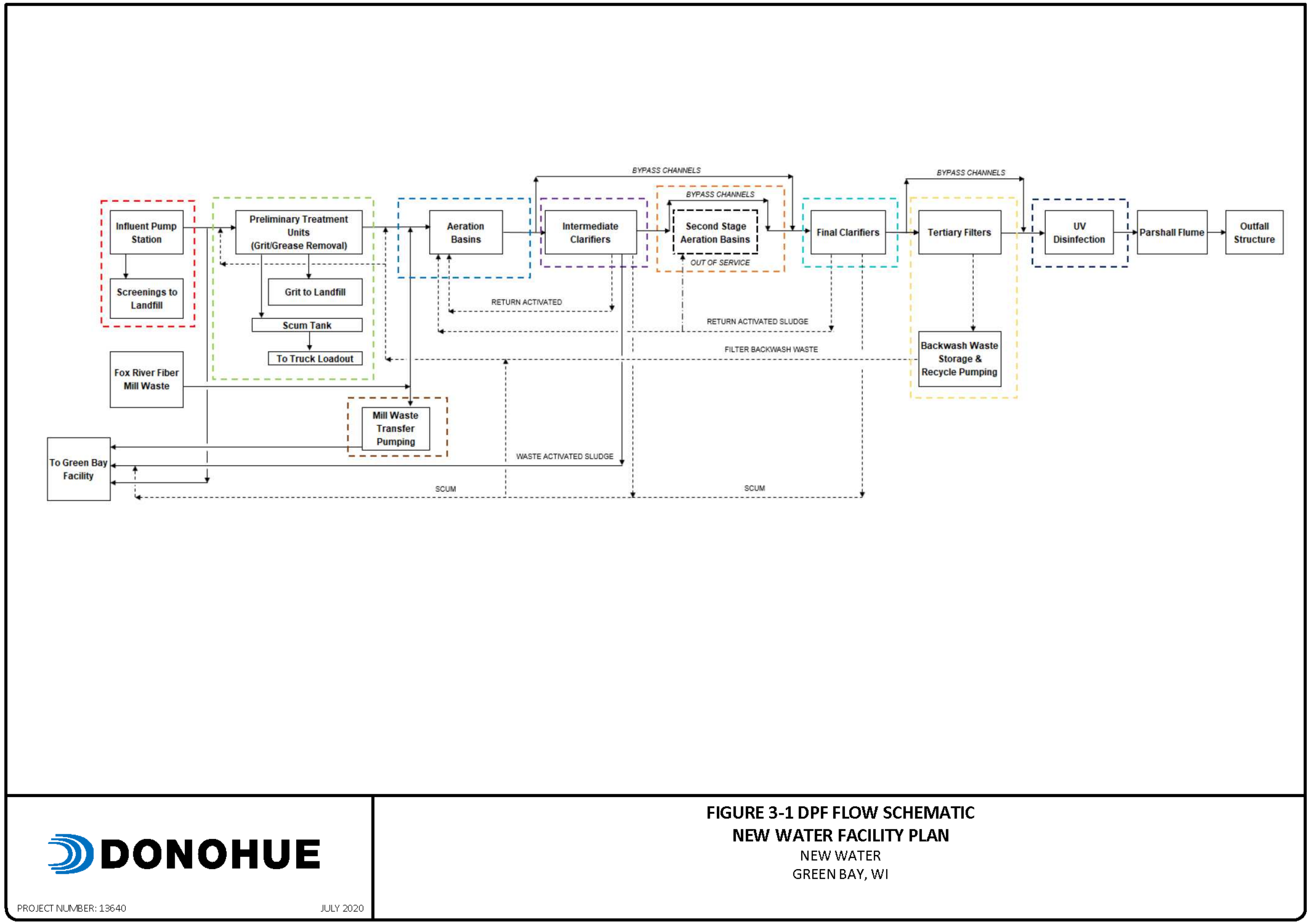

Figure 3-1 DPF Flow Schematic

Three major sources of information were used to develop a list of deficiencies with the DPF system. First, a discussion with the operators identified any critical issues experienced with each unit process. Second, Donohue conducted a process site walk-through to identify any additional unit process deficiencies that may have not been brought up during discussions. Third, Donohue incorporated notes, discussions, emails and any other communication with NEW Water that resulted in the identification of a plant unit process deficiency. The items are detailed in Table 3-1.

Table 3-1 DPF Site Assessment Notes and Deficiency Summary

STRUCTURE	NOTE/DEFICIENCY
Influent Screens	• Hydraulic bypass overflow issues during peak flow events • Side panels get rags clogged in them • Screens have bypass channel; bypass occurs periodically during high flow events • Large debris often breaks teeth off bar screens • Difficult to work on bar screens. Requires entering wetwell to compete work as screens cannot be removed from channel. • Rags pass through to grit removal and clarification • Control weirs upstream of influent screens limit control ability and regularly overflow at 40 mgd • Washer/compactor has mechanical limitation and require frequent replacement – agitator requires replacement every 6 to 9 months • Age and condition are a concern
Pump Station	• Small wetwell volume and depth requires complex control to keep water level below screen bypass gates during peak flows • Pumps are undersized for peak flow events • Pumps have had normal rebuilds over years after initial installation • Knife gate valves need replacements, difficult to open and close • Pumps 2 and 5 pumps to DPF – for the past 2 to 3 years the pump station has been maxed out at peak flows • Max pumping rate to GBF is currently limited to 5.0 mgd. Ideally transfer capability to GBF would be maximized to increase flexibly.
Preliminary Treatment Units	• Preliminary treatment units undersized for peak flows • System is not setup for operating one unit at average flows and bringing the second unit on line at higher flows • Rehabilitate/evaluate concrete in and around tank • Evaluate replacement with more reliable technology for grit removal • Lack of scum management
Grit Building and handling	• Grit separators not in proper operation and seem to allow grit to escape back to the forward flow • Age and condition of equipment is a concern. Grit washers are only 12 years old but have many holes in 304 stainless steel tanks. • Age and condition of grit pumps is a concern • Scum pumping has clogging issues
First Stage Aeration Tanks	• MLSS solids inventory management at projected 2040 loadings requires expansion of tankage

STRUCTURE	NOTE/DEFICIENCY
	• Aeration control system valves, meters, and probes require replacement in planning period • Additional walls are needed in aeration basins to create defined zones • All gates/control weirs need replacement. Currently all main isolation gates are manual drop gates, which require 3 people to set and remove. • Currently there is no controlled flow splitting into the aeration basins. Imbalanced flows and loadings occur. • Lack of basin drains
Aeration Blowers in Blower Building No. 2	• Blowers will reach end of useful life in planning period
Intermediate Clarifiers	• Lack of capacity for peak flows and regularly overloaded • Age deficiencies identified in separate clarifier evaluation • Failure of the clarifiers occurs often and solids washout • Age and condition of all valves and gates associated with these clarifiers is a concern • Lack of basin drains • Lack of scum management
First Stage Return Activated Sludge Pumps	• Age and condition of RAS pumping system is a concern
Final Clarifiers	• Lack of capacity for peak flows • Age deficiencies identified in separate clarifier evaluation • Age and condition of RAS and WAS pumping system is a concern • Lack of scum management • Age and condition of electrical feeders and panels is a concern • Area only has a single power feed (rest of the facility has redundant power feed lines to each building). Importance of this issue increases if intermediate clarifiers are removed from service. • Lack of basin drains • Influent and effluent gates for second stage aeration channels leak and are in poor condition. These gates are needed to convey flow to final clarifiers.
Tertiary Filters	• Lack of capacity for peak flows • Age deficiencies identified in separate filter evaluation
UV Disinfection	• Undersized – designed to treat 25 mgd with a peak flow capacity of 30 mgd • Lack of automatic controls (all manual gates)

3.1 DPF – INFLUENT PUMP STATION

Within the Gap Analysis spreadsheet, the tab labeled “Influent Pump Station” goes through the evaluation of two major sets of equipment, the metro pumps and the fine bar screens related to the headworks at the DPF. The Influent Pump Station is located on the North East side of the DPF site (

Figure 3-2). The major process gap is outlined in .

Table 3-2 Major Unit Process Gap

UNIT PROCESS	MAJOR GAPS
Influent Pumps	Influent pumping capacity is insufficient
Influent Screens	Screens performance is limited. Screens are also hydraulically limiting and are bypassed during peak flow events

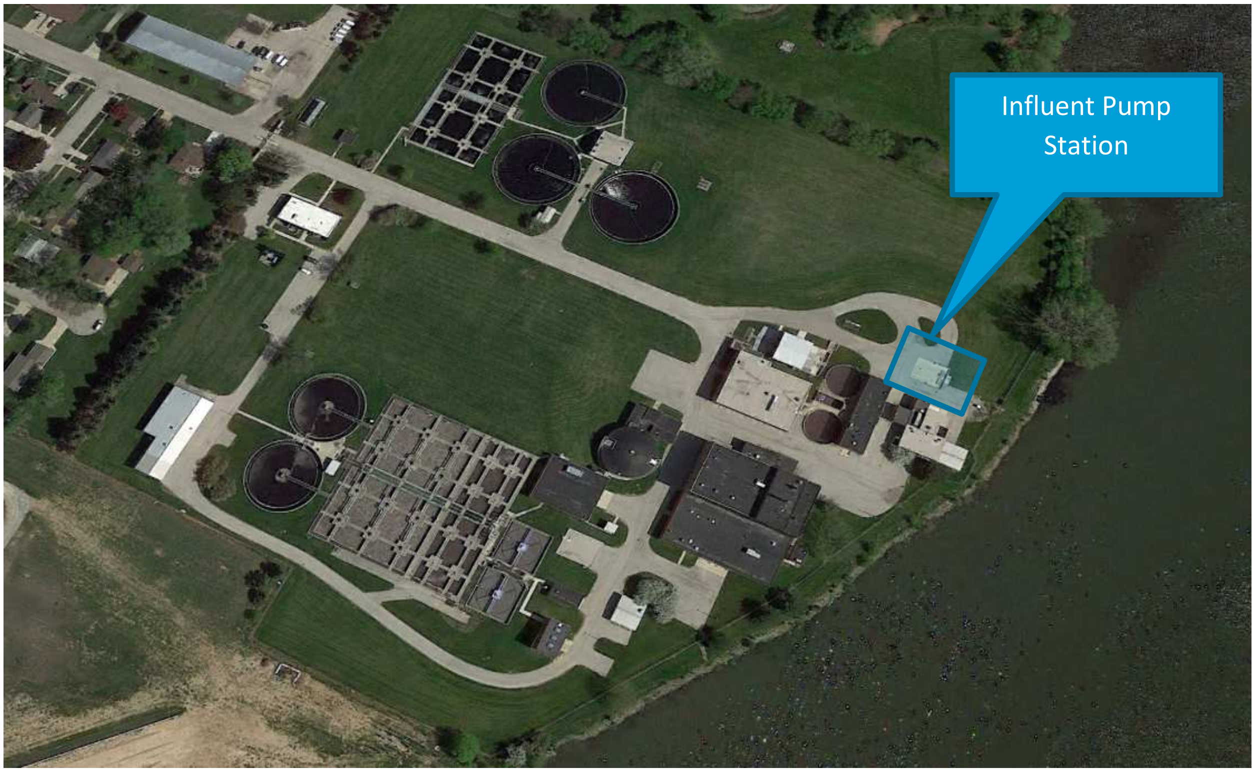

Figure 3-2 Location of Existing DPF Influent Pump Station

3.2 SITE ASSESSMENT AND ASSET MANAGEMENT REVIEW SUMMARY

A summary of the identified site assessment and asset management review gaps are presented in Table 3-3.

Table 3-3 DPF Influent Pump Station Site Assessment Deficiency Summary

STRUCTURE	NOTE/DEFICIENCY
Influent Screens	• Hydraulic bypass overflow issues during peak flow events • Side panels get rags clogged in them • Screens have bypass channel; bypass occurs periodically during high flow events • Large debris often breaks teeth off bar screens • Difficult to work on bar screens. Requires confined space entry to compete work as screens cannot be removed from channel. • Rags pass through to grit removal and clarification • Control weirs upstream of influent screens limit control ability and regularly overflow at 40 mgd • Washer/compactor has mechanical limitation and require frequent replacement – agitator requires replacement every 6 to 9 months o Age and condition are a concern
Pump Station	• Small wetwell volume and depth requires complex control to keep water level below screen bypass gates during peak flows

STRUCTURE	NOTE/DEFICIENCY
	• Pumps are undersized for peak flow events • Pumps have had normal rebuilds over years after initial installation • Knife gate valves need replacements, difficult to open and close • Pumps 2 and 5 pumps to DPF – for the past 2 to 3 years the pump station has been maxed out at peak flows • Max pumping rate to GBF is currently limited to 5.0 mgd. Ideally transfer capability to GBF would be maximized to increase flexibly.

3.2.1 Design Basis Capacity Analysis Summary

The first summary shown is for the *Design Basis Capacity Analysis*. This summary displays the results of the percent capacity of each equipment set and will be replicated for each unit process. The design capacity analysis for the equipment was based upon the hydraulic throughput capacity of the screens and the firm capacity of the pumps and is presented through the percent utilization (capacity) of the equipment. The percent capacity was based upon the estimated future flows for the 2020, 2025, 2030, 2040, and 2070 design years determined in TM 2.1. This data is also presented in the summary tab labeled *Flow & Load Capacity Summary* in the form of a bar graph labeled *Influent Pump Station*.

As a result of this analysis, the Metro Pumps are not capable of handling the peak hourly flow capacity for the design years. The influent fine screens are sized appropriately for peak hourly flow up until the design year 2070. However, the facility experiences hydraulic and capture issues with both fine screens. This leaves the existing capacity questionable and may be operating at a channel depth not appropriate for the equipment capacity.

3.2.2 Asset Management Gap Analysis Summary

The highest CoF from this area was 2.0 while the highest PoF was 5.0. For this evaluation all equipment with a CoF and PoF greater than 3.0 were considered critical, for the DPF no equipment has a CoF greater than 2.0 and as a result no critical equipment was identified.

3.2.3 Equipment and Capacity Analysis

Under the *Design Basis Calculations* within the Influent Pump Station tab, the Current Equipment summary identified all major equipment related to the process including two fine screens, five metro waste pumps (one standby), one GBF transfer pump, two screening washer/compactors, and two screenings screw conveyors.

The most recent design parameters from the 2009 DPF upgrades are presented next to that with an average influent flow of 9.90 mgd and a maximum day of 27.10 mgd. Following the 2009 design flows is the future estimate design flow for each design year evaluated in TM 2.1. From this analysis, the pumps are not capable of handling the peak hour flow for the 2040 design year. The screens are capable of handling flow rates up with the exception of the 2070 peak hour flow.

Influent pumping and screening have recommended standards from the *Recommended Standards for Wastewater Facilities (2014)* also known as the 10 States Standards. The influent pumps provide redundancy but are not capable of handling peak hour flow. The fine screens provide redundancy and have 6 mm bar spacing adequate for screening facilities utilizing mechanically cleaned bar screens. The entire wetwell and screening area within the influent pump station is a Class 1 Division I rated space. There are no other process regulatory limitations provided for this section under this evaluation.

3.2.4 Hydraulic Model Summary

During peak flows, the influent screens bypass as a result of a hydraulic bottleneck.

3.3 DPF – MILL WASTE PUMP SYSTEM

The purpose of the Mill Waste Transfer pumping system is to transfer Fox River Fiber flow to the GBF through a 10-inch force main to the GBF primary influent flumes at both the NP and SP. The table in the Gap Analysis spreadsheet labeled "Mill Waste Transfer" evaluates the existing Mill Waste Pumps. No flow was transferred from August 15, 2017 to August 1, 2019 as a result of a transfer line failure. This forced all Fox River Fiber flow to join the DPF influent flow. The pump system is located in the Blower Building No. 2, located south-central on the facility site (Figure 3-3).

The major process gap is outlined in .

Table 3-4 Major Unit Process Gap

UNIT PROCESS	MAJOR GAPS
Mill Waste Pump Station	None

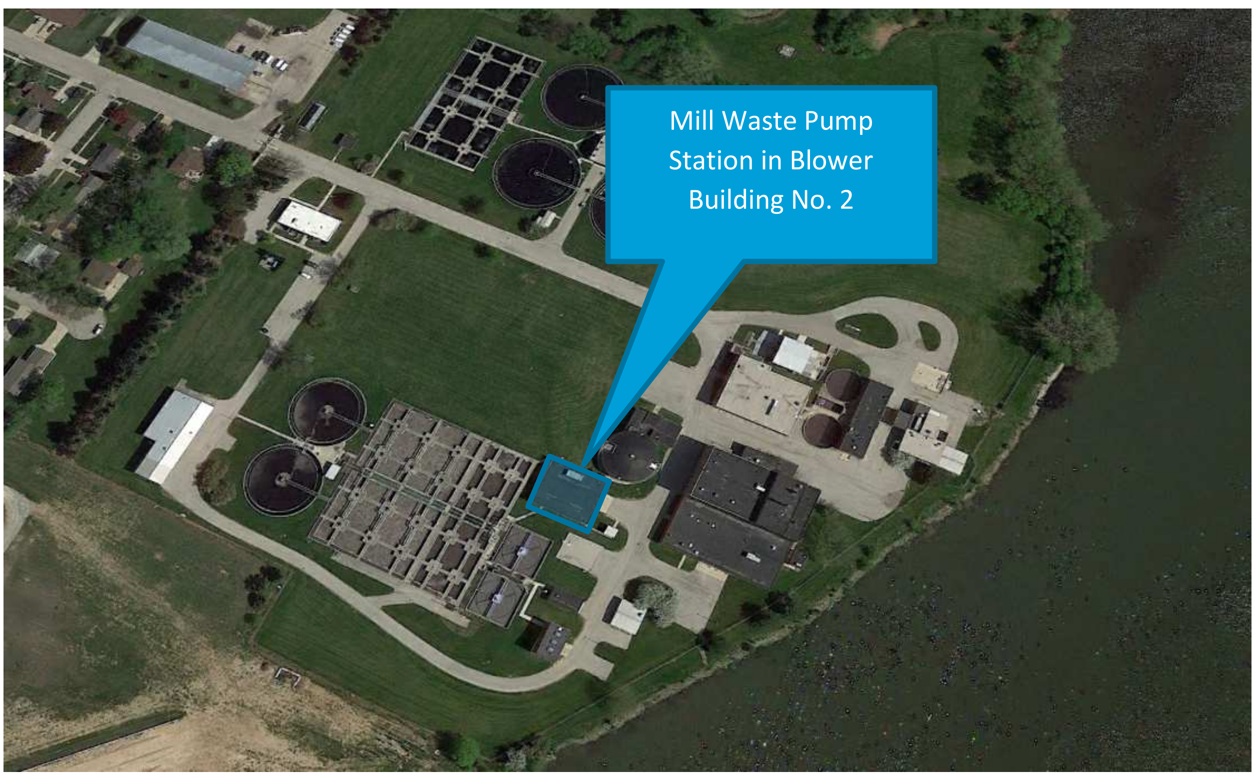

Figure 3-3 Location of Existing DPF Mill Waste Pump Station

3.3.1 Site Assessment and Asset management Review Summary

None to report.

3.3.2 Design Capacity Analysis Summary

The percent capacity was based upon the estimated future flows for the 2020, 2025, 2030, 2040, and 2070 design years determined in TM 2.1. Also, as requested by NEW Water Fox River Fiber flows and loads remained constant for all future years. As a result of this analysis, it is clear the Mill Waste Pumps are capable of handling average day, max week, max month and max day flows.

3.3.3 Asset Management Summary

The highest CoF from this area was 1.0 while the highest PoF was 3.0. For the DPF no equipment has a CoF greater than 2.0 and as a result no critical equipment was identified.

3.3.4 Equipment and Capacity Analysis

Under the *Design Basis Calculations* within the Mill Waste Transfer tab, the Current Equipment summary identified all major equipment related to the process including three mill waste pumps (one standby).

There were no recent design parameters from the 2009 DPF upgrades. Following the 2009 design flows is the future estimate design flow for each design year evaluated in TM 2.1. From this analysis, the pumps are capable of handling the peak day flow. There are no other process regulatory limitations provided for this section under this evaluation.

3.3.5 Hydraulic Model Summary

Nothing to report.

3.4 DPF – PRELIMINARY TREATMENT UNITS

Preliminary treatment units (PTUs) provide grit removal at the DPF paired with grit handling equipment and is evaluated under the “Preliminary Treatment Units” tab in the Gap Analysis spreadsheet. The PTUs are detritor tanks that are continuous flow, constant level, short detention settling tanks where the grit settles due to gravity and the wastewater flows over the outlet weirs along the perimeter. The PTUs are before the 1st Stage Aeration Basins (Figure 3-4)

The major process gap is outlined in Table 3-6.

