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# FACILITY PLAN FOR THE GREEN BAY AND DE PERE FACILITIES

B&V PROJECT NO. 402658



PREPARED FOR

NEW Water
The brand of the Green Bay Metropolitan Sewerage District

Green Bay Metropolitan Sewerage District

FEBRUARY 2022

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# Executive Summary

## Facility Plan Context and Objectives

This Facility Plan presents an evaluation of and recommendations for the NEW Water, the brand of the Green Bay Metropolitan Sewerage District, Green Bay and De Pere wastewater treatment plant facilities. Specific recommendations are provided for the next 20 years along with a 50-year vision to provide long-term context for the recommended improvements. The focus for the Facility Plan was on the liquid processes at both plants. The solids processing assets are relatively new with the Resource Recovery Electrical Energy project. Nevertheless, some recommendations are also included for improvements to the solids processing assets.

The specific objectives for the Facility Plan were as follows:

- ✓ Develop a 50-year vision for the future direction of the treatment facilities that will guide NEW Water investments at both facilities.
- ✓ Perform a holistic analysis of the treatment facilities that considers the relative advantages of the Green Bay Facility and De Pere Facility. The analysis includes an evaluation as to whether De Pere Facility operations should continue or whether all De Pere Facility flows should be pumped to the Green Bay Facility for treatment.
- ✓ Assess gaps in the treatment facilities. Gaps are defined as areas where NEW Water will not be able to meet its future vision because equipment requires replacement, is difficult to operate, or does not have adequate capacity for future flows and loads.
- ✓ Develop alternatives to not only address those gaps, but also provide for increased energy efficiency, increased resource recovery, and increased capacity that position NEW Water to meet future regulations and provide for community growth.
- ✓ Use a Multi-Attribute Utility Analysis to evaluate the various alternatives and then select the preferred alternative. The Multi-Attribute Utility Analysis helps identify preferred solutions given a variety of evaluation parameters.
- ✓ Develop a Capital Improvement Plan from the preferred solutions, assess the financial impact of NEW Water funding the recommended projects, and set an initial plan that balances revenue impacts with prioritized facility needs.

To accomplish these objectives, future flows and loads to both plants were predicted, a hydraulic model and a process model were built for both facilities to determine hydraulic and process limitations, and an infrastructure gap assessment was completed to assess where investments would be needed to meet existing or future capacity requirements, replace equipment reaching the end of its life, and improve operational performance.

Three overall conclusions were reached as described below.

## Conclusion No. 1: It Is Most Cost Effective and Overall Advantageous to NEW Water to Maintain the De Pere Facility

The Facility Plan considered two overall future alternatives for the De Pere Facility:

- Alternative 1: Maintain and Improve the De Pere Facility - Continue investment in the existing De Pere Facility to maintain and expand treatment facilities and at the same time improve its operations.
- Alternative 2: Build a De Pere Pump Station - Decommission the De Pere Facility treatment processes and regionalize treatment at the Green Bay Facility.

Figure ES-1 shows a life-cycle cost comparison of the alternatives. The O&M cost are the indicative O&M costs that would differ between the two options, and not the entirety of cost associated with operating the NEW Water facilities. Alternative 1 would have a substantial cost savings of $120 million over the next 20 years for NEW Water. In addition, the two alternatives were compared more broadly using a Multi-Attribute Utility Analysis that considered environmental, community, operational, and other consequences from both alternatives. As shown on Figure ES-2, Alternative 1 also shows better overall benefits for NEW Water when these broader considerations are considered. Therefore, this Facility Plan recommends maintaining both facilities.