Table 3-5 Major Unit Process Gap

UNIT PROCESS	MAJOR GAPS
Preliminary Treatment Units	Insufficient capacity, grit removal performance questionable, and scum removal is lacking

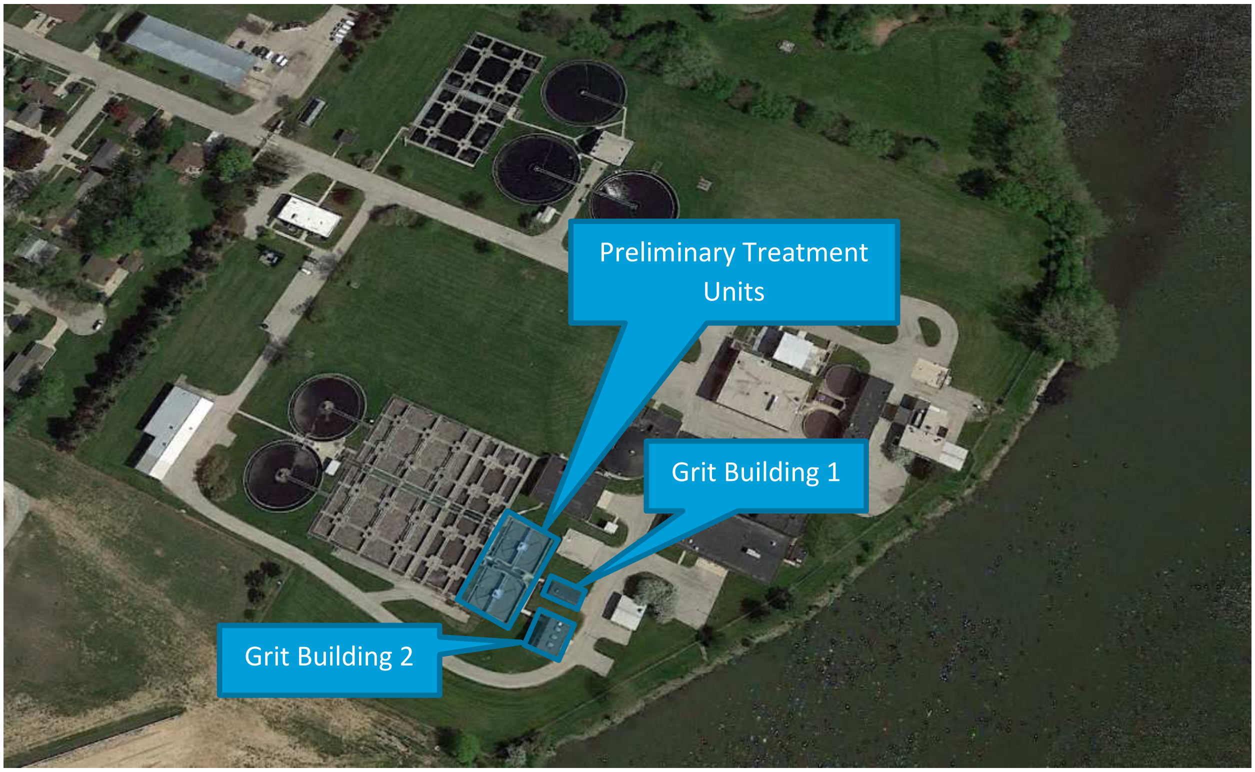

Figure 3-4 Location of Existing Grit Removal PTUs and Grit Handling Buildings

3.5 SITE ASSESSMENT AND ASSET MANAGEMENT REVIEW SUMMARY

A summary of the identified site assessment and asset management review gaps are presented in Table 3-6.

Table 3-6 DPF PTU and Grit Handling Site Assessment Deficiency Summary

STRUCTURE	NOTE/DEFICIENCY
Preliminary Treatment Units	• Preliminary treatment units undersized for peak flows • System is not setup for operating one unit at average flows and bringing the second unit on line at higher flows • Rehabilitate/evaluate concrete in and around tank • Evaluate replacement with more reliable technology for grit removal • Lack of scum management
Grit Building and handling	• Grit separators not in proper operation and seem to allow grit to escape back to the forward flow • Age and condition of equipment is a concern. Grit washers are only 12 years old but have many holes in 304 stainless steel tanks. • Age and condition of grit pumps is a concern • Scum pumping has clogging issues

3.5.1 Design Capacity Analysis Summary

The design basis summary specifies the PTU percent utilization is based on the original hydraulic throughput design of 30 mgd. Based on this analysis the PTUs are not capable of handling the maximum day or peak hour flow for all of the design years. This data is also presented in the summary tab labeled *Flow & Load Capacity Summary* in the form of a bar graph labeled *Preliminary Treatment Units.* Although, the PTUs are capable of handling many flow scenarios, operators have noticed poor grit removal performance over the range of flows experienced (both low and high flow periods).

3.5.2 Asset Management Summary

The highest CoF from this area was 1.0 while the highest PoF was 5.0. For this evaluation all equipment with a CoF and PoF greater than 3.0 were considered critical, for the PTUs no equipment has a CoF greater than 1.0 and as a result no critical equipment were identified.

The gap identification in this area states the grit separators allow carryover of grit into downstream processes, hindering performance, the scum pumping gets clogged frequently and the PTUs are undersized.

3.5.3 Equipment and Capacity Analysis

Under the *Equipment and Capacity Analysis* within the *Preliminary Treatment Units* tab, the Current Equipment summary identified all major equipment related to the process including the PTU tanks, grit pumps (3 with one standby), grit washer (2), grit classifier (2), scum pumps (2) and a scum recirculation pump. The most recent design parameters from the 2009 DPF upgrades are presented next to the equipment with an average net flow to the PTUs of 6.4 mgd and a maximum day of 24.1 mgd. Following the 2009 design flows is the future estimate design flow for each design year evaluated in TM 2.1. From this analysis, the grit removal system is not sized to handle peak hour flow from 2020 to 2070.

The PTUs are sized for a peak flow of 30 mgd total (at a detritor tank surface overflow rate (SOR) of 3,000 gpd/ ft^3). Data provided by the plant indicates it is possible to pass greater flow rates through the detritor tanks. The PTUs can operate as a primary clarifier at flowrates of 15 mgd or less (based on a maximum SOR of 3,000 gpd/ft2 provided by 10 States Standards). Therefore, at average flow and at the 2040 average design flow the tanks are capable of grit and PS removal. However, for future design an analysis of the grit distribution needs to be completed. Grit handling for the PTUs consists of two grit washers with a capacity of 250 gpm each. The grit handling does not perform as well as the plant would have expected and allows carryover of grit into downstream processes.

Grit removal has recommended standards from the *Recommended Standards for Wastewater Facilities (2014)* also known as the 10 States Standards. All equipment in grit removal areas will be Class 1, Division 1, Group D locations. All equipment is provided with redundancy and the PTUs have mechanical cleaning mechanisms. There are no other process regulatory limitations provided for this section under this evaluation.

3.5.4 Hydraulic Model Capacity Summary

The PTUs are over capacity hydraulically for peak hour flow events. The channels upstream of the PTUs bypass, appear to be a bottleneck and potentially overflow freeboard at flows greater than 32mgd. Additionally, at this flow the PTU effluent trough weirs will be completely submerged.

3.6 DPF – FIRST STAGE AERATION BASINS

Within the Gap Analysis spreadsheet, the tab labeled "Aeration Basins" goes through the evaluation of the existing biological treatment at the DPF. This included aeration basins and anaerobic basins and the required blowers for aeration. The aeration basins are located on the South West side of the DPF site (Figure 3-5).

The major process gap is outlined in .

Table 3-7 Major Unit Process Gap

UNIT PROCESS	MAJOR GAPS
First Stage Aeration	• MLSS solids inventory management at projected loadings requires expansion of tankage

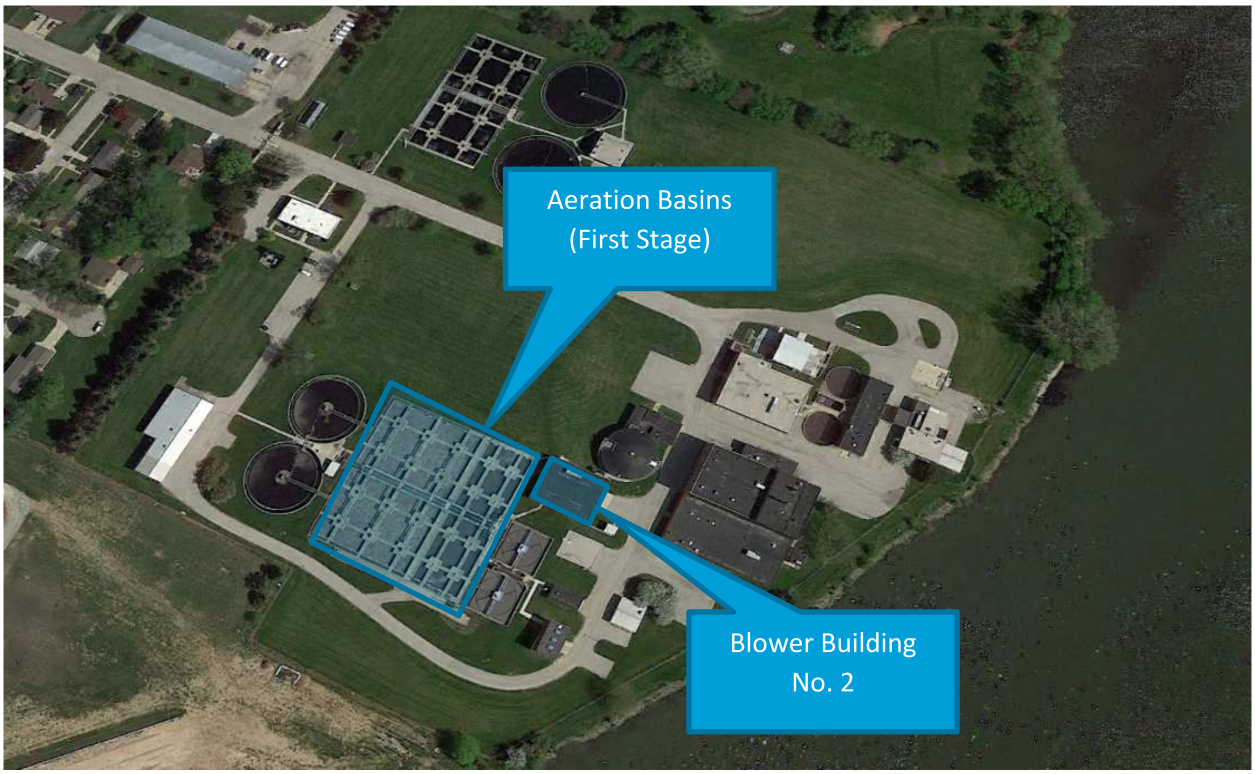

Figure 3-5 Location of Existing DPF First Stage Aeration

3.6.1 Site Assessment and Asset management Review Summary

A summary of the identified site assessment and asset management review gaps are presented in Table 3-8.

Table 3-8 DPF First Stage Activated Sludge Site Assessment Deficiency Summary

STRUCTURE	NOTE/DEFICIENCY
First Stage Aeration Tanks	• MLSS solids inventory management at projected 2040 loadings requires expansion of tankage

STRUCTURE	NOTE/DEFICIENCY
	• Aeration control system valves, meters, and probes require replacement in planning period • Additional walls are needed in aeration basins to create defined zones • All gates/control weirs need replacement. Currently all main isolation gates are manual drop gates, which require 3 people to set and remove. • Currently there is no controlled flow splitting into the aeration basins. Imbalanced flows and loadings occur. • Lack of basin drains
Aeration Blowers in Blower Building No. 2	• Blowers will reach end of useful life in planning period

3.6.2 Design Capacity Analysis Summary

The design capacity analysis for the equipment was based upon the air requirements of the biological process (BOD removal) and the ability of the aeration blowers to supply air to the biological process. The percent capacity was based upon the estimated future flows and loadings for the 2020, 2025, 2030, 2040, and 2070 design years determined in TM 2.1 as well as the BOD loading requirements provided by the 10 States Standards. This data is also presented in the summary tab labeled *Flow & Load Capacity Summary* in the form of a bar graph labeled *Aeration Basins*.

As a result of this analysis, the aeration basins are capable of the BOD mass loading up to year 2070. The blowers are capable of providing the air demand for up to the maximum day of 2070, where they exceed 100 percent utilization.

3.6.3 Asset Management Gap Analysis Summary

The highest CoF from this area was 2.0 while the highest PoF was 5.0. No equipment was rated critical (CoF and PoF both greater than 3.0).

3.6.4 Equipment and Capacity Analysis

Under the *Design Basis Calculations* within the *Aeration Basins* tab, the Current Equipment summary identifies all major equipment and associated details related to the biological processes in the first stage aeration basins. The equipment includes the aeration basins, the anaerobic zone mixers, and the blowers.

The design basis calculations for the aeration basins were completed to determine the air flow required for BOD and nitrogen removal along with the volumetric BOD loading rate. The BOD mass loading rate was required to be less than 40 lbs/day/1000 ft^3. From these calculations, it was determined that the aeration basins are capable of the BOD mass loading up until the max month of 2070. The blowers are capable of providing the air demand for BOD requirements up to the maximum day of 2070 where they exceed 100 percent utilization.

3.6.5 Process Capacity Limitations

Process model outputs confirmed that the aeration basins are capable of achieve BOD removal, nitrification, and phosphorus removal at the design loading rates for the DPF. However, the required MLSS concentration to achieve nitrification is over 6,000 mg/L when the SRT is maintained with a 2.0 safety factor through the winter months. These high MLSS concentrations could be alleviated with increased aeration basin volume at the DPF. The overall aeration basin volume is identified as a key gap for the facility.

3.6.6 Hydraulic Model Capacity Summary

Nothing to report.

3.7 DPF – INTERMEDIATE CLARIFIERS

Within the Gap Analysis spreadsheet, the tab labeled "Intermediate Clarifiers" provides the evaluation of the settling process after biological treatment at the DPF. The intermediate clarifier basins provide clarification for the 1st stage aeration basins and are located on the West side of the DPF site (Figure 3-6). The major process gap is outlined in Table 3-9.

Table 3-9 DPF Intermediate Clarifier Major Unit Process Gap

UNIT PROCESS	MAJOR GAPS
Intermediate Clarifiers	• Capacity limitations and equipment upgrades/improvement required • Hydraulic limitations also existing in the splitting structure

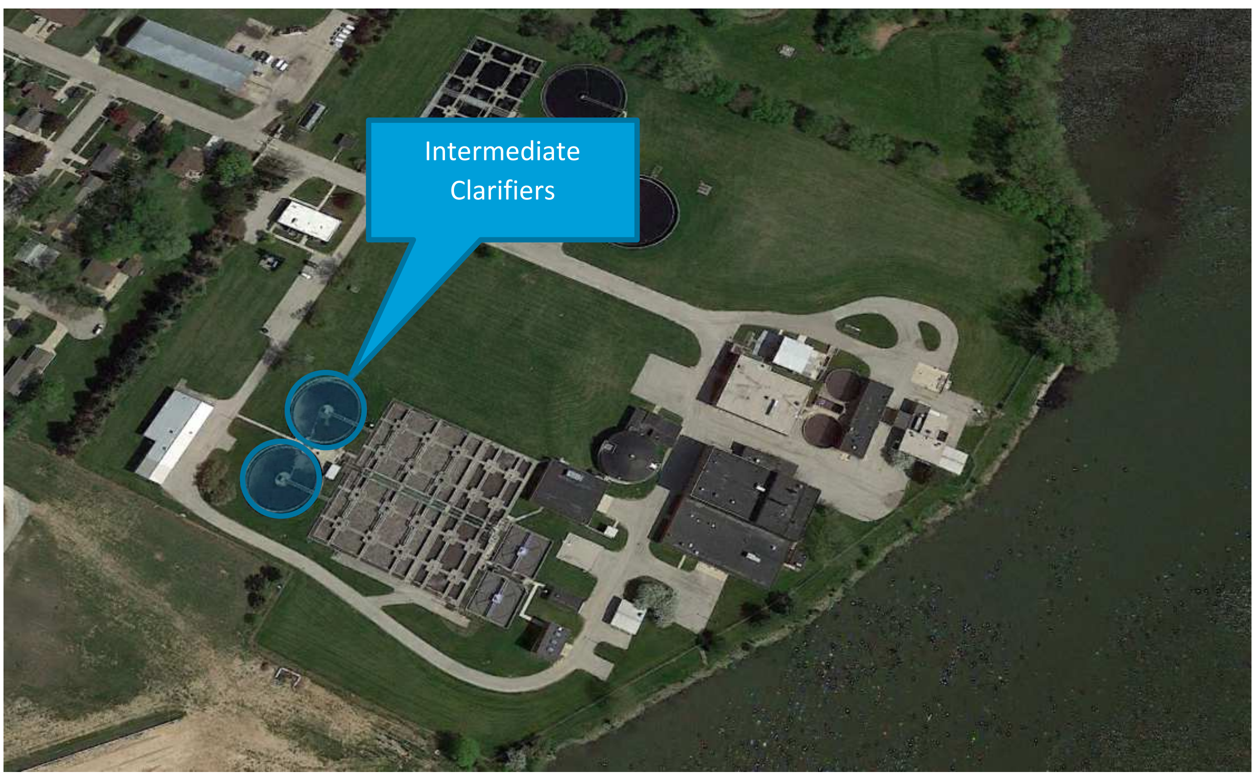

Figure 3-6 Location of the Intermediate Clarifiers

3.7.1 Site Assessment and Asset management Review Summary

A summary of the identified site assessment and asset management review gaps are presented in Table 3-10.

Table 3-10 DPF Intermediate Clarifiers and RAS Pumping Site Assessment Deficiency Summary

STRUCTURE	NOTE/DEFICIENCY
Intermediate Clarifiers	• Lack of capacity for peak flows and regularly overloaded • Age deficiencies identified in separate clarifier evaluation • Failure of the clarifiers occurs often and solids washout • Age and condition of all valves and gates associated with these clarifiers is a concern • Lack of basin drains • Lack of scum management
First Stage Return Activated Sludge Pumps	• Age and condition of RAS pumping system is a concern

3.7.2 Equipment and Capacity Analysis

The design capacity analysis for the equipment was based upon the settling requirements and the retention times for the clarifiers. This included the SOR for the peak hour flow of 1000 gpd/ft^2 for extended aeration nitrification, the solids loading rate to the clarifiers for the average flow and peak hour (NR110 and 10 States Standards), RAS pumping (NR110 and 10 States Standards) and WAS pumping.

As a result of this analysis, it is clear the intermediate clarifiers are undersized for maximum month, week, day, and peak hour for flow and solids loading. The average solids loading (based on solids loading of 1.2 lb/hr/ft^2 for extended aeration final clarifiers as per NR110). The RAS pumping utilization is appropriately sized for average flow for all future years. The WAS pumping is undersized for the maximum day for all design years and for the max month, week and day of 2070.

3.7.3 Asset Management Gap Analysis Summary

The highest CoF from this area was 1.0 while the highest PoF was 5.0. Based on the asset management ratings no equipment was rated critical (CoF and PoF both greater than 3.0).

The 2018 *Clarifier Rehabilitation Study Engineering Alternatives Report* completed by Donohue evaluated the clarifier performance and condition. Upgrade recommendations were provided for the Intermediate Clarifiers and included replacement of the items listed in Table 3-11.

Table 3-11 Recommended alternative upgrades to DPF Intermediate Clarifiers from clarifier study

COMPONENT	ALTERNATIVE	SUB-ALTERNATIVE
Mechanism	Replacement	Sludge Header
		Energy-Dissipating Inlet
Scum Collection	Replacement	

Launders	Replacement Replacement Replacement	Wall-Mounted Concrete
Sunlight Blocking Covers	Replacement	Geotextile

The evaluation recommended some additional process improvements including a drain addition to the intermediate clarifiers and reconfiguring the activated sludge clarifiers. Drain addition would improve the ability to switch tanks in service. To avoid failure of the intermediate clarifiers it was suggested to take them out of service.

In addition, structural improvements and miscellaneous improvements were identified. As requested by NEW Water structural improvements included the addition of safety platforms, with hoist bases should be added. Expansion joint repair, new floor grout topping, and wall crack injection were identified by the clarifier assessment. Other miscellaneous components to be upgraded included replacement of scum pumps and a RAS pump rebuild.

3.7.4 Equipment and Capacity Analysis

Under the *Equipment and Capacity Analysis* within the *Intermediate Clarifier* tab, the Current Equipment summary identifies all major equipment and associated details related to the settling of biological solids that have passed through the North and South first stage aeration contact basins. The equipment includes the clarifiers, the RAS pumps, WAS transfer pumps, and scum pumps.

The design basis calculations for the intermediate clarifiers were completed to determine the existing tank performance regarding the SORs, the solids loading rates for NR110, the solids loading rates for 10 States Standards, and the WAS and RAS pumping rate capacity. The solids mass loading rate from the 10 States Standards for extended activated sludge was 35 lb/day/ft^2. The Wisconsin Administrative Code requires a solids loading for average flow of 1.2 lb/ft^2-hr and 2.0 lb/ft^2-hr for peak hourly flow. From these calculations, it was determined that the intermediate clarifiers are undersized. Intermediate clarifier evaluations were summarized in DPF Clarifier Study conducted in 2018 and summarized in Section 3.7.3.

3.7.5 Process Model Capacity Analysis

The intermediate clarifiers were shown to be a major bottleneck for the DPF. At the MLSS concentrations required for nitrification, stable operation of the intermediate clarifiers was not achieved at a flow rate about 25 mgd. Addressing the intermediate clarifier operation and function is a major gap for the DPF.

3.7.6 Hydraulic Model Capacity Summary

The intermediate clarifiers do not have sufficient capacity for peak hour flowrate. At flows greater than 32.3 mgd the intermediate clarifier splitter box weir will be submerged.

3.8 DPF – FINAL CLARIFIERS

Within the Gap Analysis spreadsheet, the tab labeled "Final Clarifiers" summarized the final clarification process which provides settling after biological treatment and intermediate clarification at the DPF. The final clarifiers provide clarification for the 2nd stage aeration (not in operation) and are located on the North side of the DPF site (Figure 3-7). The major process gap is outlined in Table 3-16.