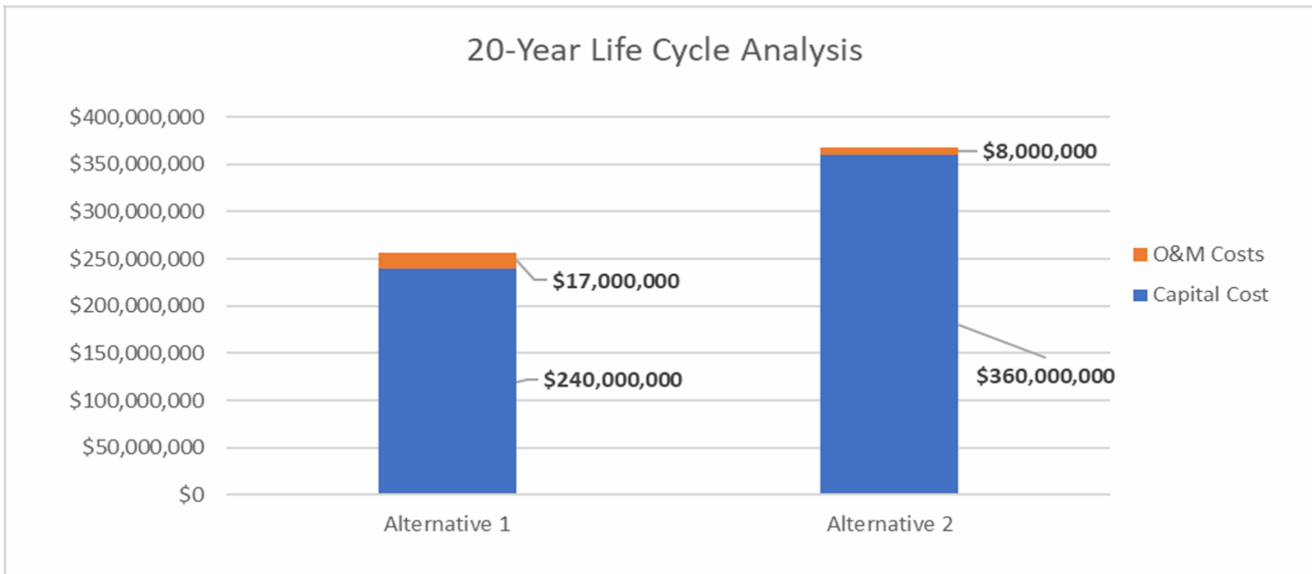



**Figure ES-1 Life-Cycle Comparison of Future De Pere Alternatives**

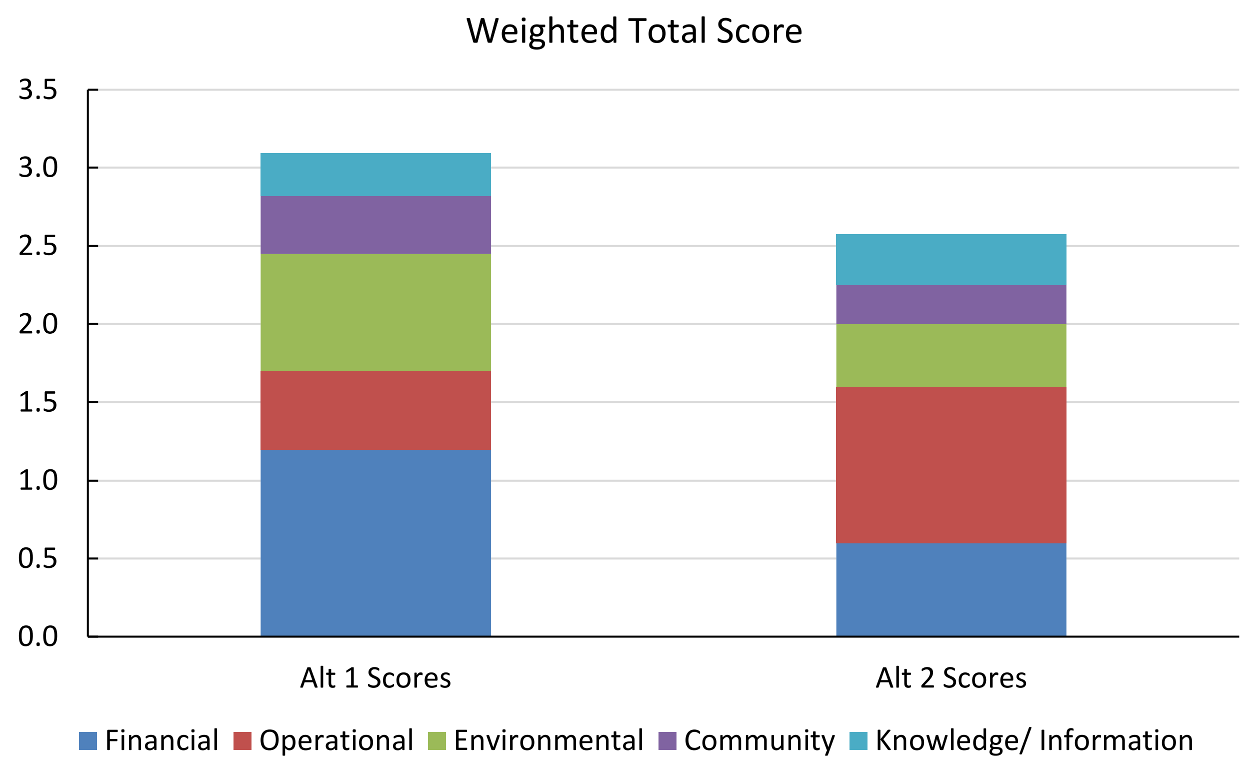



**Figure ES-2 Multi-Attribute Utility Analysis of Future De Pere Facility Alternatives**

## Conclusion No. 2: New Water Needs to Invest Between $260 Million - $360 Million over the Next 20 Years to Meet Its Objectives

Both NEW Water facilities will require significant investment over the coming decades. Much of the infrastructure is over 20-years old and is reaching the end of its useful life. Figures ES-3 and ES-4 show investments needed at both facilities, the cost of those investments, the drivers for those investments, and the target completion year in which those investments need to be made. It is important to note that additional investment is required in the NEW Water interceptor system, but this was not part of this Facility Plan. Attachment A to the Executive Summary summarizes each recommended project. These investments are required for NEW Water to address existing and future flows and loads, meet expected future regulatory requirements, replace aging equipment, and improve existing operational challenges.

These projects were developed through an analysis that considered several different alternatives to select the best suite of infrastructure projects for NEW Water to meet its objectives. Project decisions were made through a series of collaborative workshops with NEW Water leadership and the consulting engineer.

In addition to the costs shown on Figures ES-3 and ES-4, NEW Water estimates that it will need approximately $50 million in simple equipment replacement between 2030 and 2040, primarily associated with equipment installed as part of the Resource Recovery Electrical Energy project, which will be 25 years old by the end of this planning period.