Table 3-12 Major Unit Process Gap

UNIT PROCESS	MAJOR GAPS
Final Clarifiers	• Undersized capacity for SOR and SLR • WAS pumping undersized • RAS, WAS, and Scum pumping requires improvements • Requires overall rehabilitation

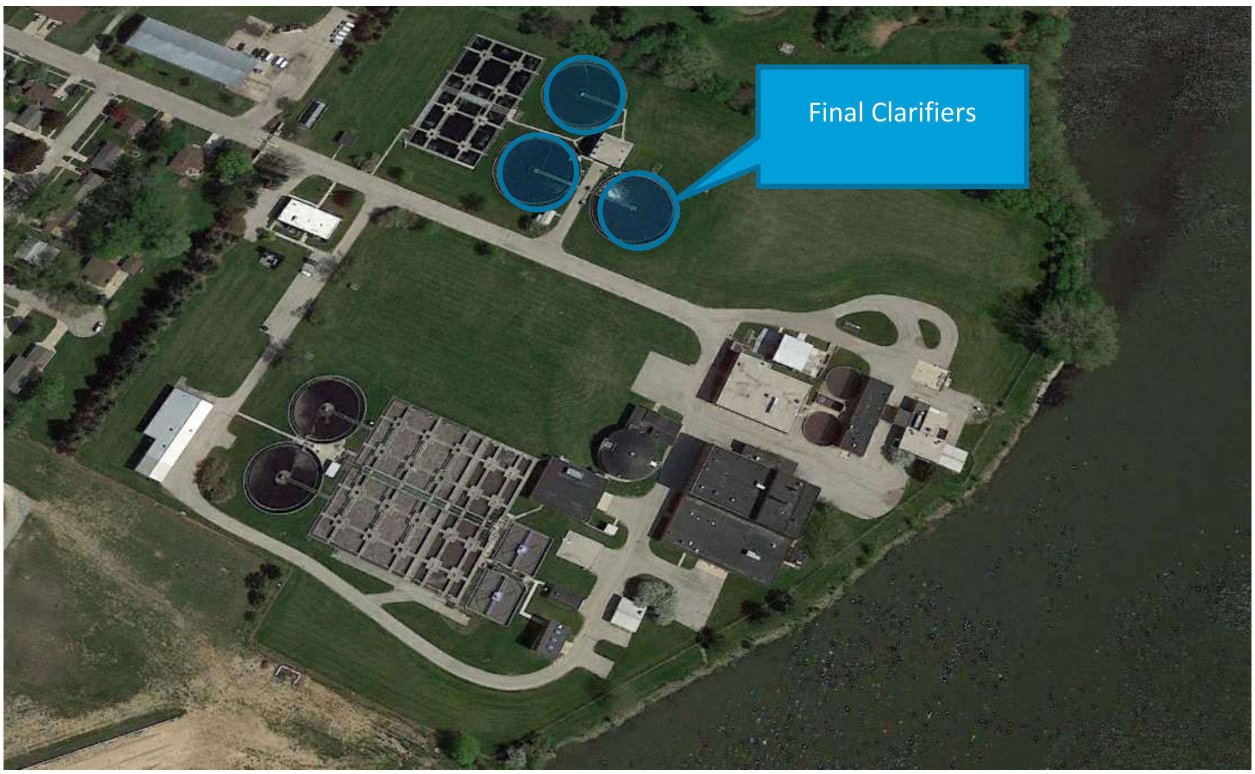

Figure 3-7 Location of the Final Clarifiers

3.8.1 Site Assessment and Asset management Review Summary

A summary of the identified site assessment and asset management review gaps are presented in Table 3-18.

Table 3-13 DPF Final Clarifier Site Assessment Deficiency Summary

STRUCTURE	NOTE/DEFICIENCY
Final Clarifiers	• Lack of capacity for peak flows • Age deficiencies identified in separate clarifier evaluation • Age and condition of RAS and WAS pumping system is a concern

STRUCTURE	NOTE/DEFICIENCY
	• Lack of scum management • Age and condition of electrical feeders and panels is a concern • Area only has a single power feed (rest of the facility has redundant power feed lines to each building). Importance of this issue increases if intermediate clarifiers are removed from service. • Lack of basin drains • Influent and effluent gates for second stage aeration channels leak and are in poor condition. These gates are needed to convey flow to final clarifiers.

3.8.2 Equipment and Capacity Analysis

The design capacity analysis was based upon the settling requirements and the retention times for the final clarifiers. This included the SOR for the peak hour flow of 1000 gpd/ft^2 for extended aeration nitrification, the solids loading rate to the clarifiers for the average flow and peak hour (NR110 and 10 States Standards), RAS pumping (NR110 and 10 States Standards) and WAS pumping.

As a result of this analysis, it is clear the final clarifiers are undersized for peak hour SOR for each design year. The DPF final clarifiers are also undersized for the solids loading rate recommended from the 10 States Standards max day and peak hour for all design years. For 2070 design year, the final clarifiers are undersized for the solids loading rate from the 10 States Standards for the max month, week, day, and hour. The average solids loading (based on solids loading of 1.2 lb/hr/ft^2 for extended aeration final clarifiers as per NR110). The RAS pumping utilization is appropriately sized for average flow for all future years. The WAS pumping is undersized for the maximum day for all design years.

3.8.3 Asset Management Gap Analysis Summary

The highest CoF from this area was 2.0 while the highest PoF was 6.0. No equipment was rated critical (CoF and PoF both greater than 3.0).

The 2018 *Clarifier Rehabilitation Study Engineering Alternatives Report* conducted by Donohue recommended a number of upgrades and recommendations to the final clarifiers. Replacement of the items listed in Table 3-14 was recommended.

Table 3-14 Recommended alternative upgrades to DPF Final Clarifiers from clarifier study

COMPONENT	ALTERNATIVE	SUB-ALTERNATIVE
Mechanism	Replacement	Sludge Header
Scum Collection	Replacement	
Launders	Replacement Replacement Replacement	Wall-Mounted Concrete
Sunlight Blocking Covers	Replacement	Geotextile

The evaluation recommended some process improvements including replacement of the scum, RAS, and WAS pumps. The current RAS pumps are oversized and will handle flow up past the 2070 design year.

In addition, some structural improvements and miscellaneous improvements were identified. As with the Intermediate Clarifiers and as requested by NEW Water, structural improvements included the addition of safety platforms, with hoist bases should be added. Expansion joint repair, new floor grout topping, and wall crack injection were identified by the clarifier assessment as well. Other miscellaneous components to be upgraded included replacement of scum pumps and RAS pumps.

3.8.4 Equipment and Capacity Analysis

Under the *Design Basis Calculations* within the *Final Clarifier* tab, the Current Equipment summary identifies all major equipment and associated details related to the settling of biological solids passed through the intermediate clarifiers from the North and South contact basins. The equipment includes the clarifiers, the RAS pumps, WAS transfer pumps, and scum pumps.

The design basis calculations for the final clarifiers were completed to determine the existing tank performance regarding the SORs, the solids loading rates for NR110, the solids loading rates for 10 States Standards, and the WAS and RAS pumping rate capacity. The solids mass loading rate from the 10 States Standards for extended activated sludge was 35 lb/day/ft^2. The Wisconsin Administrative Code requires a solids loading for average flow of 1.2 lb/ft^2-hr and 2.0 lb/ft^2-hr for peak hourly flow. From these calculations, it was determined that the final clarifiers are undersized. Final clarifier evaluations were summarized in the DPF *Clarifier Rehabilitation Study Engineering Alternatives Report* conducted in 2018 and summarized in section 3.8.3.

3.8.5 Process Model Capacity Analysis

The final clarifiers at the DPF are currently used downstream of the intermediate clarifiers, which presents an interesting operational situation for solids removal. For the process capacity assessment, the loading rates were evaluated assuming the intermediate clarifiers were not in operation. At the simulated MLSS concentrations, the three existing final clarifiers exhibited stable operation at flows between 37 and 44 mgd. The major gap for the final clarifiers would be reducing the operating MLSS concentration and improving the settleability of the solids.

3.8.6 Hydraulic Model Capacity Summary

Nothing to report.

3.9 DPF – TERTIARY FILTERS

Within the Gap Analysis spreadsheet, the tab labeled "Tertiary Filters" provide gravity sand filtration after final clarification at the DPF. The tertiary filters are located in the Gravity Filter Building on the Northeast side of the DPF site (Figure 3-8).

The major process gap is outlined in Table 3-15.

Table 3-15 Major Unit Process Gap

UNIT PROCESS	MAJOR GAP

Tertiary Filters	• Capacity limitation and aged equipment (currently being addressed in improvements project)

Figure 3-8 Location of the Gravity Filter Building with tertiary filtration

3.9.1 Site Assessment and Asset management Review Summary

A summary of the identified site assessment and asset management review gaps are presented in Table 3-16.

Table 3-16 DPF Tertiary Filter Building Site Assessment Deficiency Summary

STRUCTURE	NOTE/DEFICIENCY
Tertiary Filters	• Lack of capacity for peak flows • Age deficiencies identified in separate filter evaluation

3.9.2 Design Basis Capacity

The design capacity analysis for the equipment was based upon the filter capacity, with a maximum loading rate of 5 gpm/ft^2 with one filter backwashing or out of service. The total capacity of the existing filters is 18 mgd and thus significantly undersized for a peak hour flow of 57.3 mgd.

As a result of this analysis, the tertiary filters are undersized for maximum week, maximum day, and peak hour for each design year. The filters are also undersized for max month for 2030, 2040, and 2070. NEW Water is currently preparing a design to replace the filters with disc filters sized to handle the peak hour flow of 57 mgd. The existing system overflows into the filter bypass at approximately 30 mgd.

3.9.3 Asset Management Gap Analysis Summary

The highest CoF from this area was 1.0 while the highest PoF was 6.0. No equipment was rated critical (CoF and PoF both greater than 3.0).

An evaluation of the gravity filters was completed in April of 2019 titled *De Pere Facility Tertiary Filtration, Service Water, and Scum Pumping Engineering Report* that provided a summary of capacity deficiencies and recommended improvements. Based on the NR110 code requirement of a maximum surface loading rate of 5 gpm/ft^2 at peak hour flow with one unit out of service the existing filters have a capacity of 18 mgd and are therefore much less than half of the required 2040 peak hour estimated flow. In addition to the capacity deficiencies described in the 2019 report, some major pieces of equipment were identified as nearing the end of their useful life. The equipment includes the backwash pumps and the backwash return pumps as they are nearing 40 years old and will require replacement. Other filter components such as valves, actuators, and underdrains are also aged and will require rehabilitation or replacement soon. The backwash storage tanks were also identified as requiring repairs if they are to continue to be used. The evaluation conducted in 2019 recommended the replacement of the gravity sand filters with higher efficiency disc filters. This replacement project is in progress.

3.9.4 Equipment and Capacity Analysis

Under the *Equipment and Capacity Analysis* tab, the Current Equipment summary identifies all major equipment and associated details related to the tertiary filtration system. The equipment includes the gravity filters, the air scour blowers, backwash pumps, waste backwash pumps, and waste backwash tanks.

The design basis calculations for the tertiary filters were completed to determine the existing filter performance regarding the capacity of the filters and the future flows. As mentioned, from NR110 the maximum allowable loading rate to the filters is 5.0 gpm/ft^2. From these calculations, it was determined that the tertiary filters are undersized. Tertiary filter evaluations were clearly summarized in the 2019 Strand Report conducted in 2019 and summarized in section 3.9.33.8.3.

3.9.5 Hydraulic Model Capacity Summary

Nothing to report.

3.10 DPF – UV DISINFECTION

Within the Gap Analysis spreadsheet, the tab labeled “Disinfection” provides data related to the final stage of treatment before the outfall, UV disinfection. UV disinfection is located in the on the East side of the DPF site (Figure 3-9). The major process gap is outlined in Table 3-17.

Table 3-17 Major Unit Process Gap

UNIT PROCESS	MAJOR GAP
UV Disinfection	• Hydraulically undersized for peak hour flow

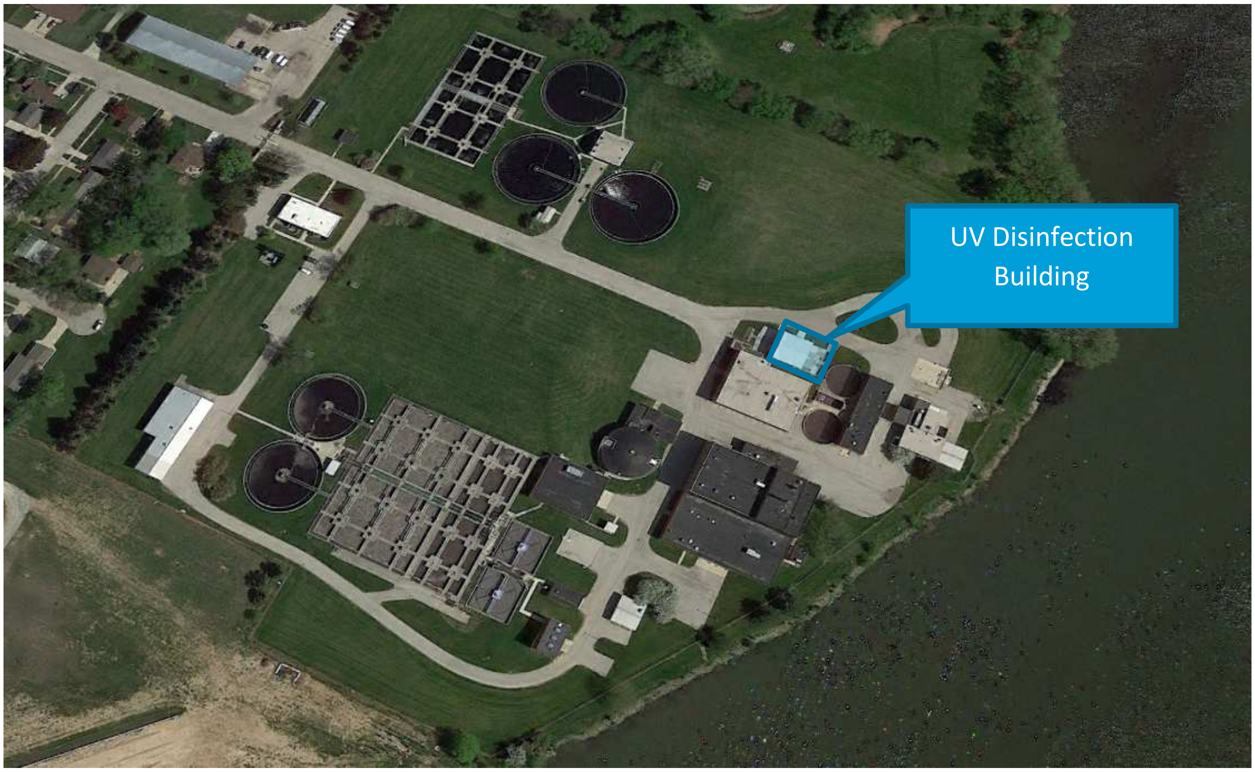

Figure 3-9 Location of the Gravity Filter Building with tertiary filtration

3.10.1 Site Assessment and Asset management Review Summary

All site assessment and asset management review gaps are presented in Table 3-18.

Table 3-18 DPF Mill Waste Pump Station Site Assessment Deficiency Summary

STRUCTURE	NOTE/DEFICIENCY
UV Disinfection	• Undersized – designed to treat 25 mgd with a peak flow capacity of 30 mgd • Lack of automatic controls (all manual gates)

3.10.2 Design Capacity Analysis Summary

The design capacity analysis for the UV disinfection was based upon the peak instantaneous design flow used in the hydraulic profile for the 2014 UV disinfection expansion design. The total capacity of the existing system is 31.2 mgd and thus undersized for a peak hour flow of 57.3 mgd.

As a result of this analysis, it is clear the UV disinfection undersized for peak hour for each design year and the maximum day flow for 2070.

3.10.3 Asset Management Gap Analysis Summary

The highest CoF from this area was 3.0 while the highest PoF was 5.0. The sump pit high level sensor was rated critical (CoF and PoF both greater or equal to 3.0).

3.10.4 Equipment and Capacity Analysis

Under the *Design Basis Calculations* within the *UV Disinfection* tab, the Current Equipment summary identifies all major equipment and associated details related to the tertiary filtration system. The equipment includes the gravity filters, the air scour blowers, backwash pumps, waste backwash pumps, and waste backwash tanks.

The most recent design parameters from the 2009 DPF upgrades are presented next to the equipment list. Next to the 2009 design flows is the future estimate design flow and estimated loadings calculated for each design year evaluated in TM 2.1.

The design basis calculations for the UV disinfection were completed to determine the existing disinfection system performance and capacity. From these calculations, it was determined that the UV filtration system is undersized. 3.8.3

3.10.5 Hydraulic Model Capacity Summary

The UV disinfection system is hydraulically undersized and cannot meet the hydraulic through-put at the identified peak hour flow.

4 Green Bay Facility Infrastructure Gap Assessment Results

The GBF treated an average of 36.6 mgd of total wastewater in 2019 with a liquid treatment train consisting of influent pumping, screening, primary clarification, primary sludge grit removal, activated sludge configured for enhanced biological phosphorus removal (EBPR), secondary clarification, and is disinfected with sodium hypochlorite and dechlorinated with sodium bisulfite. The solids handling treatment train includes sludge thickening with gravity belt thickeners and gravity thickeners followed by anaerobic digestion with co-digestion of high strength waste (HSW), centrifuge dewatering, and ending with solids drying and incineration (Figure 4-1). The GBF receives hauled waste (HW), which is screened and discharged to the plant influent and HSW, which is fed to the digesters. Industrial wastewater flows are pumped to the plant from Proctor & Gamble, Green Bay Packaging and Fox River Fiber.

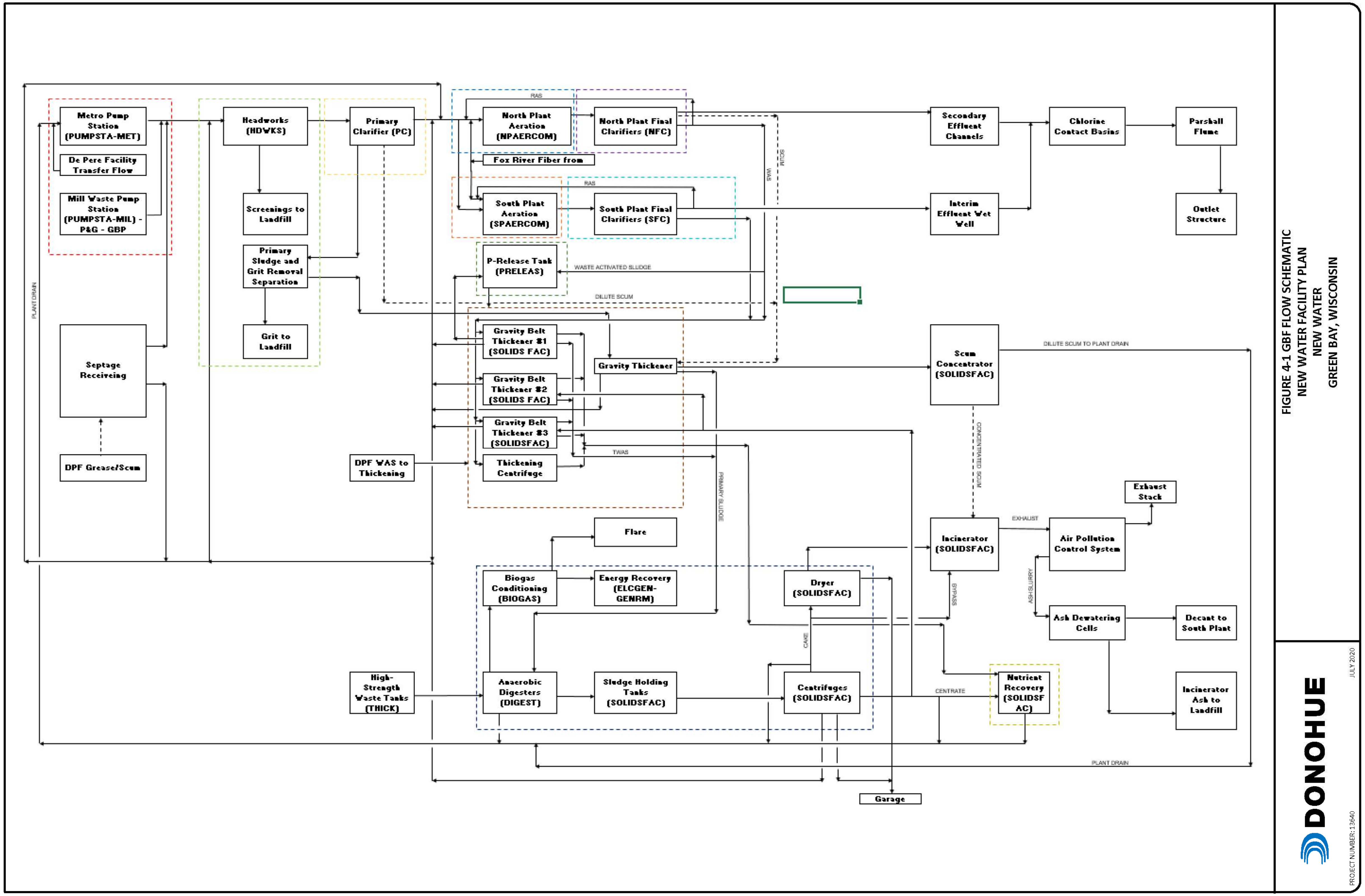

Figure 4-1 GBF Flow Schematic

Three major sources of information were used to develop a list of deficiencies with the GBF system. First, a discussion with the operators identified any critical issues experienced with each unit process. Second, Donohue conducted a process site walk-through to identify any additional unit process deficiencies that may have not been brought up during discussions. Third, Donohue incorporated notes, discussions, emails and any other communication with NEW Water that resulted in the identification of a plant unit process deficiency. The items are detailed in Table 4-1.

Table 4-1 GBF Site Assessment Notes and Deficiency Summary

STRUCTURE	NOTE/DEFICIENCY
Influent Pump Station	• Metro Pumps not sized for 2040 peak hour flow • Discharge piping inside pump station is leaking • Trash racks are unreliable, have poor performance, cable issues, and have frequent failures. Cables were replaced in 2010 and again in 2021 • Separate plant return flows from metro flow • Power feed failure has occurred – need another permanent feeder • Switch gear and MCC gear are an age and condition concern • Eddy current drives require replacement • Dewatering pumps/flood pumps nearing end of life (large and old pumps) • Bubble tube level sensors have frequent errors due to tubing deterioration • Improve odor control • Mill pumps and drives are an age and condition concern
Headworks	• Poor performance with fine screens, allow rags and plastic through likely due to high velocity through the screens • Screens installed in 1999 • Cannot run fine screens with mat in place during high flow events so they are run continuously • Leaking joints in structure near and after bypass channel • Bypass channels begin to bypass at about 140 mgd • Gates upstream of screens for flow splitting have little freeboard and don't properly isolate due to water over-topping • HVAC in headworks needs evaluation and possible replacement and improved odor control • Valves and piping for mill waste ahead of bar screens require replacement • Gravity thickener return piping and valves require replacement • Primary sludge grit removal performance is questionable and is apparent because the thickening centrifuge, and PC pumps see a great deal of wear and tear • Piping and valves associated with grit removal systems needs replacement • Grit operation is complicated with switching every 30 minutes taking PSD from one clarifier and then the other • Primary sludge pumps need replacement • Degritted PSD pumps have VFDs for no process related reason

STRUCTURE	NOTE/DEFICIENCY
	• Combined pumping WAS and PS to GBTs began about 5 years ago, recently switched to thickening WAS with GBTs and PS with gravity thickeners. Centrifuge is used for WAS thickening only
Primary Clarifiers	• Age and condition of mechanisms and launders is a concern • Hydraulic capacity issue at peak flow • Scum pumps, valves, and piping need to be replaced • Lack of scum management • Square clarifiers cause corner sweep maintenance issues
Activated Sludge Aeration	• Blowers – discharge piping leaks air at North and South basins • Age of blowers is a concern • Have evaluation completed on blowers • Concrete in aeration basins degraded • Issues with settleability in final clarifiers • Would like better aeration control • Isolation gates need replacement • Re-evaluate step feed process operation • Channel liner –new liner failed, channel condition is questionable • Consider tunnel structural rehabilitation • Consider rehabilitation of tunnel trench drain system
Blower Building	• HVAC system in blower building requires evaluation and possible replacement • Common discharge line to North and South Plant is a common point of failure and leaks • Blowers have a faulty breaker on MCC1 (CMC-C1) • Electrical feeders routing electrical to building are damaged and conduits are prone to leaking water. Electrical boxes also leaking water. • Replace blower building air filters • Blowers will reach end of useful life in planning period
Final Clarifiers	• North Plant o Replace Scum pumps o Replace wash water piping o Replace/Rehabilitate walkway structure on clarifier o Rehabilitate concrete o Lack of scum management o Square clarifiers cause hydraulic performance issues and corner sweep maintenance issues • South Plant o Replace all pumps (RAS, Scum, and wash water) o Currently sending ash decant – monitor and identify long term approach ▪ Ash cell overflow goes into south plant and alters VS in aeration basin along with biology ▪ Too wet to send to landfill and is not accepted ▪ Evaluation of possible resource recovery or other on-site uses

STRUCTURE	NOTE/DEFICIENCY
Disinfection	• Detention time does not meet code for projected 2040 peak flow – evaluate for timing and sizing

Thickening	• Primary sludge thickening
	   o Hydraulic pumping issues destroy pumps
	   o Difficult to get consistent feed – large variability in PSD concentration
	   o Grease remains in PSD
	   o Not enough capacity
	   o Grease and rags cause issues with pumping across GBTs
	   o Update overall grit removal to protect thickening of PSD
	   o Recommend developing method to handle grease in PSD
	   o Provide more capacity, redundancy, and overall reliability
	   o Improve odor control
	• WAS Thickening
	   o Gravity belt thickeners (3 meter at 600 gpm) are in good condition but at end of life as they are nearly 30 years old (installed 1990) – update mechanisms and rehabilitate concrete
	   o Pumps and piping are hydraulic bottleneck – difficult to pump TWAS with polymer
	   o Capacity during peak flow events is inadequate
	   o Polymer feed systems need replacing
	• Thickening building has low ceiling as building was retrofitted from an older structure
	• Centrifuge in operation for WAS thickening only (not able to be utilized for primary sludge thickening or co-thickening)
	• Evaluate option of rehabilitating gravity thickeners for use
	• Replace scum pump with non-clog type as they clog with grease, rags, and plastics

Anaerobic Digestion and R2E2 Building	• Grease concentrator undersized at 200 gpm when the flow is really 500 to 600 gpm. Cannot operate skimmer continuously, manually turn to allow scum dewatering. Recommend evaluation and rehabilitation or replacement • Evaluate scum and grease dewatering pumping and disposal – currently cannot pump product to incinerator from oversized pumps with too much make-up water • Plastic and rags destroy mixing pumps • Existing thickening issues cause reduced detention time and volatile solids destruction
P-Release	• *Not in operation*
Nutrient Recovery	• *Not in operation*
Miscellaneous	• TEF Pumps and piping need replacement • Evaluate plant sampling systems • Replace service water system (in progress)

4.1 GBF – INFLUENT PUMP STATION

Within the Gap Analysis spreadsheet, the tab labeled "Influent Pump Station" provides the evaluation of three major sets of equipment, the metro pumps, the mill pumps, and the influent bar screens. The Influent Pump Station is located on the East side of the GBF site (Figure 4-2). The metro pumps pump from the influent pump station to the headworks building. The mill pumps pump from a separate wetwell next to the influent pump station and discharge just upstream of the fine screens in the headworks. The major process gap is outlined in Table 4-2.

Table 4-2 GBF Influent Pump Station Major Unit Process Gap

UNIT PROCESS	MAJOR GAP
Influent Pump Station	• Capacity and deteriorating assets

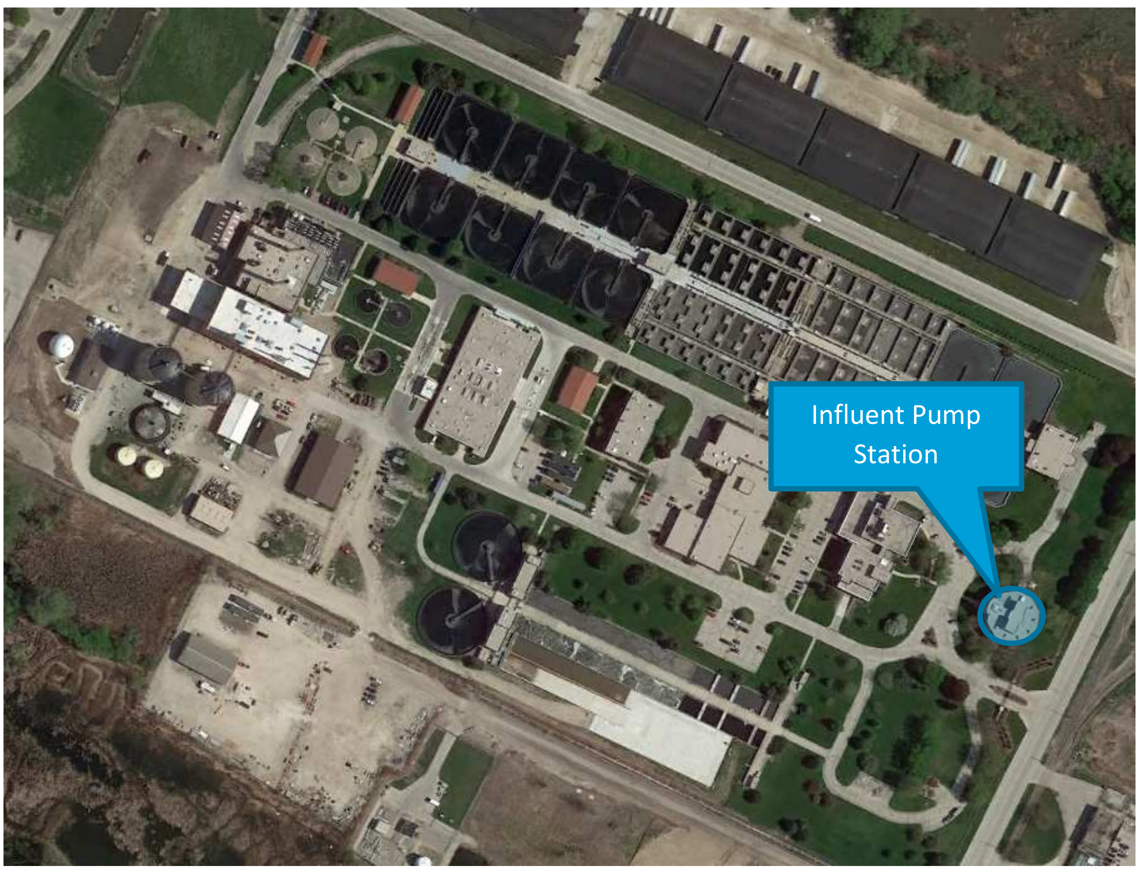

Figure 4-2 Location of Existing GBF Influent Pump Station

4.1.1 Site Assessment and Asset management Review Summary

A summary of the identified site assessment and asset management review gaps are presented in Table 4-1.

Table 4-3 GBF Influent Pump Station Site Assessment Notes and Deficiency Summary

STRUCTURE	NOTE/DEFICIENCY
Influent Pump Station	• Metro Pumps not sized for 2040 peak hour flow • Discharge piping inside pump station is leaking • Trash racks are unreliable, have poor performance, cable issues, and have frequent failures. Cables were replaced in 2010 and again in 2021. • Separate plant return flows from metro flow • Power feed failure has occurred – need another permanent feeder • Switch gear and MCC gear are an age and condition concern • Eddy current drives require replacement • Dewatering pumps/flood pumps nearing end of life (large and old pumps) • Bubble tube level sensors have frequent errors due to tubing deterioration • Improve odor control • Mill pumps and drives are an age and condition concern

4.1.2 Design Basis Capacity Analysis Summary

The design capacity analysis for the equipment was based upon the hydraulic throughput capacity of the screens and the firm capacity the pumps and is presented through the percent utilization (capacity) of the equipment. The percent capacity was based upon the estimated future flows for the 2020, 2025, 2030, 2040, and 2070 design years determined in TM 2.1. This data is also presented in the summary tab labeled *Flow & Load Capacity Summary* in the form of a bar graph labeled *Influent Pump Station*. This will be consistent through the rest of the unit processes.

As a result of this analysis, the metro pumps are not capable of handling the peak hourly flow capacity for the design years. The influent screens (“trash racks”) are sized appropriately for peak hourly flow up until the design year 2070. However, the facility experiences capture, cleaning, and clogging issues with both screens.

4.1.3 Asset Management Gap Analysis Summary

The highest CoF from this area was 5.0 and the highest PoF was 5.0. For this evaluation all equipment (assets) with a CoF and PoF greater than 3.0 were considered critical, for the GBF there were 20 assets were identified as “Desktop” critical and 20 assets were identified as “Field” critical.

4.1.4 Equipment and Capacity Analysis

Under the *Design Basis Calculations* within the *Influent Pump Station* tab, the Current Equipment summary identified all major equipment related to the process including two bar screens, four metro waste pumps (one as a standby), two mill waste pumps (7,600 gpm), and one smaller mill waste pump (4,500 gpm).

The 1989 design parameters are presented next to the equipment information with an average day flow of 32.40 mgd and a maximum month of 49.20 mgd. Following the 1989 design flows are the future estimated design flow for each design year identified in TM 2.1. From this analysis, the pumps are not capable of handling the peak hour flow. The screens are capable of handling all design year flow rates with the caveat that their performance is not adequate, as they are often unreliable, have cable issues, and have frequent failures.

Influent pumping and screening have recommended standards from the *Recommended Standards for Wastewater Facilities (2014)* also known as the 10 States Standards. The influent pumps provide redundancy but are not capable of handling peak hour flow. The coarse screens provide redundancy and have 2-inch bar spacing adequate for removal of large debris to protect the influent pumps. The entire wetwell and screening area within the influent pump station should be rated a Class 1 Division rated space. There are no other process regulatory limitations provided for this section under this evaluation.

4.1.5 Hydraulic Model Capacity Summary

At the influent pump station there are limits on the ability to convey flows over 120 mgd (firm capacity) as a result of the influent pump sizing. The existing operation for high flows allows for the water level to increase to 57’ within the wetwell and possibly up to 62’ during peak events.

The design water elevations of the pump wetwell (from NEW Water’s SOP) range from 34’ to 57’ with a design peak water level of 53’. Current control operates the wetwell at a normal elevation of 45’, with the top of the incoming 108” pipe invert at 51’. According to NEW Water’s SOP documentation, the peak water elevation is allowed to rise to 57’. See Figure 4-1 for a cross-sectional view of these elevations in the existing wetwell.

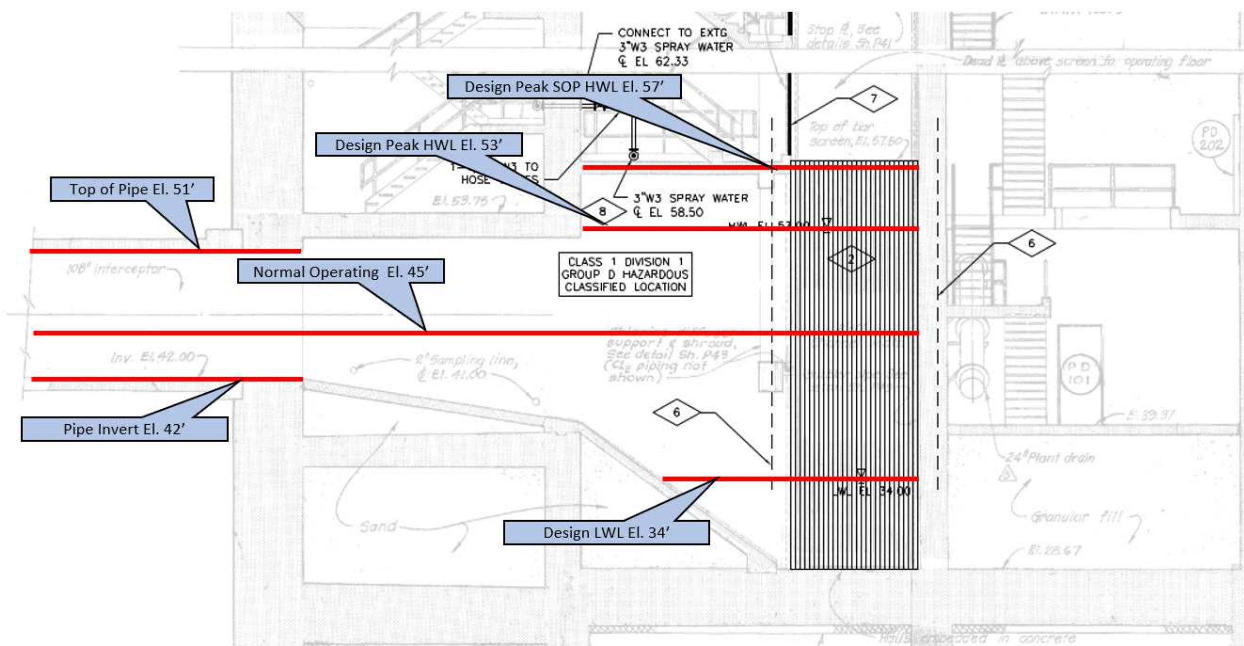

Figure 4-3 Cross section drawing identifying influent pump station interceptor and wetwell operating water elevations

It is recommended to operate similar to the existing process, however, the water level should remain at or under 53'. This strategy would create slightly higher TDH conditions on the increased capacity pumps, however, the pumps already require replacement.

4.2 GBF – HEADWORKS

Within the Gap Analysis spreadsheet, the tab labeled "Headworks" goes through the evaluation of the major equipment in the headworks including the fine bar screens. The Headworks building is located on the East side of the GBF site (Figure 4-4). The headworks facility also provides primary sludge grit removal using Hydro TeaCups®, grit handling, and screenings handling. The major process gaps are outlined in Table 4-4.

Table 4-4 GBF Headworks Major Unit Process Gap

UNIT PROCESS	MAJOR GAP
Headworks	• Fine screen capacity, aging equipment, and overall performance • TeaCup® capacity, age, and performance

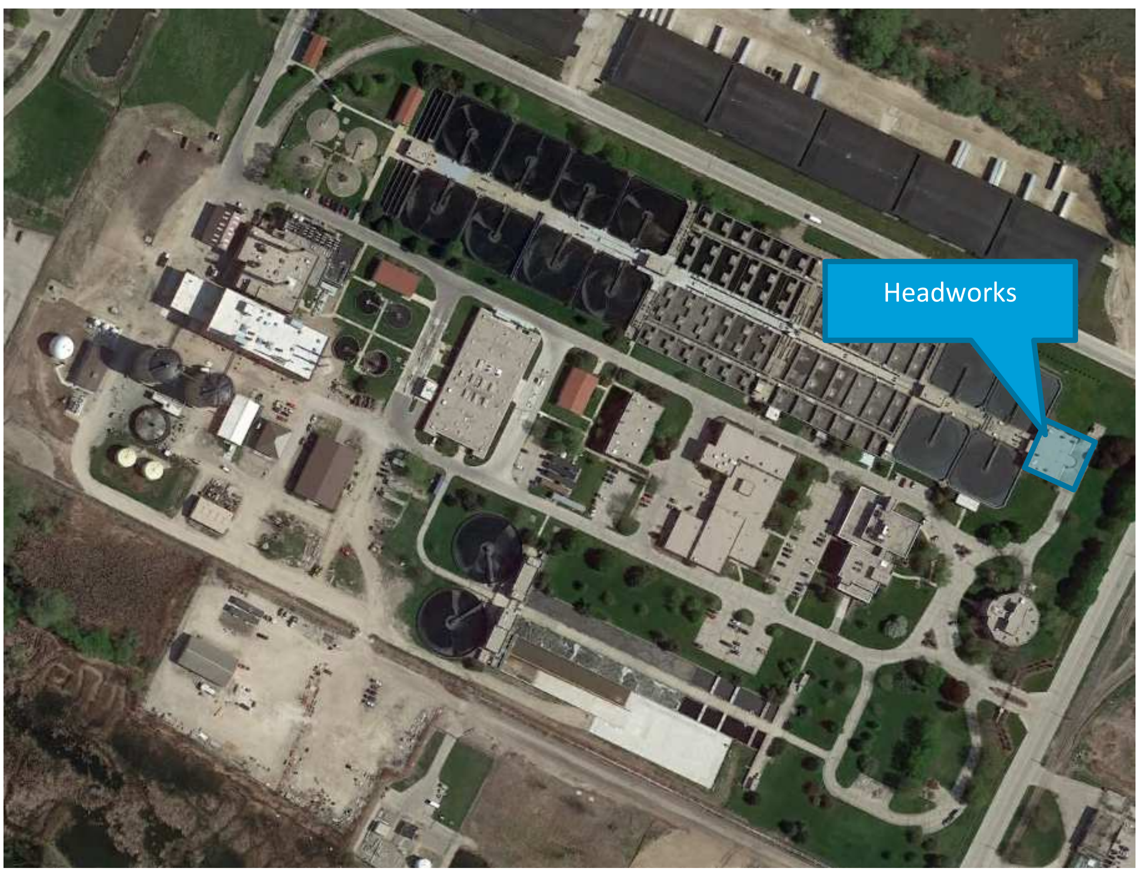

Figure 4-4 Location of Existing Headworks facility

4.2.1 Site Assessment and Asset management Review Summary

A summary of the identified site assessment and asset management review gaps are presented in Table 4-5.

Table 4-5 GBF Headworks Site Assessment Notes and Deficiency Summary

STRUCTURE	NOTE/DEFICIENCY
Headworks	• Poor performance with fine screens, allow rags and plastic through likely due to high velocity through the screens • Screens installed in 1999 • Cannot run fine screens with mat in place during high flow events so they are run continuously • Leaking joints in structure near and after bypass channel • Bypass channels begin to bypass at about 140 mgd • Gates upstream of screens for flow splitting have little freeboard and don't properly isolate due to water over-topping • HVAC in headworks needs evaluation and possible replacement and improved odor control • Valves and piping for mill waste ahead of bar screens require replacement • Gravity thickener return piping and valves require replacement • Primary sludge grit removal performance is questionable and is apparent because the thickening centrifuge, and PC pumps see a great deal of wear and tear • Piping and valves associated with grit removal systems needs replacement • Grit operation is complicated with switching every 30 minutes taking PSD from one clarifier and then the other • Primary sludge pumps need replacement • Degritted PSD pumps have VFDs for no process related reason • Combined pumping WAS and PS to GBTs began about 5 years ago, recently switched to thickening WAS with GBTs and PS with gravity thickeners. Centrifuge is used for WAS thickening only

4.2.2 Design Basis Capacity Analysis Summary

The design capacity analysis for the equipment was based upon the hydraulic throughput capacity of the fine screens and the design capacity of the TeaCups® and is presented through the percent utilization (capacity) of the equipment.

As a result of this analysis, it was identified the fine bar screens are not capable of handling the peak hourly flow capacity for the design years. Additionally, the bar screens are hydraulically undersized for the velocity through the channels at flows above 110 mgd and will push through rags on to downstream processes and eliminate the mat. At flows above 140 mgd, the screen bypass begins to overflow and passes through rags, debris, and plastics on to downstream treatment processes. The TeaCup® degritters are undersized for peak day flow primary sludge.

4.2.3 Asset Management Gap Analysis Summary

The highest CoF from this area was 4.0 and the highest PoF was 5.0. For this evaluation all equipment (assets) with a CoF and PoF greater than 3.0 were considered critical, for the GBF there were 22 assets were identified as "Desktop" critical and 16 assets were identified as "Field" critical.

4.2.4 Equipment and Capacity Analysis

Under the *Equipment and Capacity Analysis* within the *Headworks* tab, the Current Equipment summary identified all major equipment related to the process including two washer compactors, and four TeaCup® degritters.

The 1989 design parameters are presented next to the equipment information with an average day flow of 32.40 mgd and a max month of 49.20 mgd. Following the 1989 design flows are the future estimated design flow for each design year identified in TM 2.1. From this analysis, the fine screens are not capable of handling the peak hour flow. The TeaCup® degritters have a capacity of 400 gpm and each draw from the primary clarifiers in 30-minute increments at concentration of 0.4 to 2.0 percent. At peak day flow it was assumed they would operate continuously at full capacity and are slightly undersized for each design year.