Finally, while not included in the cost range above, possible future regulations for nutrients and disinfection could require still more treatment, and NEW Water needs to consider, and its financial planning needs to provide for, the contingency that these additional investments may be required before 2040. These projects could require another $30 million to $100 million.

## FACILITY PLAN NEAR-TERM IMPROVEMENTS SUMMARY

AT THE GREEN BAY FACILITY

| PROJECT | DRIVERS | CAPITAL COST RANGE (2021$) | TARGET COMPLETION YEAR |
|---|---|---|---|
| Thickening Improvements | Capacity, O&M, Asset Renewal | $14-21M | 2022 |
| Primary Sludge Degritting | O&M, Asset Renewal | $8-10M | 2023 |
| Primary Clarifier Rehabilitation | Asset Renewal, Capacity | $14-20M | 2024 |
| GBF North Final Clarifiers | Asset Renewal, O&M | $21-31M | 2024 |
| Biosolids Handling and Storage | Capacity, O&M | $13-19M | 2025 |
| GBF Headworks and Pumping | Capacity, O&M, Asset Renewal | $30-44M | 2025 |
| GBF Aeration Basin Improvements | O&M, Regulatory, Energy | $4-6M | 2029 |
| GBF Blowers | Asset Renewal, O&M, Energy | $22-33M | 2029 |
| GBF South Final Clarifiers | Asset Renewal, O&M | $8-11M | 2029 |
| Sludge Screening | O&M | $9-13M | 2030 |

**Figure ES-3 Expected Investments Required at the Green Bay Facility**

# FACILITY PLAN NEAR-TERM IMPROVEMENTS SUMMARY

## AT THE DE PERE FACILITY

| PROJECT | DRIVERS | CAPITAL COST RANGE (2021$) | TARGET COMPLETION YEAR |
|---|---|---|---|
| DPF Pumping and Headworks | Capacity, O&M, Asset Renewal | $21-31M | 2024 |
| DPF Final Clarifier and RAS | Capacity, Asset Renewal, O&M | $8-11M | 2025 |
| DPF Aeration Basin Improvements | Capacity, O&M, Regulatory, Energy | $24-34M | 2026 |
| DPF Equalization | Capacity, O&M | $8-12M | 2027 |
| DPF UV Disinfection | Capacity, O&M | $3-4M | 2027 |

**Figure ES-4 Expected Investments Required at the De Pere Facility**

## Conclusion 3: NEW Water Will Need to Increase Its Annual Revenue by Approximately 5.5 to 7 Percent per Year for the Next 10 Years in Order to Fund these Required Projects

A Capital Improvement Plan financial model was developed as part of this Facility Plan to help show the future revenue needed to pay for recommended projects given various assumptions of the growth of other costs for NEW Water outside its capital improvement plan, inflation, interest rates, and the availability of grant funding. Note that the financial impacts of NEW Water's planned interceptor projects were included in this analysis. Table ES-1 summarizes the projects recommended above, their desired completion date, and when they could be completed under various revenue growth scenarios. The desired completion year considered the urgency for equipment replacement and the need to accommodate future flows and loads. Years shown in green indicate the project would be completed within 2 years of the desired completion date. Yellow indicates the project would be completed within 5 years of the project desired completion date. Red shows a delay of more than 5 years beyond the project desired completion date. As shown on Table ES-1, based on assumed increases of annual operations and maintenance costs, annual capital costs (costs used to complete minor projects each year), assumed interest rates and assumed inflation, total revenue increases of approximately 5.5 to 7 percent will be required each year for the next 10 to 15 years to complete all the projects by their desired completion year. These assumptions will be reviewed and updated annually.

**Table ES-1 Comparison of Annual Revenue Increases and Project Completion Dates**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Target Total Revenue Annual Increase | | 3.50% | 4.00% | 4.50% | 5.00% | 5.50% | 6.00% | 7.00% |
| Target O&M Revenue Annual Increase | | 3.50% | 3.50% | 3.50% | 3.50% | 3.50% | 3.50% | 3.50% |
| Annual Minor Project Increase | | 3.50% | 3.50% | 3.50% | 3.50% | 3.50% | 3.50% | 3.50% |
| Assumed Interest Rate | | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% |
| Include Grant Funding? | | No | No | No | No | No | No | No |
| Escalation Percentage | | 3.00% | 3.00% | 3.00% | 3.00% | 3.00% | 3.00% | 3.00% |
| Escalation Start Year | | 2021 | 2021 | 2021 | 2021 | 2021 | 2021 | 2021 |
| MUA Scaling Factor | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Project** | **Desired Year** | **Modeled Year** | **Modeled Year** | **Modeled Year** | **Modeled Year** | **Modled Year** | **Modeled Year** | **Modeled Year** |
| **Near-Term Projects** | | | | | | | | |
| DPF Pumping and Headworks (DPF) | 2024 | 2029 | 2025 | 2024 | 2024 | 2024 | 2024 | 2024 |
| GBF North Final Clarifiers | 2024 | 2031 | 2029 | 2026 | 2025 | 2025 | 2024 | 2024 |
| GBF Primary Clarifier Improvements | 2024 | 2033 | 2030 | 2029 | 2026 | 2025 | 2025 | 2024 |
| GBF Pumping and Headworks (GBF) | 2025 | 2034 | 2034 | 2032 | 2031 | 2030 | 2029 | 2027 |
| GBF Thickening Improvements | 2022 | 2024 | 2024 | 2023 | 2023 | 2022 | 2022 | 2022 |
| GBF Biosolids Handling and Storage | 2025 | 2034 | 2031 | 2029 | 2027 | 2026 | 2025 | 2025 |
| GBF Mill Pumps | 2026 | 2034 | 2033 | 2031 | 2030 | 2029 | 2027 | 2026 |
| GBF Primary Sludge Degritting | 2023 | 2032 | 2030 | 2026 | 2023 | 2023 | 2023 | 2023 |
| GBF Blowers | 2029 | 2039 | 2034 | 2034 | 2034 | 2032 | 2031 | 2029 |
| DPF Final Clarifiers and RAS | 2025 | 2034 | 2032 | 2030 | 2029 | 2027 | 2026 | 2025 |
| DPF UV Disinfection | 2027 | 2038 | 2034 | 2034 | 2033 | 2031 | 2030 | 2027 |
| GBF Maintenance Building | 2027 | 2040 | 2035 | 2034 | 2034 | 2032 | 2031 | 2027 |
| GBF South Final Clarifiers | 2029 | 2040 | 2035 | 2034 | 2034 | 2032 | 2031 | 2029 |
| DPF Aeration Basin Improvements (DPF) | 2026 | 2034 | 2033 | 2031 | 2030 | 2029 | 2027 | 2026 |
| DPF Equalization | 2027 | 2038 | 2034 | 2034 | 2032 | 2031 | 2030 | 2027 |
| GBF Aeration Basin Improvements (GBF) | 2029 | 2039 | 2035 | 2034 | 2033 | 2031 | 2031 | 2029 |
| GBF Sludge Screening | 2030 | 2041 | 2036 | 2034 | 2034 | 2033 | 2031 | 2030 |