Headworks processes have recommended standards from the *Recommended Standards for Wastewater Facilities (2014)* also known as the 10 States Standards. The influent fine screens do not provide redundancy to handle peak hour flow or peak hour flow in general as the current design is for 110 mgd. The screens are preceded by trash racks in the Influent Pump Station. There are no other process regulatory limitations provided for this section under this evaluation.

4.2.5 Hydraulic Model Capacity Summary

A number of major critical hydraulic elements were identified in the headworks processes during this evaluation. At peak flows, freeboard limitations of less than 6" to the top of the channel were identified at the bar screen bypass channel and within the bar screen channel itself. Overflow, into the bypass channel at the bar screens has been noted to occur at about 140 mgd as the bar screen channels and bar screens are sized for 110 mgd.

Table 4-6 Headworks Critical Hydraulic Analysis Results for Channel/Pipe Velocity and Freeboard Limitations

CONDITION	CURRENT CONDITIONS	20-YEAR FUTURE	50-YEAR FUTURE	CURRENT CONDITIONS	20-YEAR FUTURE	50-YEAR FUTURE
Recurrence Interval (years)	10	10	10	25	25	25
Flow (mgd)	128	135	148	151	159	175
Freeboard Limitations						
2 Bar Screen Bypass Channel	NO	NO	NO	NO	FLOOD	FLOOD
3 Bar Screen Channel	NO	NO	NO	NO	FLOOD	FLOOD

Non-critical hydraulic limitations related to the headworks were also identified. Those included one submerged weir. At all flows greater than 128 mgd the control weir into the headworks (CW-B2) was submerged (Table 4-7).

Table 4-7 Headworks Non-Critical Hydraulic Analysis Results for Submerged Flumes, Weirs and Gates

CONDITION	CURRENT CONDITIONS	20-YEAR FUTURE	50-YEAR FUTURE	CURRENT CONDITIONS	20-YEAR FUTURE	50-YEAR FUTURE
Recurrence Interval (years)	10	10	10	25	25	25
Flow (mgd)	128	135	148	151	159	175
Submerged Weirs						
Control Weir into Headworks (CW-B2)	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED

4.3 GBF – PRIMARY CLARIFIERS

Within the Gap Analysis spreadsheet, the tab labeled "Primary Clarifiers" goes through the evaluation and performance of primary clarification. The Primary Clarifiers are located on the East side of the GBF site (Figure 4-5). The primary clarifiers provide primary settling for the removal of total suspended solids from the influent flow. The major process gap is outlined in Table 4-8Table 4-2.

Table 4-8 GBF Primary Clarifier Major Unit Process Gap

UNIT PROCESS	MAJOR GAP
Primary Clarifiers	• Capacity and Aging Infrastructure

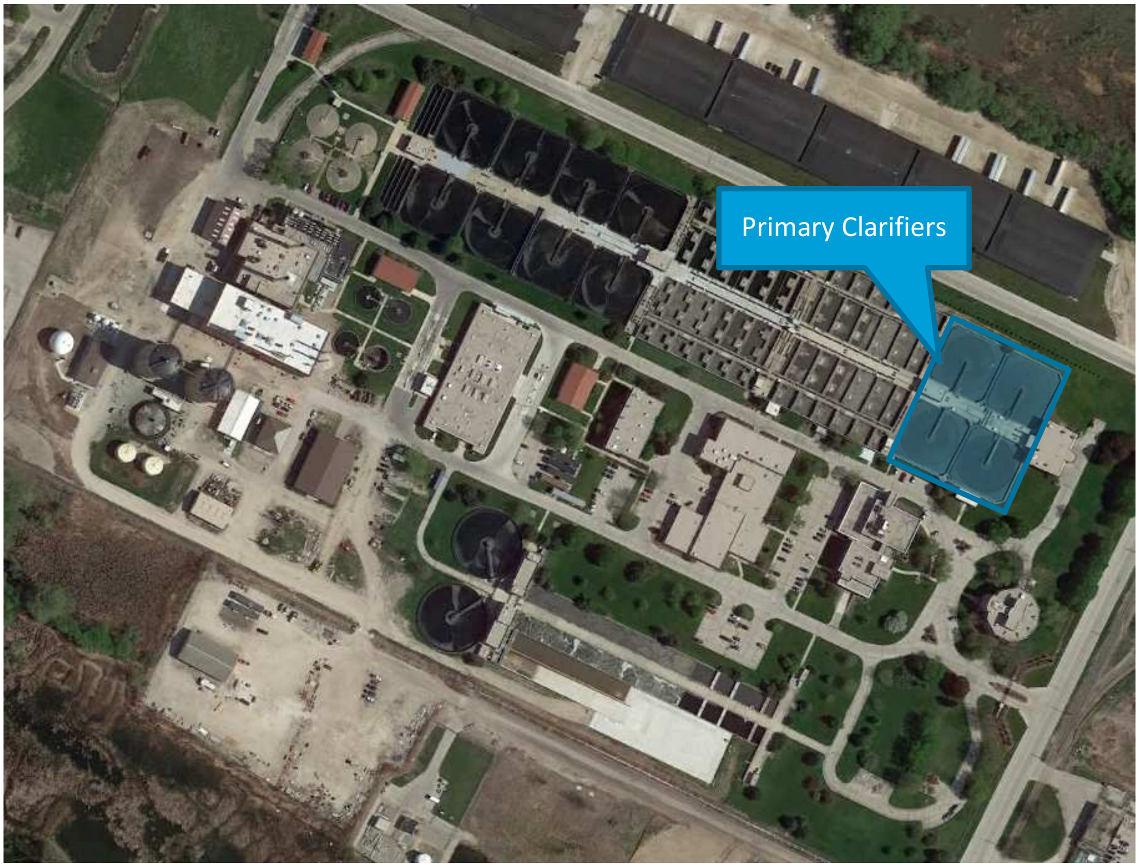

Figure 4-5 Location of Primary Clarifiers

4.3.1 Site Assessment and Asset management Review Summary

A summary of the identified site assessment and asset management review gaps are presented in Table 4-9.

Table 4-9 GBF Primary Clarifier Site Assessment Notes and Deficiency Summary

STRUCTURE	NOTE/DEFICIENCY
Primary Clarifiers	• Age and condition of mechanisms and launders is a concern • Hydraulic capacity issue at peak flow • Scum pumps, valves, and piping need to be replaced • Lack of scum management

4.3.2 Design Basis Capacity Analysis Summary

The design capacity analysis for the clarifiers was based upon the SOR presented in the 10 State Standards (1,000 gpd/ft^2 design average flow and 1,500 gpd/ft^2 for peak hourly flow). The SOR utilization was based upon the estimated future flows for the 2020, 2025, 2030, 2040, and 2070 design years determined in TM 2.1. This data is also presented in the summary tab labeled *Flow & Load Capacity Summary* in the form of a bar graph labeled *Primary Clarifiers*.

As a result of this analysis, it was identified the primary clarifiers are not capable of handling the peak hourly flow for all design years and the average day for 2070. The primary clarifier can handle the 2020 design year peak week (using the peak hourly flow criteria of 1,500 gpd/ft^2) however the clarifiers cannot handle peak week for the 2025, 2030, 2040, or 2070 design years.

4.3.3 Asset Management Gap Analysis Summary

The highest CoF from this area was 3.0 and the highest PoF was 5.0. For this evaluation all equipment (assets) with a CoF and PoF greater than 3.0 were considered critical, for the GBF there were 12 assets were identified as "Desktop" critical and 8 assets were identified as "Field" critical.

The 2018 *Clarifier Rehabilitation Study Engineering Alternatives Report* completed by Donohue recommended a number of upgrades to the primary clarifiers. Replacement of the items listed in Table 4-10 were recommended.

Table 4-10 Recommended alternative upgrades to DPF Intermediate Clarifiers from clarifier study

COMPONENT	ALTERNATIVE	SUB-ALTERNATIVE
Corner Sweep	Replacement	
Scum Collection	Replacement	
Drives	Replacement	Hydraulic
Mechanisms	Replacement	
Launders	Replacement	Wall-Mounted Concrete

The evaluation also considered a number of process improvements including:

- Rehabilitate primary clarifiers
- Rehabilitate primary clarifiers and perform Chemically Enhanced Primary Treatment (CEPT)
- Installation of primary filters

Rehabilitation of the primary clarifiers will extend their life span, improve performance, and reduce clarifier maintenance. CEPT or installation of primary filters both provide methods to optimize treatment performance by increasing BOD and TSS removals in primary treatment, which increases carbon diversion to the new anaerobic digestion system but could potentially negatively impact biological phosphorus removal. For more details on these recommendations please defer to the 2018 Donohue clarifier study.

In addition, some structural improvements and miscellaneous improvements were identified. Structural improvements North Plant decking rehabilitation, replacement of effluent splitting gate actuators, scum well crack repair, addition of a safety (fall protection) platform, new floor grout topping, and an optional wall crack injection rehabilitation.

Other miscellaneous components to be upgraded included recoating of carbon steel of the large diameter inlet piping, replacement of scum pumps replacements of sludge pumps, and the addition of odor control covers.

4.3.4 Equipment and Capacity Analysis

Under the *Design Basis Calculations* within the *Primary Clarifiers* tab, the Current Equipment summary identified all major equipment related to the process including four primary clarifiers, six primary sludge pumps, two primary sludge dump tanks, and eight primary scum pumps.

Next to the equipment information is the design basis calculations. The 1989 design parameters are presented next to the equipment information. Next to the 1989 design information is the future estimated design flow for each design year identified in TM 2.1. These calculations were completed by considering all influent flow and loading to the primary clarifiers and any return flows upstream of the clarifiers, in this case that included thickening return flows, plant drain return, and mill waste streams. Because no data was provided on thickening return flows and loads those were estimated through calculations in this analysis. As detailed in Section 4.3.2, the primary clarifiers are not sized to handle peak hourly flow as regulated by the SOR from the 10 States Standards.

For primary clarification, the 10 States Standards were used as guidelines for the capacity utilization analysis. The design capacity analysis for the clarifiers was based upon the SOR presented in the 10 State Standards (1,000 gpd/ft^2 design average flow and 1,500 gpd/ft^2 for peak hourly flow). Primary clarifier TSS and BOD removals, sludge concentrations, and sludge production were calculated based on historical data to estimate continued flow and loadings to the North and South Aeration Basins.

4.3.5 Process Model Capacity Analysis

One of the interesting aspects of primary clarifiers is that their performance does not always suffer at high surface overflow rates. The settleability is typically more a function of the settleability of solids. In the process analysis of the primary clarifiers, it was shown that removal rates did not suffer at higher surface overflow rates. Therefore, the primary clarifier gaps should be tied to hydraulic capacity and aging infrastructure.

4.3.6 Hydraulic Model Capacity Summary

A number of critical hydraulic limitations were identified from the hydraulic model relating to the Primary Clarifiers. The first major issue was found in the primary basin influent piping where at the peak hourly flow for 2040 the pipe velocity exceeded 6.0 feet per second and causes a hydraulic bottleneck at peak flows (greater than 140 mgd).

Additionally, a number of freeboard limitations were identified, see Table 4-11. The locations of these are identified by number in Figure 4-6. They occurred at the channel upstream of the influent parshall flume (4), the channel downstream of the influent parshall flume (5), channel upstream of the primary clarifier's influent basin dropbox (6), and the dropbox into the primary clarifier basins (7).

Table 4-11 Critical Criteria Hydraulic Analysis Results for Channel/Pipe Velocity and Freeboard Limitations

CONDITION	CURRENT CONDITIONS	20-YEAR FUTURE	50-YEAR FUTURE	CURRENT CONDITIONS	20-YEAR FUTURE	50-YEAR FUTURE
Recurrence Interval (years)	**10**	**10**	**10**	**25**	**25**	**25**
Flow (mgd)	**128**	**135**	**148**	**151**	**159**	**175**
Channel/ Pipe Velocity						
1 Primary Basin Influent Piping	5.27	5.55	6.07	6.19	6.51	7.16
Freeboard Limitations						
4 Channel Upstream of Influent Parshall Flume	NO	NO	NO	NO	NO	FLOOD
5 Channel Downstream of Influent Parshall Flume	NO	NO	FLOOD	FLOOD	FLOOD	FLOOD
6 Channel just Upstream of Dropbox into Primary Basin	NO	NO	NO	NO	NO	FLOOD
7 Dropbox into Primary Basin	NO	NO	NO	NO	NO	FLOOD

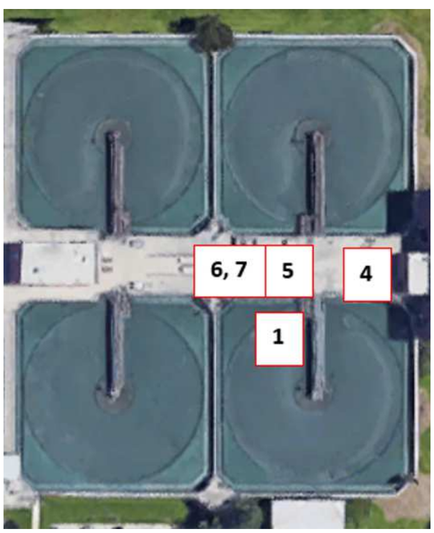

Figure 4-6 GBF Primary Clarifier Bottleneck Locations

Non-critical hydraulic limitations related to the primary clarifiers were also identified. Those included submerged weirs and gates. At all flows greater than 128 mgd the weir upstream of the influent Parshall Flume (CW-B5) was submerged and the primary basin V-notch weir was submerged at flows greater than 148 mgd. Submerged gates were identified as well as nearly all flow evaluated. The gate upstream of the primary basin influent dropbox (SG-S8) submerged at flows of 135 mgd or greater. The stop gate at the discharge of the primary basin (SG-B17) was submerged at all flows evaluated in this analysis. The gate downstream of the primary effluent channel (SG-B17) was submerged at flows of 175 mgd or greater.

Table 4-12 Non-critical Hydraulic Analysis Results for Submerged Flumes, Weirs, and Gates

CONDITION	CURRENT CONDITIONS	20-YEAR FUTURE	50-YEAR FUTURE	CURRENT CONDITIONS	20-YEAR FUTURE	50-YEAR FUTURE
Recurrence Interval (years)	**10**	**10**	**10**	**25**	**25**	**25**
Flow (mgd)	**128**	**135**	**148**	**151**	**159**	**175**
Submerged Flumes						
Influent Parshall Flume	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED
Submerged Weirs						
Control Weir Upstream of Influent Parshall Flume (CW-B5)	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED
Primary Basin V-notch Weir	NO	NO	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED
Submerged Gates						
Gate Upstream of Primary Basin Influent Dropbox (SG-B8)	NO	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED
Stop Gate at Discharge of Primary Basin (SG-B13)	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED
Gate Downstream of Primary Effluent Channel (SG-B17)	NO	NO	NO	NO	NO	SUBMERGED

4.4 GBF – NORTH PLANT (NP) AERATION BASIN AND CLARIFIERS

Within the Gap Analysis spreadsheet, the tab labeled "NP Aeration Basin and Clarifiers" goes through the evaluation and performance of the biological treatment process and solids clarification. The NP Aeration Basins and Clarifiers take up a large portion of the site and are located on the North side of the GBF site and received on average about 75 percent of the flow from the primary clarifiers (Figure 4-7). The major process gap is outlined in Table 4-13.

Table 4-13 GBF NP Aeration Basins and Clarifiers Major Unit Process Gap

UNIT PROCESS	MAJOR GAP
NP Aeration Basins and Clarifiers	• Aging infrastructure

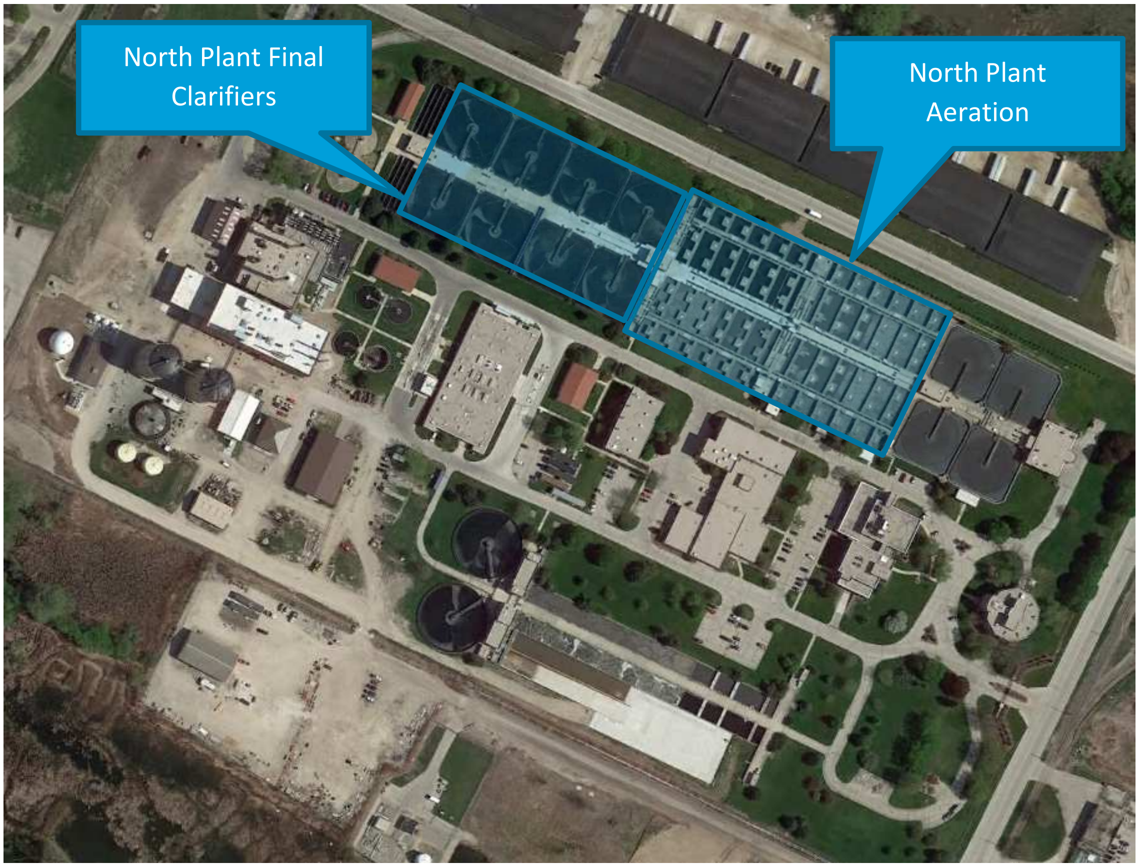

Figure 4-7 Location of GBF NP Aeration Basins and Clarifiers

4.4.1 Site Assessment and Asset management Review Summary

A summary of the identified site assessment and asset management review gaps are presented in Table 4-14.

Table 4-14 GBF NP Aeration Basins and Clarifiers Site Assessment Notes and Deficiency Summary

STRUCTURE	NOTE/DEFICIENCY
Activated Sludge Aeration	• Blowers – discharge piping leaks air at North and South basins • Age of blowers is a concern • Have evaluation completed on blowers • Concrete in aeration basins degraded • Issues with settleability in final clarifiers • Would like better aeration control • Isolation gates need replacement • Re-evaluate step feed process operation • Channel liner –new liner failed, channel condition is questionable • Consider tunnel structural rehabilitation • Consider rehabilitation of tunnel trench drain system
Blower Building	• HVAC system in blower building requires evaluation and possible replacement

STRUCTURE	NOTE/DEFICIENCY
	• Common discharge line to North and South Plant is a common point of failure and leaks • Blowers have a faulty breaker on MCC1 (CMC-C1) • Electrical feeders routing electrical to building are damaged and conduits are prone to leaking water. Electrical boxes also leaking water. • Replace blower building air filters • Blowers will reach end of useful life in planning period
Final Clarifiers	• North Plant o Replace Scum pumps o Replace wash water piping o Replace/Rehabilitate walkway structure on clarifier o Rehabilitate concrete o Lack of scum management

4.4.2 Design Basis Capacity Analysis Summary

The NP aeration basins can receive a maximum BOD loading of 89,500 lb/d and the SP aeration basins can receive 31,300 lb/d based on the 10 State Standards peak hour loading rate of 40 lb/d/1000 ft^3. The NP can receive a peak hour flow of 96.6 mgd and the SP can receive 28.6 mgd based on the recommended SOR for the final clarification from 10 States Standards of 1,000 gpd/ft^2. As a result, the design capacity analysis for the system was based upon the recommended SOR for the final clarification from 10 States Standards was 1,000 gpd/ft^2 design average flow as it was a limiting factor. Additionally, capacity was evaluated using the solid loading from NR110 of peak solids loading rate of 2.0 lb/day/ft^2 and 1.2 lb/day/ft^2. The SOR and solids loading was based upon the estimated future flows and loads for the 2020, 2025, 2030, 2040, and 2070 design years determined in TM 2.1.

From this analysis, the aeration basins are capable of handling the average day BOD loading to the aeration tanks. The clarifiers are not capable of handling peak hour SOR for any design year or the solids loading rate for the peak hour for year 2025, 2030, 2040, and 2070.

4.4.3 Asset Management Gap Analysis Summary

The highest CoF from this area was 4.0 and the highest PoF was 5.0. For this evaluation all equipment (assets) with a CoF and PoF greater than 3.0 were considered critical, for the GBF Aeration Basins and Clarifiers there were 45 assets identified as “Desktop” critical and 41 assets identified as “Field” critical.

The 2018 *Clarifier Rehabilitation Study Engineering Alternatives Report* completed by Donohue recommended a number of upgrades to the North Plant final clarifiers. Replacement of the items listed in Table 4-15 were recommended.