For future revenue needs, it is important to consider that after 2034, the existing debt associated with the Resource Recovery Electrical Energy project will be retired, and there will be an increase in available funds to pay for planned projects. The $50 million of costs associated with the Resource Recovery Electrical Energy equipment replace would generally happen after 2034 and so these costs should not significantly impact the revenue increases described above.

The Facility Plan includes several strategies NEW Water can use to potentially reduce expected project costs and defer several projects. These strategies include targeted applied research to better assess how emerging technologies can reduce the costs presented above, deferment of less critical projects, and the potential phasing of projects. Grant funding and achieving lower than planned operations and maintenance expenses in the future will provide more money for capital projects and reduce the required increases in revenue. On the other hand, it is also reasonable to expect that inflation, increasing interest rates, or higher than anticipated operational costs will negatively impact the financial analysis. Therefore, NEW Water believes that the annual revenue increases of 5.5 to 7 percent represent a reasonable base case considering current conditions and the relative ability to predict the numerous variables.

## Recommendations for Future Action

The following recommendations are based on the conclusions of this Facility Plan:

1. The infrastructure gap assessment tools included as part of this Facility Plan should be updated periodically to verify changes in flows and loads, available treatment capacity, and equipment condition.
2. The results of Item No. 1 should be used to update the desired or target completion year for each recommended project in the Capital Improvement Plan financial model.
3. The financial model should then be updated each year to account for current interest rates, inflation, and other factors to reassess the revenue required to support required projects.
4. NEW Water should immediately begin planning and design for the projected identified for the next three years on Figures ES-3 and ES-4.
5. NEW Water should begin a program of focused applied research as described in Chapter 9 to assess how evolving technologies can potentially reduce the cost of its future investments.

# 1.0 Introduction

## 1.1 Scope and Objectives of the Facility Plan

NEW Water, the brand of the Green Bay Metropolitan Sewerage District, collects and treats wastewater from 15 communities in a service area encompassing over 285 square miles with an estimated population of approximately 237,000 in 2019. The NEW Water facilities are composed of the Green Bay Facility (GBF), the De Pere Facility (DPF), the interplant pipelines, industrial forcemain, an intermediate chemical feed building, and the interceptor sewers. The facilities act as a single, integrated collection and treatment system. The NEW Water treatment facilities receive domestic, commercial, and industrial wastewater as well as hauled-in waste (HW) and high strength waste (HSW). NEW Water administers an industrial pretreatment program that regulates industrial contributors.

The scope of this Facility Plan was to assess the long-term needs of NEW Water's two wastewater treatment facilities (Green Bay Facility [GBF] and De Pere Facility [DPF) with an emphasis on the liquid treatment processes. The new biosolids processing equipment installed as part of the recent Resource Recovery Electrical Energy (R2E2) project was evaluated for providing future capacity, but a condition assessment on the R2E2 equipment was not completed. The Facility Plan scope was limited to the two treatment plants.

The Facility Plan objectives were as follows:

- Develop a 50-year vision for the future direction of the treatment facilities that will guide the Facility Plan.
- Perform a holistic analysis of the treatment facilities, considering the relative advantages of the GBF and DPF. Included in the analysis is an evaluation as to whether to continue DPF operations or pump the DPF flows to the GBF.
- Assess gaps in the treatment facilities. Gaps are defined as areas where NEW Water will not be able to meet its future vision because equipment requires replacement, is difficult to operate, or does not have adequate capacity for future flows and loads.
- Develop alternatives to address those gaps that also provide for the increased energy efficiency, increased resource recovery, and increased capacity that position NEW Water to meet future regulations.
- Use a Multi-Attribute Utility Analysis (MUA) to evaluate the various alternatives and then select the preferred alternative. The MUA helps identify preferred solutions given a variety of evaluation parameters.
- Develop a Capital Improvement Plan (CIP) from the preferred solutions.

A successful Facility Plan presents a phased, adaptable, and affordable CIP that best meets the multiple objectives. Several recommended improvements are required regardless of future flow or regulatory conditions and these triggers are noted in the recommendations at the end of the Facility Plan. The other recommended improvements are linked to triggers that will help determine when they need to be implemented. Finally, the Facility Plan provides useful, "living" tools for NEW Water, such as the hydraulic model, the process model, and the Infrastructure Gap Analysis, that NEW Water can continue to adapt to changing conditions.

## 1.2 NEW Wastewater Treatment Facilities

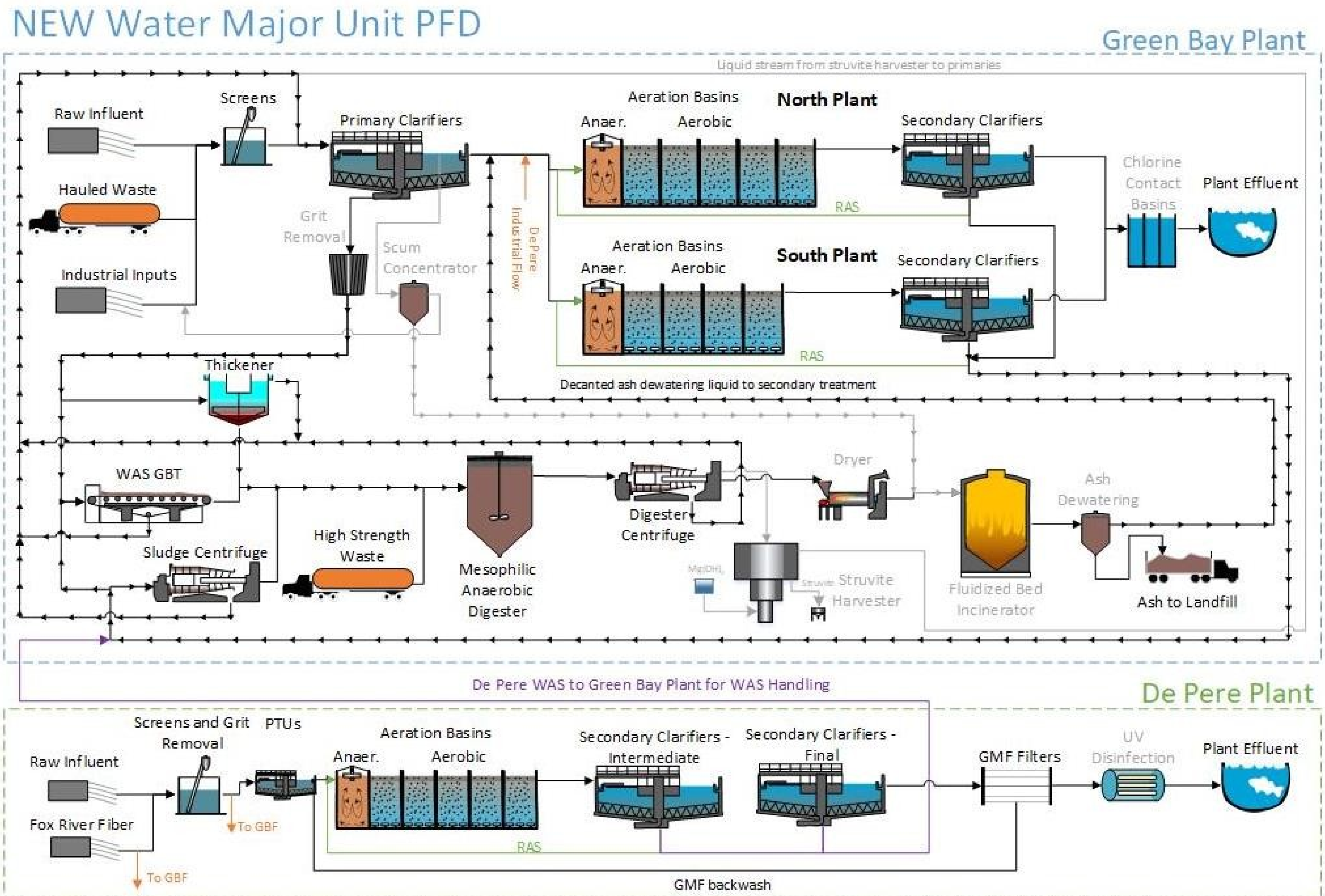
### 1.2.1 Green Bay Facility

The GBF treated an average of 36.6 million gallons per day (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 disinfection with sodium hypochlorite and de-chlorination with sodium bisulfite. The solids handling treatment train includes sludge thickening with gravity belt thickeners gravity thickeners, and thickening centrifuge followed by anaerobic digestion with co-digestion of HSW, centrifuge dewatering, and ending with solids drying and incineration (Figure 1-1). The resulting ash is dewatered and then landfilled. The GBF receives HW, which is screened and discharged to the plant influent and HSW, which is fed to the digesters. Industrial wastewater flows are conveyed to the plant from Procter & Gamble, Green Bay Packaging and Sustana Fiber.

### 1.2.2 De Pere Facility

The DPF treated an average of 8.8 mgd in 2019 of wastewater with a treatment train consisting of screening, influent pumping, grit removal, activated sludge configured for EBPR, intermediate clarification, final clarification, tertiary sand filters, and ultraviolet (UV) disinfection (Figure 1-1). An industrial force main pumps waste from the Sustana Fiber industrial customer to the DPF where it can be treated downstream of grit removal or further pumped to the GBF. Waste activated sludge (WAS) is pumped to the GBF for biosolids processing via a force main. In addition, there is an interplant transfer force main to the GBF, which provides some flexibility to send DPF influent to the GBF interceptor system for treatment at the GBF.

**Figure 1-1 Process Diagrams for the Green Bay and De Pere Facilities**



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## 1.3 Facility Plan Methodology and Outline

The facility planning methodology was built around a five-step process shown on Figure 1-2 and is described as follows.