Table 4-15 Recommended alternative upgrades to GBF North Plant Clarifiers from clarifier study

COMPONENT	ALTERNATIVE	SUB-ALTERNATIVE
Corner Sweep	Replacement	
Drive	Replacement	Hydraulic
Scum Collection	Replacement	
Mechanisms	Replacement	Sludge Header
		Energy-Dissipating Inlet
Launders	Replacement	Wall-Mounted Concrete
Sunlight Blocking Covers	Replacement	Geotextile
Additional Baffling	Stamford Baffles	FRP

The evaluation also considered a number of process improvements including:

- Flow Splitting
    - Flow Distribution
    - Flow Control
- Solids loading optimization
- Surface wasting

For improved process recommendations details see the *Clarifier Rehabilitation Study Engineering Alternatives Report*. In addition to the process improvement, some structural improvements and miscellaneous improvements were identified. Structural improvements included repairing the expansion joints, adding a new floor grout topping, and wall crack injection. Miscellaneous improvements include replacement of the scum pumps and the wash water pipes. From a 2016 field investigation was also completed by Clarifier Performance Evaluations, Inc. (CPE) and a number of improvements were recommended and are presented in Table 4-16.

Table 4-16 CPE Recommended Improvement for GBF North Final Clarifiers

ITEM	INFORMATION	COMMENT
1	Increase centerwell diameter.	Will be incorporated with new mechanism during design
2	Reduce centerwell depth.	Will be incorporated with new mechanism during design
3	Provide an energy-dissipating inlet.	Also recommended in this evaluation
4	Provide cylindrical baffles at approximately the mid-radius.	Will be evaluated during design
5	Reduce rotational rate of the mechanism to 7 to 8 fpm.	Will be incorporated with new mechanism during design

ITEM	INFORMATION	COMMENT
6	Align the draft tubes horizontally.	Replacing the draft tube mechanism with a sludge header is recommended in this evaluation
7	Replace control valves on the draft tubes with the twist-turn variety.	Replacing the draft tube mechanism with a sludge header is recommended in this evaluation
8	Replace inboard launders with launders attached to outer wall.	Also recommended in this evaluation
9	Provide Stamford baffles at the knee of the effluent launder trough.	Also recommended in this evaluation
10	Replace existing launders and weirs.	Also recommended in this evaluation
11	Provide flow meters on the influent conduit to each clarifier.	Also recommended in this evaluation
12	Improve corner sweep with link belt chain and gear.	Also recommended in this evaluation
13	Align the scum skimmer tangential to the centerwell.	Will be incorporated with new scum collection system during design
14	Provide an anti-rotation scum baffle.	Will be evaluated during design
15	Replace the scum trough with a single scum hopper of approximately six feet in length.	Also recommended in this evaluation
16	Provide a scum hopper flushing device that is actuated by the passage of the skimmer.	Also recommended in this evaluation

4.4.4 Equipment and Capacity Analysis

Under the *Design Basis Calculations* within the *NP Aeration Basin and Clarifier* tab, the Current Equipment summary identified all major equipment related to the process including four aeration basins, fine bubble aeration systems, mixed liquor recycle pumps, eight clarifiers, twelve RAS pumps, 16 scum pumps, three interim effluent pumps, and five blowers.

These calculations were completed by considering all influent flow and loadings to the aeration basins from the primary clarifiers and any return flows coming in after the primary clarifiers, in this case there is the possibility of sending thickening returns downstream of the primary clarifiers but operators stated it most often is send to just upstream of the headworks. Fox River Fiber is split between the North and South treatment plants upstream of the aeration basins. Because no data was provided on thickening return flows and loads those were estimated in this analysis. As detailed in Section 4.4.2, the NP Aeration Basins are sized to handle average day volumetric BOD loading, the NP final clarifiers are not capable of handling peak hour SOR for any year or the solids loading rate for the peak hour for year 2025, 2030, 2040, and 2070. The existing RAS pumps are not sized to handle estimate RAS production at peak hour for years 2025, 2030, 2040 and 2070.

For aeration and final clarification, the 10 States Standards and the Wisconsin Administrative Code NR110 were used as guidelines and regulations for the capacity utilization analysis. The design capacity analysis for the system was based upon the BOD loading rate at 40 lb/d/1000 ft^3 recommended in the 10 State Standards. The SOR for the final clarification from 10 States Standards was 1,000 gpd/ft^2 design average flow and a solid loading from NR110 of peak solids loading rate of 2.0 lb/day/ft^2 and 1.2 lb/day/ft^2.

4.4.5 Process Model Capacity Analysis

The GBF North Plant aeration basins and clarifiers do not present an infrastructure gap at the current peak flows, but there are several operations/maintenance gaps that should be addressed. The current management of MLSS concentration by swing operation of an aeration basins provides the ability to meet effluent TSS requirements. However, if the settleability could be improved, this operational strategy could be limited, and the capacity of the North Plant could be optimized. A focus for future efforts related to the North Plant will be identifying the root cause of poor settleability and identifying operational strategies and infrastructure to improve the settleability.

4.4.6 Hydraulic Model Capacity Summary

A number of critical hydraulic limitations were identified from the hydraulic model relating to the NP Aeration Basin and Clarifiers. A number of freeboard limitations were identified, see Table 4-17. The locations of these are identified by number in Figure 4-8 GBF NP Aeration Basin and Final Clarifier Bottleneck Locations. They occurred at the channel downstream of the primary effluent gate channel gate (8), the channel from the final basin discharge to the effluent channel (9), and the final effluent channel downstream of the final basin (10).

Table 4-17 Critical Criteria Hydraulic Analysis Results for Channel/Pipe Velocity and Freeboard Limitations

CONDITION	CURRENT CONDITIONS	20-YEAR FUTURE	50-YEAR FUTURE	CURRENT CONDITIONS	20-YEAR FUTURE	50-YEAR FUTURE
Recurrence Interval (years)	**10**	**10**	**10**	**25**	**25**	**25**
Flow (mgd)	**128**	**135**	**148**	**151**	**159**	**175**
Freeboard Limitations						
8 Channel Downstream of Primary Effluent Channel Gate	NO	NO	NO	NO	NO	FLOOD
9 Channel from Final Basin Discharge to Effluent Channel	NO	NO	NO	NO	NO	FLOOD
10 Final Effluent Channel Downstream of Final Basin	NO	NO	NO	NO	NO	FLOOD

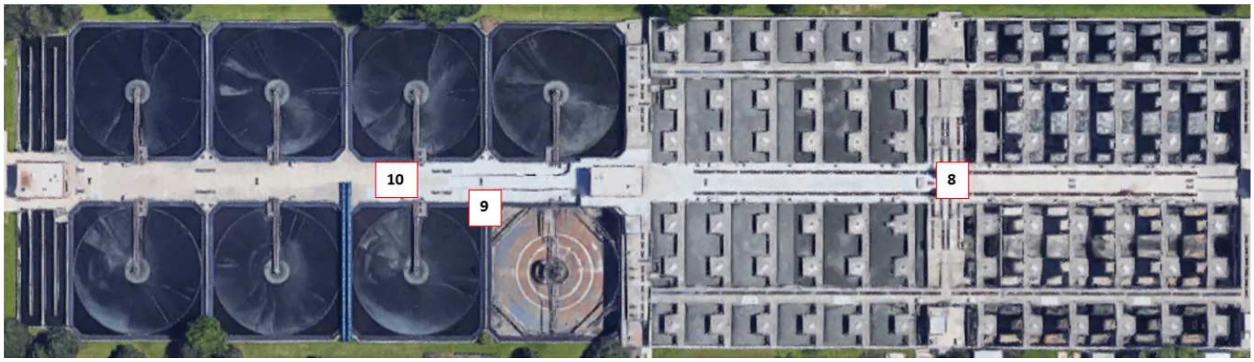

Figure 4-8 GBF NP Aeration Basin and Final Clarifier Bottleneck Locations

Non-critical hydraulic limitations related to the NP Aeration Basins and Clarifiers were also identified (Table 4-18). Those included submerged flumes, weirs and gates. At all flows greater than 128 mgd flumes at the aeration splitter and the effluent Parshall flume were completely submerged. Two weirs were completely submerged at all flows including the weir upstream of the aeration splitter parshall flume (CW-B9) and weir upstream of the contact basin (CW-B21). Two weirs were submerged at flows at and greater than 148 mgd, including the weir upstream of the final basin dropbox (SG-B94) and the final basin v-notch weir.

Table 4-18 Non-Critical Hydraulic Analysis Results for Submerged Flumes, Weirs and Gates

CONDITION	CURRENT CONDITIONS	20-YEAR FUTURE	50-YEAR FUTURE	CURRENT CONDITIONS	20-YEAR FUTURE	50-YEAR FUTURE
Recurrence Interval (years)	**10**	**10**	**10**	**25**	**25**	**25**
Flow (mgd)	**128**	**135**	**148**	**151**	**159**	**175**
Submerged Flumes						
Aeration Splitter Parshall Flume	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED
Effluent Parshall Flume	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED
Submerged Weirs						
Weir Upstream of Aeration Splitter Parshall Flume (CW-B9)	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED
Weir Upstream of Contact Basin (CW-B21)	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED
Weir Upstream of Final Basin Dropbox (SG-B94)	NO	NO	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED
Final Basin V-notch Weir	NO	NO	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED
Submerged Gates						
Final Basin Effluent Gate (SG-101)	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED

4.5 GBF – SOUTH PLANT (SP) AERATION BASIN AND CLARIFIERS

Within the Gap Analysis spreadsheet, the tab labeled "SP Aeration Basin and Clarifiers" goes through the evaluation and performance of the biological treatment process and solids clarification. The SP Aeration Basins and Clarifiers are located on the South side of the GBF site and receive about 25 percent of the flow from the primary clarifiers up to the maximum (Figure 4-9). The major process gap is outlined in Table 4-19.

Table 4-19 GBF SP Aeration Basin and Clarifiers Major Unit Process Gap

UNIT PROCESS	MAJOR GAP
SP Aeration Basins and Clarifiers	• Capacity and deteriorating assets

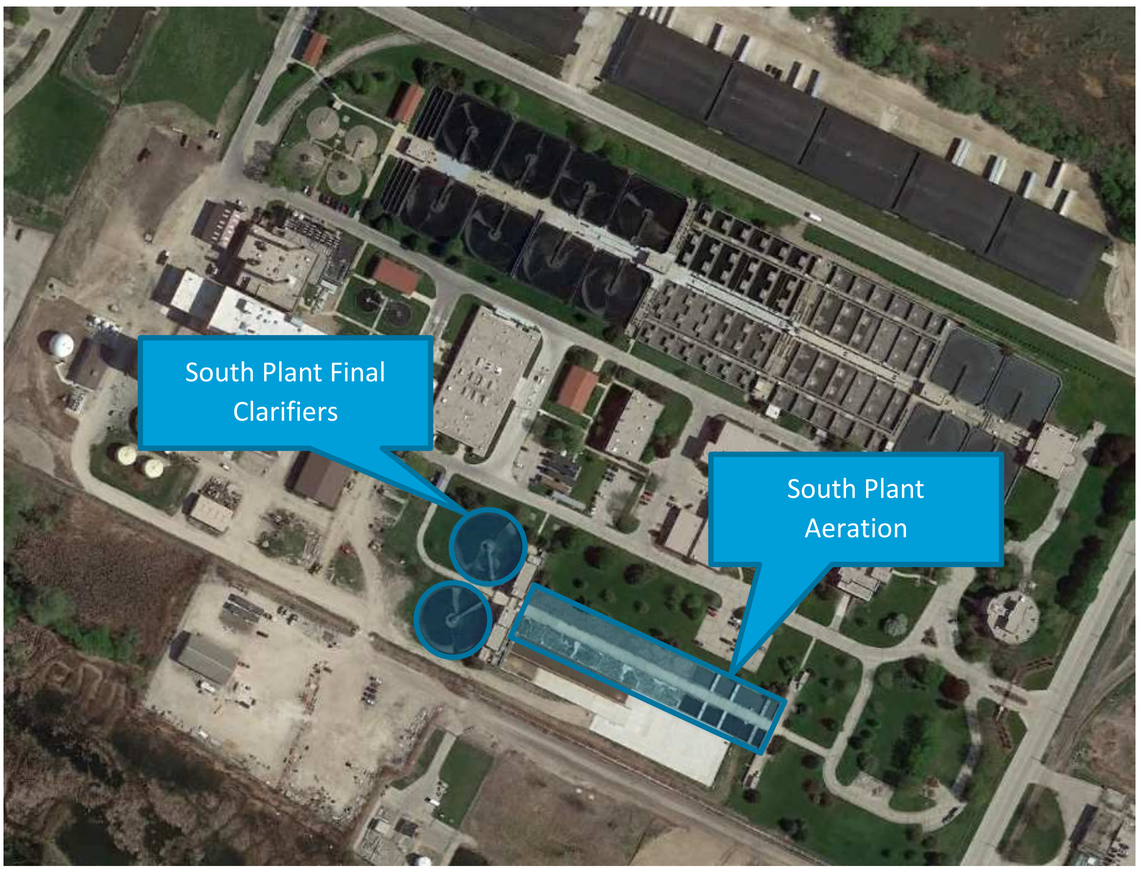

Figure 4-9 Location of GBF SP Aeration Basins and Clarifiers

4.5.1 Site Assessment and Asset management Review Summary

A summary of the identified site assessment and asset management review gaps are presented in Table 4-20.

Table 4-20 GBF SP Aeration Basins and Clarifiers Site Assessment Notes and Deficiency Summary

STRUCTURE	NOTE/DEFICIENCY
Activated Sludge Aeration	• See Table 4-14
Blower Building	• See Table 4-14
Final Clarifiers	• South Plant o Replace all pumps (RAS, Scum, and wash water) o Currently sending ash decant – monitor and identify long term approach ▪ Ash cell overflow goes into south plant and alters VS in aeration basin along with biology ▪ Too wet to send to landfill and is not accepted ▪ Evaluation of possible resource recovery or other on-site uses

4.5.2 Design Basis Capacity Analysis Summary

This summary displays the results of the percent capacity for the biological and settling process associated with the SP Aeration Basins and Clarifiers. The design capacity analysis for the aeration basins was based upon the BOD loading rate at 40 lb/d/1000 ft^3 recommended in the 10 State Standards. The SOR for the final clarification from 10 States Standards was 1,000 gpd/ft^2 design average flow and a solid loading from NR110 of peak solids loading rate of 2.0 lb/day/ft^2 and 1.2 lb/day/ft^2. The maximum loading capacity to the aeration basins is 31,300 lb/d and the maximum flow to the SP Final Clarifiers is 28.6 mgd (based on recommended SOR of 1,000 gpd/ft^2). The final clarifier maximum capacity is the limiting parameter and is thus the design capacity for the SP.

From this analysis, the aeration basins are capable of handling the average day BOD loading to the aeration tanks. If the flow remains below the max surface overflow rate and settleability is controlled/improved the final clarifiers are capable of handling the possible peak loading.

4.5.3 Asset Management Gap Analysis Summary

The highest CoF from this area was 4.0 and the highest PoF was 5.0. For this evaluation all equipment (assets) with a CoF and PoF greater than 3.0 were considered critical, for the GBF SP Aeration Basins and Clarifiers there were 48 assets identified as “Desktop” critical and 43 assets identified as “Field” critical.

The 2018 *Clarifier Rehabilitation Study Engineering Alternatives Report* completed by Donohue recommended a number of upgrades to the South Plant final clarifiers. Replacement of the items listed in Table 4-21 were recommended.

Table 4-21 Recommended alternative upgrades to GBF North Plant Clarifiers from clarifier study

COMPONENT	ALTERNATIVE	SUB-ALTERNATIVE
Drive	Replacement	Hydraulic
Scum Collection	Replacement	

COMPONENT	ALTERNATIVE	SUB-ALTERNATIVE
Mechanisms	Replacement	Sludge Header
Sunlight Blocking Covers	Replacement	Geotextile

In addition to the process improvement, some structural improvements and miscellaneous improvements were identified. Structural improvements included repairing the expansion joints, adding a new floor grout topping, and wall crack injection. Miscellaneous improvements include replacement of the scum pumps, RAS pump, WAS pumps, and replace FRP weirs. From a 2016 field investigation was also completed by Clarifier Performance Evaluations, Inc. (CPE) and a number of improvements were recommended and are presented in Table 4-22.

Table 4-22 CPE Recommended Improvement for GBF North Final Clarifiers

ITEM	INFORMATION	COMMENT
1	Reduce centerwell depth.	Will be incorporated with new mechanism during design
2	Provide an energy-dissipating inlet.	Also recommended in this evaluation
3	Provide cylindrical baffles at approximately the mid-radius.	Will be evaluated during design
4	Align the draft tubes horizontally.	Replacing the draft tube mechanism with a sludge header is recommended in this evaluation
5	Increase the draft tube capacity to handle the maximum RAS flow for future conditions.	Replacing the draft tube mechanism with sludge header is recommended in this evaluation
6	Modify the indicator attachment, so the interior of each tube can be more readily accessible for sampling.	Replacing the draft tube mechanism with a sludge header is recommended in this evaluation
7	Provide a method to measure flow entering and exiting each clarifier.	Also recommended in this evaluation
8	Align the single scum skimmer tangential to the centerwell.	Will be incorporated with new scum collection system during design
9	Provide an anti-rotation scum baffle	Will be evaluated during design
10	Replace the scum trough with a single scum hopper of approximately six feet in length.	Also recommended in this evaluation
11	Provide a scum hopper flushing device that is actuated by the passage of the skimmer.	Also recommended in this evaluation

4.5.4 Equipment and Capacity Analysis

Under the *Design Basis Calculations* within the *SP Aeration Basin and Clarifier* tab, the Current Equipment summary identified all major equipment related to the process including two aeration basins equipped with fine bubble aeration, two clarifiers, four RAS pumps, four waste sludge pumps, four secondary scum pumps, three interim effluent pumps, and two ash decant pumps.

These calculations were completed by considering all influent flow and loadings to the aeration basins from the primary clarifiers and any return flows coming in after the primary clarifiers, in this case there is the possibility of sending thickening returns downstream of the primary clarifiers but operators stated it most often is send to just upstream of the headworks. Fox River Fiber is split between the North and South treatment plants upstream of the aeration basins. Because no data was provided on thickening return flows and loads those were estimated in this analysis. As detailed in Section 4.5.2, the aeration basins are capable of handling the average day BOD loading to the aeration tanks. The clarifiers are capable of handling maximum possible flow. With the maximum flow the RAS pumps are capable of handling estimated RAS production flows.

For aeration and final clarification, the 10 States Standards and the Wisconsin Administrative Code NR110 were used as guidelines and regulations for the capacity utilization analysis. The design capacity analysis for the system was based upon the BOD loading rate at 40 lb/d/1000 ft^3 recommended in the 10 State Standards. The SOR for the final clarification from 10 States Standards was 1,000 gpd/ft^2 design average flow and a solid loading from NR110 of peak solids loading rate of 2.0 lb/day/ft^2 and 1.2 lb/day/ft^2.

4.5.5 Process Model Capacity Analysis

There is a similar conclusion for the South Plant gaps related to the process model capacity analysis. If settleability could be improved, the South Plant could operate at a peak capacity that approaches 40 mgd. A focus on settleability improvements will be a key aspect of future infrastructure and operations improvements for the South Plant.

4.5.6 Hydraulic Model Capacity Summary

Nothing to report.

4.6 GBF – DISINFECTION

Within the Gap Analysis spreadsheet, the tab labeled "Disinfection" goes through the evaluation and performance of the chlorination and dechlorination of the plant effluent. The disinfection system is located on the Northwestern portion of the site (Figure 4-10). The major process gap is outlined in Table 4-2.

Table 4-23 GBF Disinfection Major Unit Process Gap

UNIT PROCESS	MAJOR GAP
Disinfection	• Peak Day Capacity

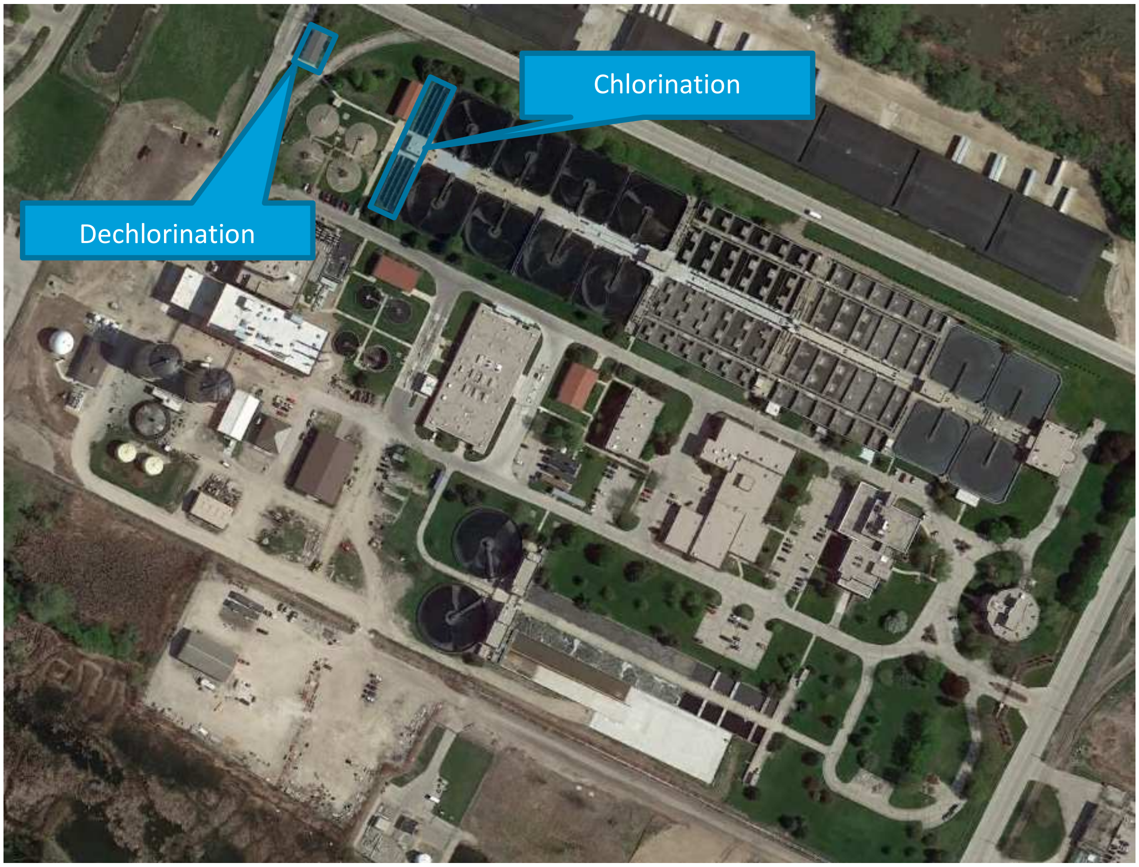

Figure 4-10 Location of GBF Disinfection System

4.6.1 Site Assessment and Asset management Review Summary

A summary of the identified site assessment and asset management review gaps are presented in Table 4-24.