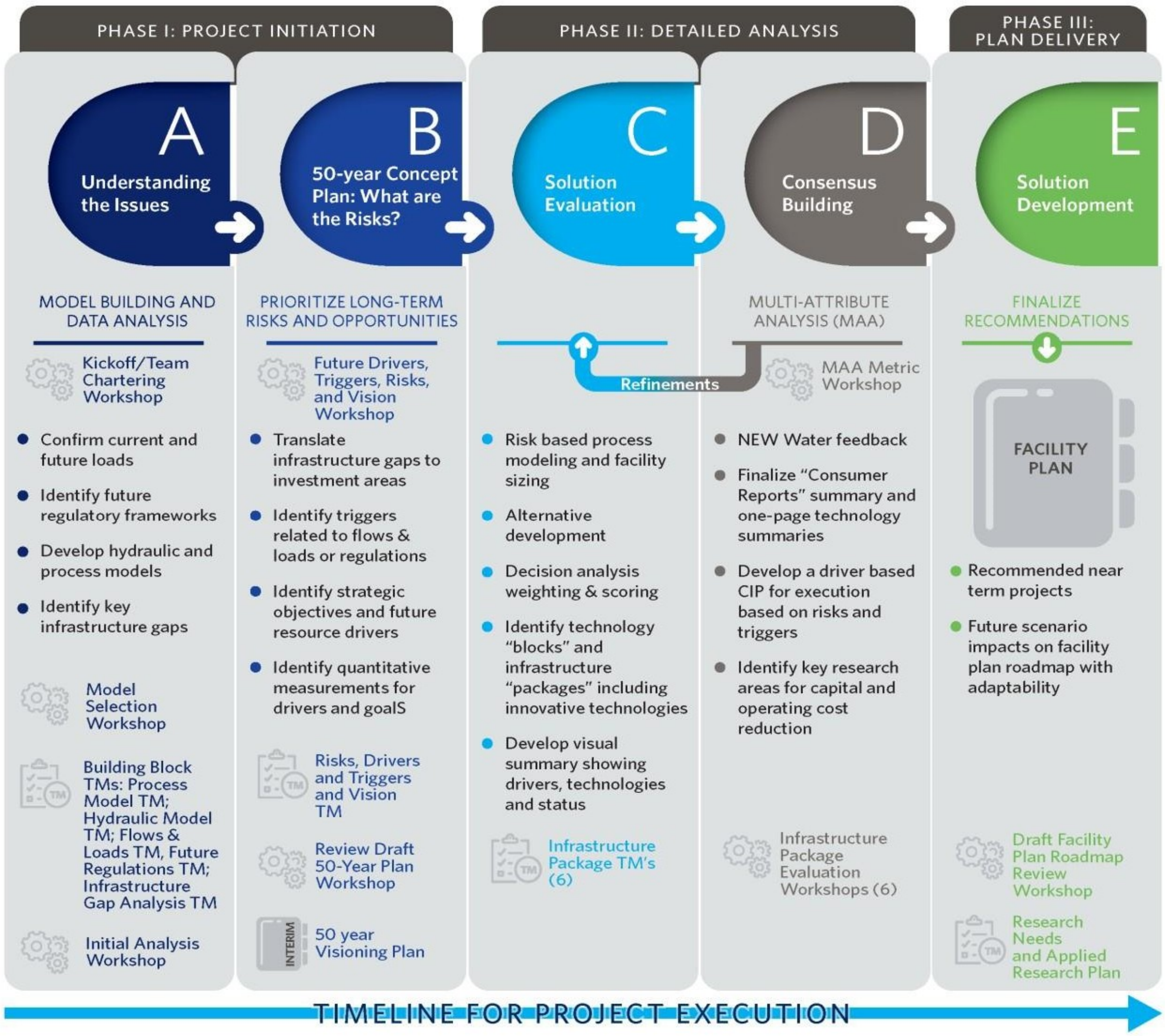


**Figure 1-2 Overview of the Facility Plan Process**

- **Step A, Understanding the Issues**, consisted of several activities and Technical Memorandums (TMs) to develop future flows and loads, develop a hydraulic model for both plants, develop a process model for both plants, assess the future regulatory framework, and present infrastructure gaps, which are areas where investments need to be made to address future flows, replace aging equipment, or improve operations. These TMs are summarized in Chapters 2 and 3 and are referred to as Facility Plan Tools.
- **Step B, 50-Year Vision**, consisted of developing a future, long-term (50-year) vision for NEW Water. The vision set the overall direction for NEW Water and established objectives by which alternatives could be evaluated. The future vision is summarized in Chapter 4.

- **Step C, Solution Evaluation**, consisted of evaluating the GBF and DPF through a series of six TMs that assessed various parts of the plants. The TMs address 1) screening and grit removal, 2) thickening, 3) the long-term plan for the DPF, 4) aeration and nutrient removal, 5) whole plant odor control and 6) energy and nutrient recovery. Chapter 6 summarizes the long-term plan for the DPF and Chapter 7 summarizes the other TMs.
- **Step D, Consensus Building**, involved developing various system wide alternatives around possible solution in the six TMs discussed above and using a multi-attribute analysis to evaluate the various alternatives. The MUA is presented in Chapter 5 and the various system wide alternatives are described in Chapter 8.
- **Step E, Solution Development**, is built on the recommended alternative from Step D and expanded the alternative into a CIP and Applied Research Plan, as described in Chapter 9.