Table 4-24 GBF Disinfection Site Assessment Notes and Deficiency Summary

STRUCTURE	NOTE/DEFICIENCY
Disinfection	• Detention time does not meet code for projected 2040 peak flow – evaluate for timing and sizing

4.6.2 Design Basis Capacity Analysis Summary

The design capacity analysis for the disinfection system was based upon a chlorine contact tank time of 15 minutes at peak hour design flow as required by 10 States Standards. The contact time was based upon the estimated future peak hour flows for the 2020, 2025, 2030, 2040, and 2070 design years determined in TM 2.1.

From this analysis, the disinfection system is undersized for peak day flow contact times. It is recommended to upgrade this system with either a new more efficient technology such as ultraviolet disinfection or increasing the basin size by adding more contact tanks. Adding more contact tanks would be difficult due to area limitations, although investigating a retrofit of the existing tankage with UV may be a viable option.

4.6.3 Asset Management Gap Analysis Summary

The highest CoF from this area was 4.0 and the highest PoF was 5.0. For this evaluation all equipment (assets) with a CoF and PoF greater than 3.0 were considered critical, for the GBF Disinfection unit process there were 5 assets identified as "Desktop" critical and 5 assets identified as "Field" critical.

4.6.4 Equipment and Capacity Analysis

Under the *Design Basis Calculations* within the Disinfection tab, the Current Equipment summary identified all major equipment related to the process including two aeration basins equipped with chlorine contact tanks, sodium hypochlorite storage systems, RAS day tanks, hypochlorite day tanks, bulk transfer pumps, hypochlorite feed pumps, RAS chlorination feed pumps, chemical feed pumps, a chlorine contact tank flash mixer, sodium bisulfate tanks, and sodium bisulfate pumps.

The design parameters from the 2015 design are presented next to the equipment information. The design information includes the future estimated design flows from secondary treatment for each design year identified in TM 2.1. As detailed in Section 4.6.2, the Disinfection tanks are undersized for the detention time required by the 10 States Standards for the peak hour for all years.

The 10 States Standards were used as regulations for the capacity utilization analysis. The design capacity analysis for the system was based upon a detention time of 15 minutes at peak hour design flow.

4.6.5 Hydraulic Model Capacity Summary

Non-critical hydraulic limitations related to Disinfection were identified during the hydraulic evaluation and are presented Table 4-25. The hydraulic issue identified by the model was a submerged gate, the stop gate upstream of the chlorine contact basin (SG-B108).

Table 4-25 Non-Critical Hydraulic Analysis Results for Submerged Flumes, Weirs and Gates

CONDITION	CURRENT CONDITIONS	20-YEAR FUTURE	50-YEAR FUTURE	CURRENT CONDITIONS	20-YEAR FUTURE	50-YEAR FUTURE
Recurrence Interval (years)	**10**	**10**	**10**	**25**	**25**	**25**
Flow (mgd)	**128**	**135**	**148**	**151**	**159**	**175**
Submerged Gates						
Stop Gate Upstream of Chlorine Contact Basin (SG-B108)	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED	SUBMERGED

In addition to this bottleneck, the overall hydraulic retention time required for chlorine contact required by NR110 is too small. It is recommended to re-evaluate disinfection options including technology and expansion.

4.7 GBF – THICKENING

Within the Gap Analysis spreadsheet, the tab labeled "Thickening" goes through the evaluation and performance of the solids thickening and sludge dewatering. Thickening processes are located central to the site and include processing of GBF PSD and DPF and GBF WAS (Figure 4-11). The major process gap is outlined in Table 4-26.

Table 4-26 GBF Thickening Major Unit Process Gap

UNIT PROCESS	MAJOR GAP
Thickening	• Capacity and deteriorating assets

Figure 4-11 Location of GBF Thickening Building

4.7.1 Site Assessment and Asset management Review Summary

A summary of the identified site assessment and asset management review gaps are presented in Table 4-27.

Table 4-27 GBF Thickening Site Assessment Notes and Deficiency Summary

STRUCTURE	NOTE/DEFICIENCY
Thickening	• Primary sludge thickening

STRUCTURE	NOTE/DEFICIENCY
	○ Hydraulic pumping issues destroy pumps ○ Difficult to get consistent feed – large variability in PSD concentration ○ Grease remains in PSD ○ Solids fluctuation ○ Not enough capacity ○ Grease and rags cause issues with pumping across GBTs ○ Update overall grit removal to protect thickening of PSD ○ Recommend developing method to handle grease in PSD ○ Provide more capacity, redundancy, and overall reliability ○ Improve odor control • WAS Thickening ○ Gravity belt thickeners (3 meter at 600 gpm) are in good condition but at end of life as they are nearly 30 years old (installed 1990) – update mechanisms and rehabilitate concrete ○ Pumps and piping are hydraulic bottleneck – difficult to pump TWAS with polymer ○ Capacity during peak flow events is inadequate ○ Polymer feed systems need replacing • Thickening building has low ceiling as building was retrofitted from an older structure • Centrifuge in operation for WAS thickening only (not able to be utilized for primary sludge thickening or co-thickening) • Evaluate option of rehabilitating gravity thickeners for use • Replace scum pump with non-clog type as they clog with grease, rags, and plastics

4.7.2 Design Basis Capacity Analysis Summary

The design capacity analysis for the thickening equipment is based upon the design capacity of each type of thickener and sludge flow rate. The majority of the thickening equipment is undersized for average day, maximum month, and maximum week for all years. The gravity belt thickeners will exceed their maximum month design capacity at year 2025. Maximum day flows for gravity thickeners exceed 100 percent utilization at year 2030, 2040, and 2070. The primary sludge feed pump exceeded 100 percent capacity on maximum day flow for year 2070. Dewatering equipment is sized well for all design years.

In summary, the majority of the thickening equipment is undersized, and operators experience performance issues with grit and debris buildup on a regular basis and the ability to achieve desired solids concentration. Dewatering equipment is sized well.

4.7.3 Asset Management Gap Analysis Summary

The highest CoF from thickening was 4.0 and the highest PoF was 5.0. For this evaluation all equipment (assets) with a CoF and PoF greater than 3.0 were considered critical, for the GBF thickening there were 39 assets identified as "Desktop" critical and 35 assets identified as "Field" critical.

4.7.4 Equipment and Capacity Analysis

Under the *Design Basis Calculations* within the Thickening tab, the Current Equipment summary identified all major equipment related to the thickening process including primary sludge pumps, thickening feed wetwells, GBT feed pumps, centrifuge feed pump, sludge grinder, gravity belt thickeners, thickening centrifuge, thickening blended sludge pump, gravity thickeners, thickened sludge pumps, thickener scum pumps, WAS feed wet wells, GBTs, polymer feed pumps, thickened WAS pumps, sludge holding tanks, sludge dewatering feed tanks, dewatering meet tank mixing system, dewatering feed pumps, WAS polymer feed pumps, dewatering units, and centrifuge cake pumps.

The design parameters are presented next to the equipment information from the R2E2 data. Next to the design information is the future design year calculations for each design year carried over from previous tabs. These calculations were completed by considering sludge flows from the primary clarifiers, WAS from the DPF, and the GBF WAS from the North and South Plant final clarifiers. As detailed in Section 4.7.2. In summary, the majority of the thickening and dewatering equipment is undersized, and operators experience performance issues on a regular basis and therefore further thickening evaluation should be completed to improve thickening processes. Recommendations include developing a more appropriate system of operating sludge processing including:

- Continue Current operation: primary sludge thickened separately, GBF, and DPF WAS combined
- Separate sludge streams: all three sludge streams management separately
- Co-thickening: all sludge streams combined prior to mechanical thickening

4.7.5 Hydraulic Model Capacity Summary

Nothing to report.

4.8 GBF – ANAEROBIC DIGESTION

Within the Gap Analysis spreadsheet, the tab labeled "Anaerobic Digestion" goes through the evaluation and performance of the solid's stabilization process used at the GBF to produce sludge and biogas. This system was installed in 2018 under the R2E2 project. Anaerobic digestion is located on the East side of the site (Figure 4-12). The major process gap is outlined in Table 4-28.

Table 4-28 GBF Anaerobic Digestion Major Unit Process Gap

UNIT PROCESS	MAJOR GAP
Anaerobic Digestion	• Ensuring thickened solids are 6% or greater

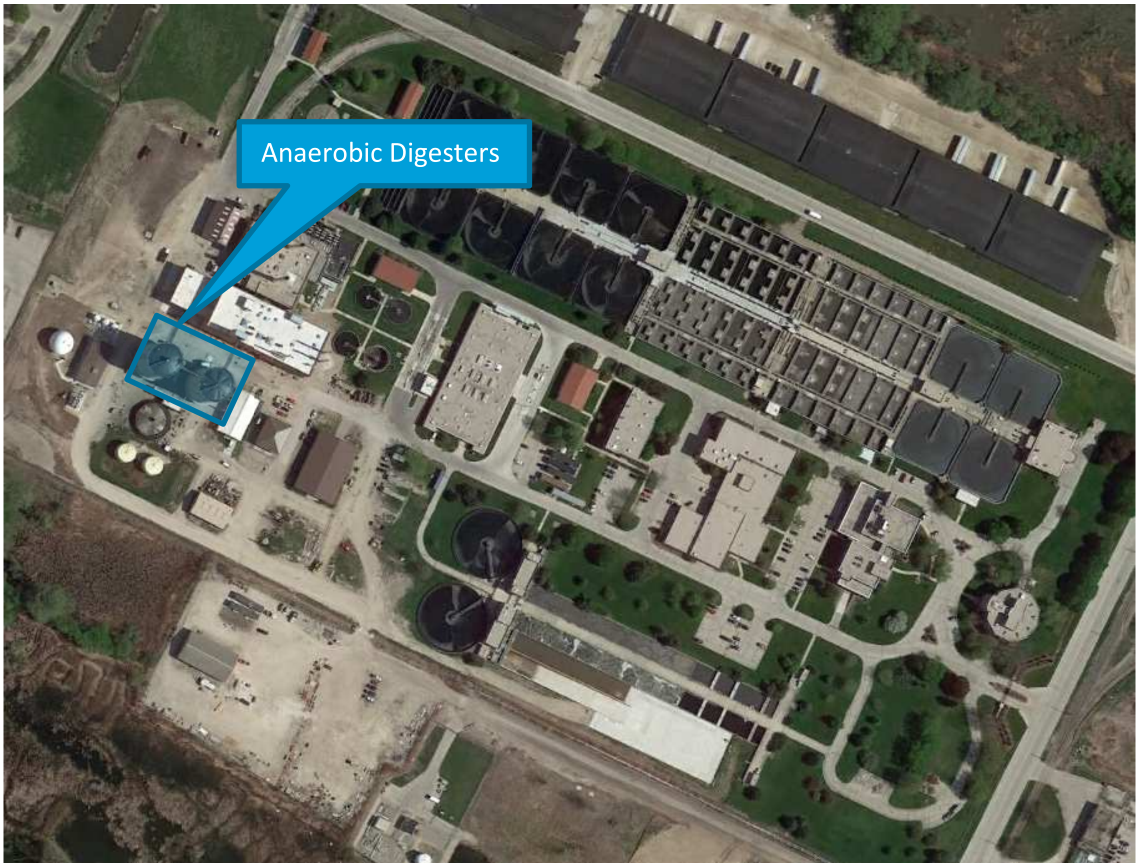

Figure 4-12 Location of GBF Anaerobic Digestion

4.8.1 Site Assessment and Asset management Review Summary

A summary of the identified site assessment and asset management review gaps are presented in Table 4-29.

Table 4-29 GBF Anaerobic Digestion Site Assessment Notes and Deficiency Summary

STRUCTURE	NOTE/DEFICIENCY
Anaerobic Digestion and R2E2 Building	• Grease concentrator undersized at 200 gpm when the flow is really 500 to 600 gpm. Cannot operate skimmer continuously, manually turn to allow scum dewatering. Recommend evaluation and rehabilitation or replacement • Evaluate scum and grease dewatering pumping and disposal – currently cannot pump product to incinerator from oversized pumps with too much make-up water • Plastic and rags destroy mixing pumps • Existing thickening issues cause reduced detention time and volatile solids destruction

4.8.2 Design Basis Capacity Analysis Summary

This summary displays the results of the percent capacity for the anaerobic digesters. The design capacity analysis is based upon the maximum system loading of 235 pounds of volatile solids per 1,000 cubic feet of volume per day per the R2E2 design loading rate. The sludge rate estimates were based on the future peak month thickened sludge loadings for the 2020, 2025, 2030, 2040, and 2070 design years.

The majority of the anaerobic digestion equipment is based upon sizing for the peak month VSS loading and for this system is adequately sized for all years and flows.

4.8.3 Asset Management Gap Analysis Summary

The highest CoF from anaerobic digestion was 4.0 and the highest PoF was 2.0. For this evaluation all equipment (assets) with a CoF and PoF greater than 3.0 were considered critical, for the GBF thickening there were no assets identified as "Desktop" critical and no assets identified as "Field" critical.

4.8.4 Equipment and Capacity Analysis

Under the *Design Basis Calculations* within the Anaerobic Digestion tab, the Current Equipment summary identified all major equipment related to the digestion process including the digester tanks, digester mixing systems, draft tube, sludge recirculation pumps, digested sludge transfer pumps, sludge heat exchangers, hot water recirculation pumps, biogas storage tanks, and booster blowers.

Digestion calculations were completed by considering sludge flows from the primary clarifiers, WAS from the DPF, GBF WAS from the North and South Plant final clarifiers, and HSW. As detailed in Section 4.8.2, the maximum month VSS loading for all years was lower than the 235 lbs VSS/1,000 ft^3/d available for digestion. However, there were a number of issues identified with grit and screenings contamination in the digestion system requiring additional maintenance, repair, and cleaning. Recommendations include an evaluation of the impact of grit and screenings on digestions, VS loading, and biogas production including possible upgrades and rehabilitation.

4.8.5 Process Model Capacity Summary

Anaerobic digester solids retention time (SRT) was simulated for each of the four 10-year dynamic scenarios (i.e., 2020, 2025, 2040, and 2070) at two different thickened solids concentrations: 5 and 6 percent (blue and orange boxes, respectively, Figure 4-13). SRT was calculated using the total volume of both digesters (i.e., 4.4 MG).

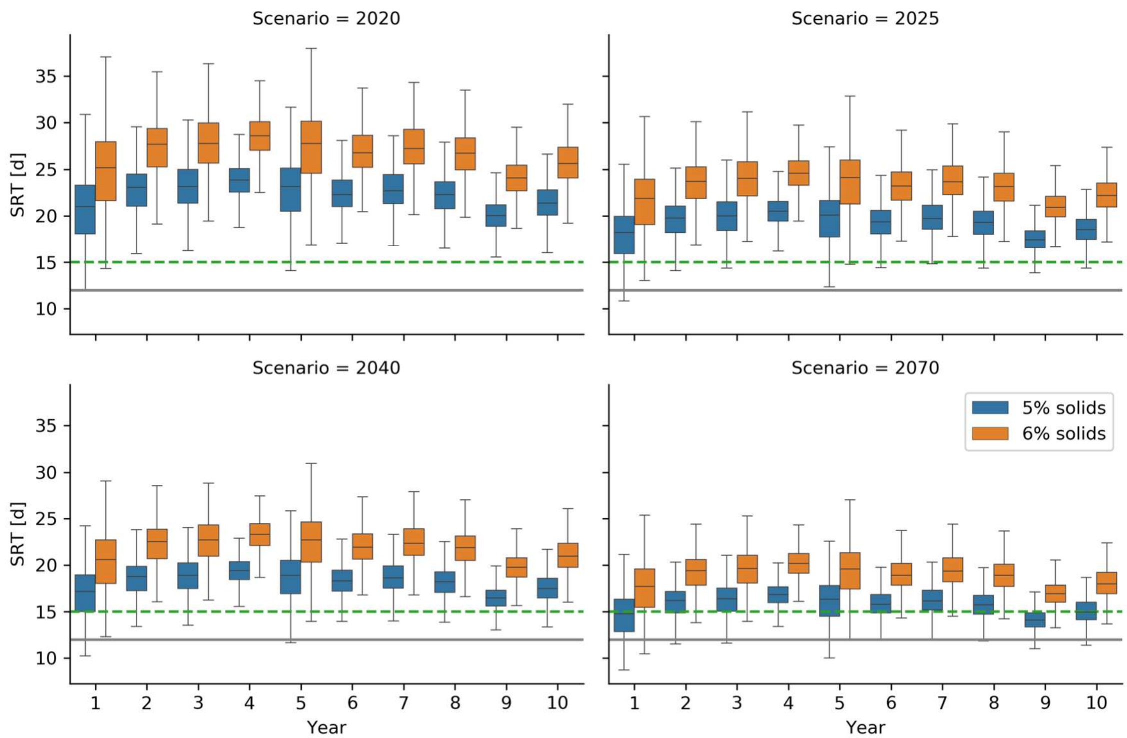

Figure 4-13 Boxplots of 10-Year Dynamic Simulations for Anaerobic Digester SRT.

Each subplot corresponds to a simulation year (i.e., 2020, 2025, 2040, or 2070). Each simulation year was modeled at 5 and 6 percent solids concentration. The green dashed line denotes a 15-d SRT; the gray solid line denotes a 12-d SRT.

Digesters typically require an SRT of 15 days (i.e., maximum month) in order to operate properly, and an SRT of 12 days serving as an absolute minimum. Looking at the 5 percent solids scenarios, digester SRT is above the 15-day limit at least 90 percent of the time across the 10 years for the first three simulations. However, in the 2070 simulation, these SRTs are only above the 15-day limit 25-50 percent of the time, indicating insufficient ability to handle these solids loads. The 6 percent solids scenarios fare better, maintaining SRTs above the 15-day limit through 2070. Based on these results, if incoming solids can be thickened to a sufficiently high concentration, the anaerobic digesters should not be limited based on their current capacity.

Table 4-30 SRT percentiles (90th, 95th, and 98th) for each of the four dynamic scenarios and at 5 or 6 percent solids.

SCENARIO	5 PERCENT SOLIDS			6 PERCENT SOLIDS		
	90th	95th	98th	90th	95th	98th
2020	18.58	17.51	15.79	22.29	21.02	18.95
2025	16.24	15.36	14.08	19.49	18.43	16.90
2040	15.36	14.46	13.23	18.43	17.36	15.88
2070	13.19	12.43	11.43	15.83	14.91	13.71

4.8.6 Hydraulic Model Capacity Summary

Nothing to report.

5 NEW Water Infrastructure Gap Analysis Results and Recommendations

The Infrastructure Gap Analysis Tool provides a summary of each plant in terms of major equipment, process, and hydraulic gaps identified at each facility. The overall purpose is to identify the required improvements needed to bring each facility up to a level of operation that provides improved treatment, reduced operation and maintenance, improved peak flow management, and ease of use for operators. Currently, each plant has some major infrastructure challenges that will require attention in the very near future. The overall gaps have been summarized in terms of capacity and process to identify and recommend solutions to the top issues within each plant.

5.1 DESIGN CAPACITY AND OPERATIONAL SUMMARY

5.1.1 De Pere Facility

Table 5-1 provides a summary of the 2020 identified peak condition, the 2040 peak condition, the rated capacity of each unit process, and the loading basis for each unit process. These are summarized by percent utilization in Figure 5-1 The rated capacity is dependent upon the unit process, which can be dictated by the process equipment capacity, the process requirement, or the hydraulic requirement.

Table 5-1 DPF Unit Process Capacity

UNIT PROCESS	2020 IDENTIFIED PEAK CONDITION	2040 IDENTIFIED PEAK CONDITION	RATED CAPACITY	UNITS	LOADING BASIS
Influent Pumps	53.4	57.3	40.4	mgd	Peak Hour Flow
Influent Screens	53.4	57.3	59.4	mgd	Peak Hour Flow
Preliminary Treatment Units*	52.6	56.4	30.0	mgd	Peak Hour Flow
Activated Sludge	20,662	25,488	38,881	lb/day	Peak month BOD Loading
Intermediate Clarifiers	52.7	55.6	15.7	mgd	Peak Hour Flow, SOR
Intermediate Clarifiers Solids Loading Rate	58,370	64,317	22,907	lb/hr	Peak Day Flow, SLR
RAS Pumping	9.9	11.1	14.4	mgd	Average Day
Final Clarifiers	53	56	37	mgd	Peak Hour Flow, SOR
Final Clarifiers Solids Loading Rate	58,370	64,317	53,689	lb/hr	Peak Day Flow, SLR

UNIT PROCESS	2020 IDENTIFIED PEAK CONDITION	2040 IDENTIFIED PEAK CONDITION	RATED CAPACITY	UNITS	LOADING BASIS
Tertiary Filters**	53	56	18***	mgd	Peak Hour Flow
UV Disinfection	53	56	31	mgd	Peak Hour Flow

* Based on original design for peak flow of 30 mgd
** Existing gravity filters are currently in design phase to be replaced with disc filters
*** Rated capacity with one filter basin out of service and based on 5 gpm/ft^2

Figure 5-1 summarizes the utilization of each process. The greatest limiting processes at the DPF appears to be the influent pumps, the Preliminary Treatment Units, the Intermediate Clarifiers, the Final Clarifiers, and UV Disinfection. Tertiary filtration was not included in the list due to the ongoing disc filter update project. Most of these limiting factors are related to peak flow capacity issues.

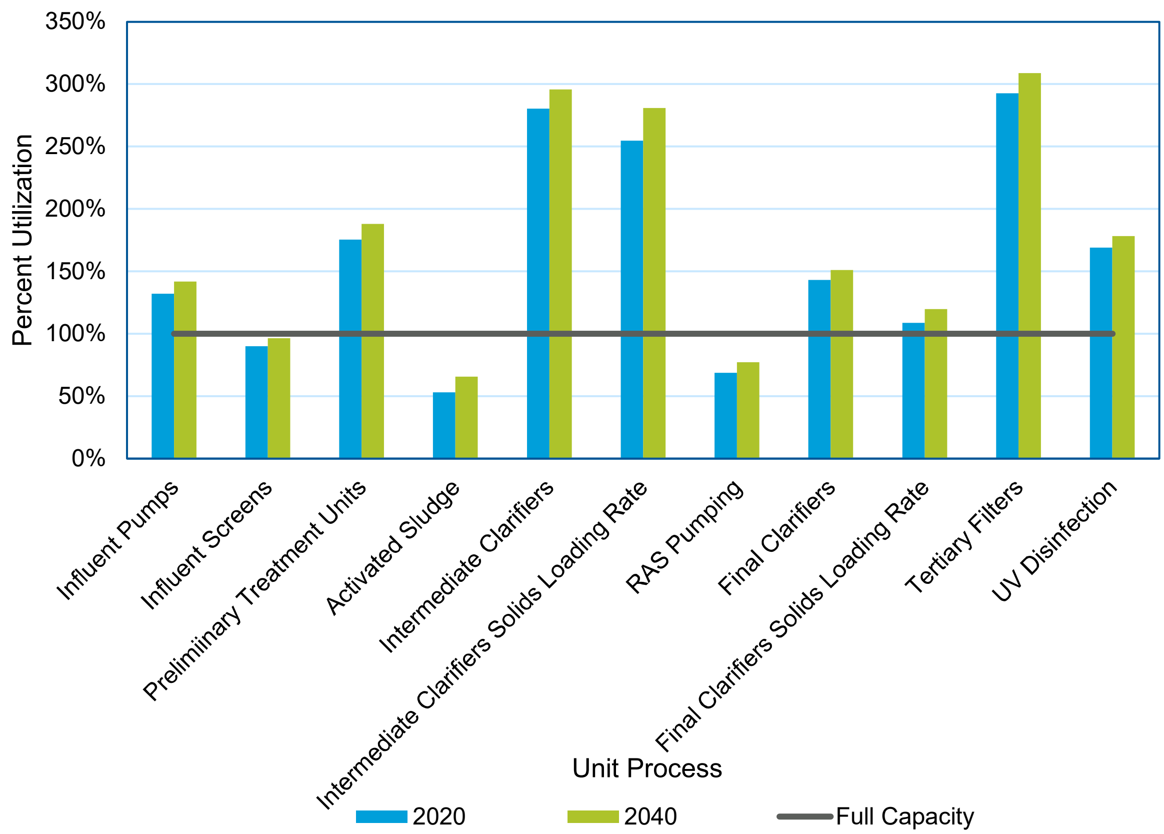

Figure 5-1 DPF Unit Process Utilization Percent

Most of the identified flow conditions (Table 5-2) would not cause significant peak flow management issues at the plant but nearly all unit processes are unable to handle the peak hour flow. The evaluation of the plant capacity based on the peak hour flow to each unit process is presented in Figure 5-2 The rated capacity is depicted by the bars while the peak hour flow rates for are shown by the 2020 (blue) and 2040 (green) expected flows. Therefore, if the bars are below the line the capacity is insufficient to handle the flow. Additionally, the final clarifier capacity is shown by the orange line as it will represent the major limiting process. The overall volume gap of peak flow from the 2040 year and the minimum limiting process was 36.8 million gallons for the intermediate clarifiers. The overall DPF infrastructure gaps are presented in Table 5-3.

Table 5-2 DPF Influent Future Flow and Load Estimates

YEAR	INFLUENT PARAMETER	AVERAGE DAY	MAXIMUM 30-DAY RA	MAXIMUM 7-DAY RA	MAXIMUM DAY	PEAK HOUR
2020	Flow (MGD)	9.5	14.6	17.5	34.2	53.4
2040	Flow (MGD)	11.0	18.4	21.4	38.0	57.3
AVAILABLE CAPACITY	Limiting unit process Intermediate Clarifiers capable of **18.8 mgd** **30.0 mgd** is next limiting process through Primary Clarifiers					

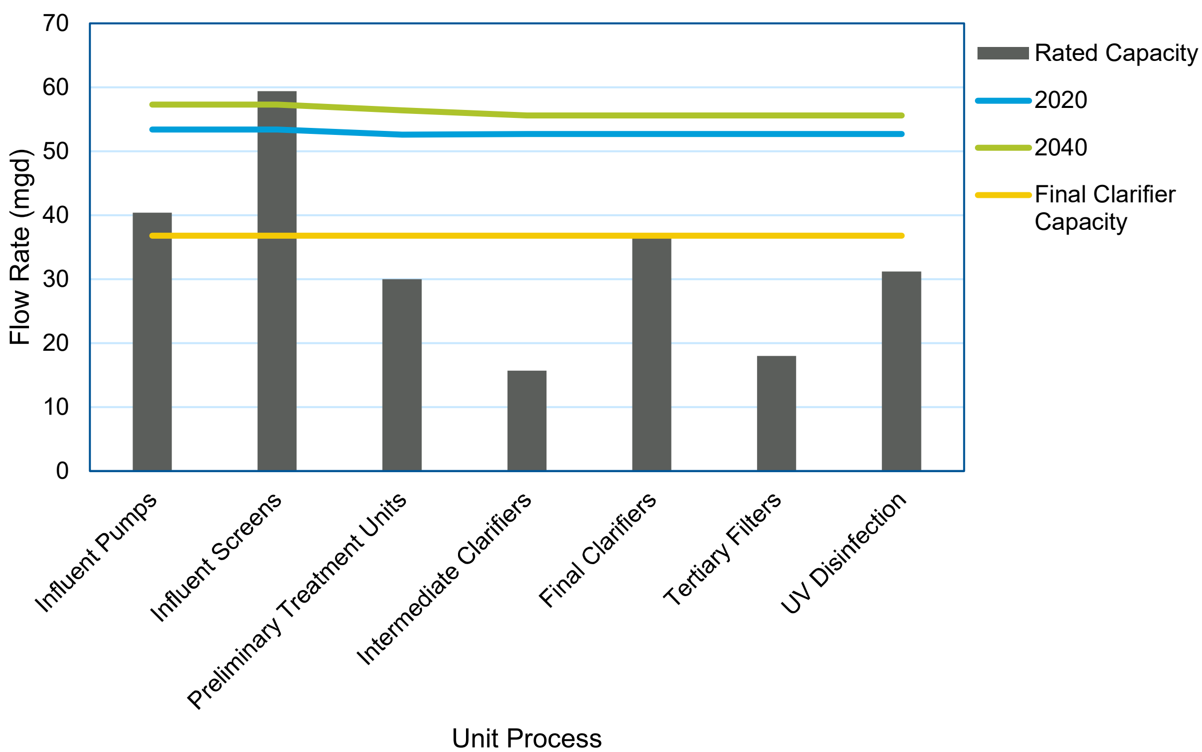

Figure 5-2 DPF Unit Process Flow Rate Capacity

Table 5-3 DPF Infrastructure Gap Summary

UNIT PROCESS	CAPACITY GAP?	OPERATIONS / MAINTENANCE GAP?	ASSET / CONDITION GAP?
Influent Pump Station	Yes Capacity for maximum day, but not peak hour	Yes Have required rebuild in past	Yes Aged
Influent Screens	No	Yes Performance is questionable and allow bypass during peak flow events	Yes
Mill Waste Pump Station	No	No	No
Preliminary Treatment Units*	Yes Capacity insufficient for maximum day or peak hour	Yes Requires concrete rehabilitation, grit handling requires reevaluation, scum pumping clogs	Yes Aged and unreliable
Activated Sludge	Yes Aeration basin volume is undersized. Blowers will exceed 100 percent capacity at the maximum day of 2070 (50-Year)	Yes Operations has solids inventory management deficiency requiring MLSS or 6,000 mg/L for nitrification	Yes Age related replacements will be required for aeration system blowers, control valves, meters, and probes
Intermediate Clarifiers	Yes Capacity limitations, undersized for SLR and WAS pumping	Yes Hydraulic limitations with submerged weirs at peak flows, clarifiers fail often and solids washout, RAS pumps	Yes Equipment upgrades/improvements required, and RAS pumps required rebuild
Final Clarifiers	Yes Undersized for SOR, SLR, and WAS pumping	Yes RAS, WAS, and scum pumping requires improvement	Yes Requires overall rehabilitation
Tertiary Filters**	Yes	No	Yes Aged equipment
UV Disinfection	Yes	Yes Manual gates require significant operations effort during peak events	No

5.1.2 Green Bay Facility

Table 5-4 provides a summary of the GBF 2020 identified peak condition, the 2040 peak condition, the rated capacity of each unit process, and the loading basis for each unit process. These are summarized by percent utilization in Figure 5-3 The rated capacity is dependent upon the unit process, which can be dictated by the process equipment capacity, the process requirement, or the hydraulic requirement.

Table 5-4 GBF Unit Process Capacity Rating Summary

UNIT PROCESS	2020 IDENTIFIED PEAK CONDITION	2040 IDENTIFIED PEAK CONDITION	RATED CAPACITY	UNITS	LOADING BASIS
Metro Influent Pumps	136.8	148.8	121	mgd	Peak Hour Flow
Trash Racks	136.8	148.8	240	mgd	Peak Hour Flow
Influent Fine Screens	141	153.4	110	mgd	Peak Hour Flow
Primary Clarifiers	136.8	148.8	67.9	mgd	Peak Hour Flow
NP Aeration Basin	25,837	37,754	89,412	lb/d	Peak month BOD Loading
NP Final Clarifier SOR	102.6	111.6	96.6	mgd	Peak Hour Flow, SOR
NP Final Clarifier SLR	127,523	139,116	193,216	lb/hr	Peak Day Flow, SLR
NP RAS Pumps	42	48	36	mgd	Average Day Flow
SP Aeration Basin	12,623	16,595	29,304.8	lb/d	Peak month BOD Loading
SP Final Clarifier SOR	34.9	38.0	28.6	mgd	Peak Hour Flow, SOR
SP Final Clarifier SLR	28,628	31,205	57,256	lb/hr	Peak Day Flow, SLR
SP RAS Pumping	15	18	12	mgd	Average Day Flow
Disinfection	137.6	148.4	84.5	mgd	Peak Hour Flow
GBTs	710	893	2250	gpm	Peak Month Flow
Gravity Thickeners Loading Rate	0.385	0.448	0.30	lb/ft^2-hr	Peak Month TSS Loading
Gravity Thickeners Overflow Rate	377	438.802	200	gpd/ft^2	Peak Month Flow
Dewatering Units	139	174	390	gpm	Peak Month Flow
Anaerobic Digestion	104	130	235	lb VS/1000 cfd	Peak Month VSS Loading

Figure 5-3 summarizes the utilization of each process. The greatest limiting processes at the GBF appears to be the influent pumps, the influent fine screens, the primary clarifiers, process operation within aeration, RAS pumping, and disinfection. Another major area of operation limitation is thickening and solids handling.

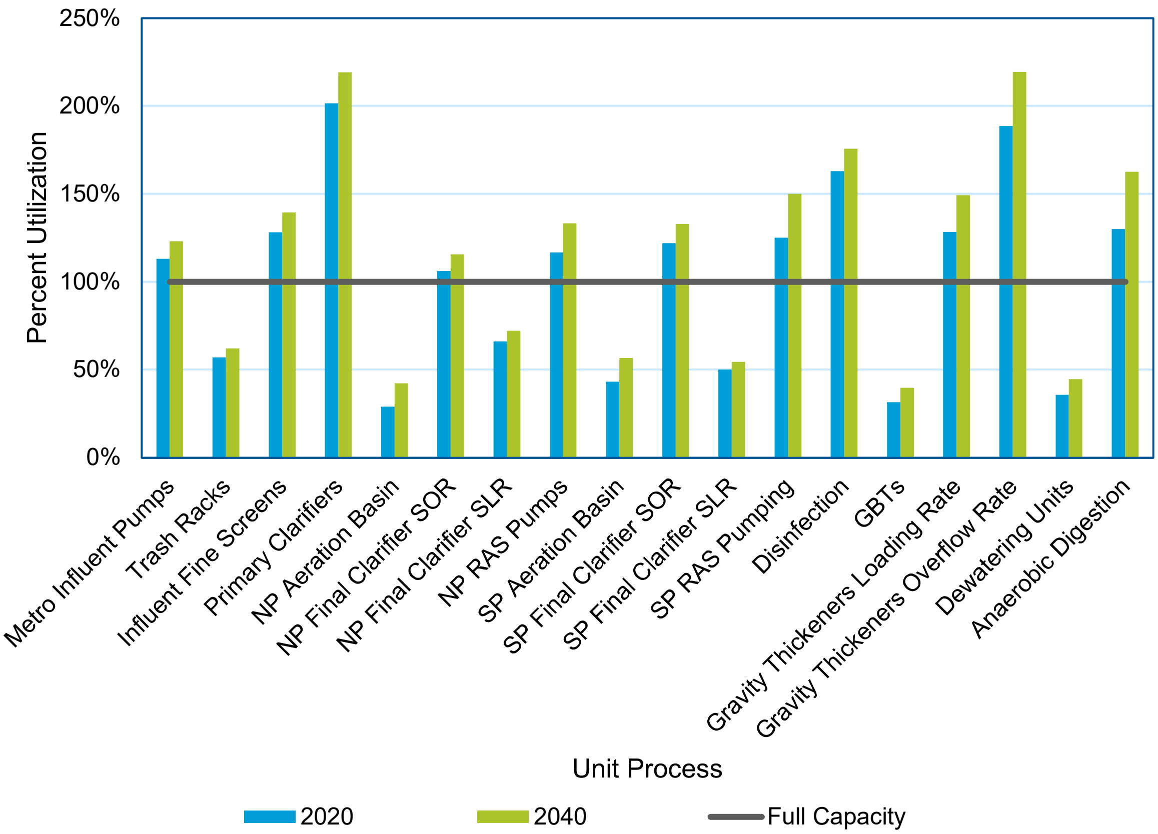

Figure 5-3 GBF Unit Process Utilization Percent

Many of the identified flow conditions (Table 5-5) would not cause significant peak flow management issues at the plant but nearly all unit processes are unable to handle the peak hour flow. Evaluation of the plant capacity based on the peak hour flow to each unit process is presented in Figure 5-4. The rated capacity is depicted by the bars while the peak hour flow rates for are shown by the 2020 (blue) and 2040 (green) expected flows. Therefore, if the bars are below the line the capacity is insufficient to handle the flow. The primary clarifier capacity is shown by the yellow line as it will represent the major limiting process. The overall volume gap of peak flow from the 2040 design year and overall hydraulic capacity of the GBF (140 mgd) is 8.8 mgd. The overall GBF infrastructure gaps are presented in Table 5-7.

Table 5-5 GBF future flow and load estimates including residential, commercial, light industrial, SIUS, HW, and I/I

YEAR	INFLUENT PARAMETER	AVERAGE DAY	MAXIMUM 30-DAY RA	MAXIMUM 7-DAY RA	MAXIMUM DAY	PEAK HOUR
2020	Flow (MGD)	38.6	55.3	64.9	96.8	136.8
2040	Flow (MGD)	43.2	62.8	72.5	104.4	148.8
AVAILABLE CAPACITY	Major limiting capacity is Primary Clarifiers at **67.9 mgd**					

Table 5-6 GBF Unit Process Capacity Rating Summary

UNIT PROCESS	2020 IDENTIFIED PEAK CONDITION	2040 IDENTIFIED PEAK CONDITION	RATED CAPACITY	UNITS	LOADING BASIS
Metro Influent Pumps	136.8	148.8	121	mgd	Peak Hour Flow
Trash Racks	136.8	148.8	240	mgd	Peak Hour Flow
Influent Fine Screens	141	153.4	110	mgd	Peak Hour Flow
Primary Clarifiers	136.8	148.8	67.9	mgd	Peak Hour Flow
Final Clarifiers (North and South)	137.5	149.6	125.2	mgd	Peak Hour Flow
Disinfection	137.6	148.4	84.5	mgd	Peak Hour Flow

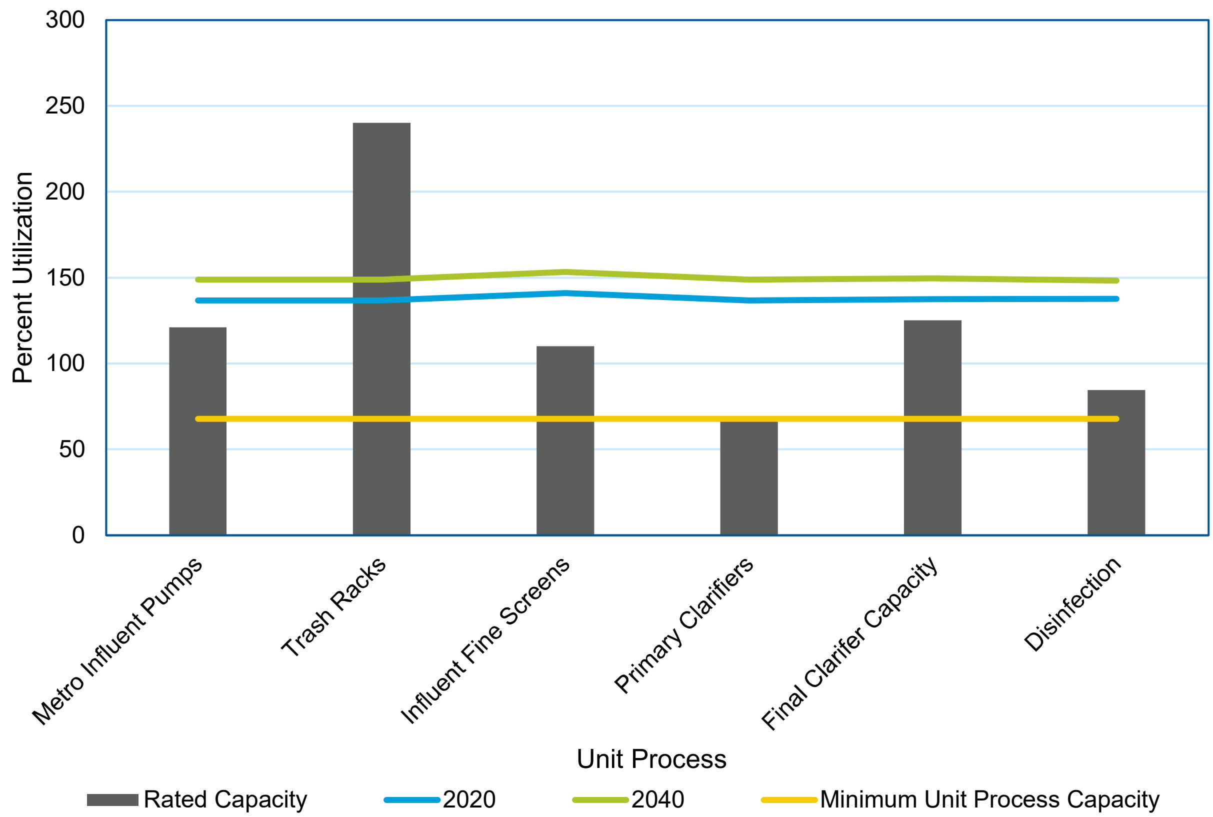

Figure 5-4 GPF Unit Process Flow Rate Capacity

Table 5-7 GBF Infrastructure Gap Summary

UNIT PROCESS	CAPACITY GAP?	OPERATIONS / MAINTENANCE GAP?	ASSET / CONDITION GAP?
Influent Pump Station	Yes Pumps undersized for 2040 design year peak hour flow	Yes Leaking piping and unreliable performance	Yes Aged and deteriorating infrastructure
Headworks	Yes Fine screens undersized with poor performance TeaCups® undersized for design year peak day	Yes Screens and grit removal require additional maintenance via clogging and pump deterioration	Yes Aged and deteriorating infrastructure
Primary Clarifiers	Yes Capacity	No	Yes Aged and condition of mechanisms and launders is of concern

UNIT PROCESS	CAPACITY GAP?	OPERATIONS / MAINTENANCE GAP?	ASSET / CONDITION GAP?
NP Aeration Basins and Clarifiers	Yes SLR to Clarifiers and operating SVI/Settleability in Clarifiers	Yes Leaking aeration piping and requires improved settleability to optimize NP performance	Yes Aged and deteriorating infrastructure, clarifiers require substantial rehabilitation
SP Aeration Basins and Clarifiers	No	Yes Settleability required improvement	Yes Aged and deteriorating infrastructure
Disinfection	Yes Undersized for peak day capacity	NO	Yes Aged and deteriorating infrastructure
Thickening	Yes Undersized	Yes Poor performance and maintenance issues	Yes Aged and deteriorating infrastructure
Sludge Storage	Yes Off-line aeration tanks are used for WAS storage when incinerator is off	Yes Significant manual operations effort required for storing WAS in off-line aeration tanks	No
Anaerobic Digestion	Yes Only if solids are not thickened sufficiently	No	No

5.2 FUTURE USE OF THE INFRASTRUCTURE GAP ANALYSIS TOOL

The gap analysis tool provides NEW Water with an entire system summary with a design basis and equipment list that can be updated and manipulated. The design basis can be used for future plant updates and analysis of processes to ensure proper operation after comparing to actual plant data and can be manipulated to estimate how process changes may impact performance. Additionally, new equipment can be easily added, and analysis figures can be updated to have all equipment information summarized in one location.