# 2.0 Facility Plan Tools

The purpose of this chapter is to summarize the following three facility plan tools that were developed to support the overall Facility Plan:

- **Future Flows and Loads**. Future flows and loads are developed through the year 2070, but the focus of the Facility Plan is to develop alternatives to meet the expected flows and loads through 2040.
- **Hydraulic Model Development and Analysis**. The hydraulic analysis included development of a hydraulic model and an assessment of where the existing facilities would not be able to manage future flows.
- **Process Model Development and Analysis.** A process model was developed to aid in the analysis of the treatment facilities' ability to meet existing and future flows and loads and to provide NEW Water with a legacy tool by which it can conduct future process evaluations.

## 2.1 Development of Future Flows and Loads

Establishing current and future flows and loadings is a critical first step to every planning process for wastewater utilities. Without agreed upon current conditions and future projections at the start of a planning project, it is not possible to effectively understand infrastructure gaps and develop solutions for the future facilities. Future flow and loading projections were developed for each of the sources described in current conditions: domestic, industrial, and HW flow. I/I was evaluated to determine whether there was significant flow from I/I during wet weather events; the information developed in the current flows and loadings was used to develop future flow and loading planning criteria. **Appendix A – Flows and Loads** presents additional detail on the development of flows and loads.

### 2.1.1 Current Flows and Loadings

Residential and commercial flows (domestic flows) are generated by the public and flow in a diurnalflow pattern that reflects the timing that the water is used within a community, with peaks in the morning and evening hours. The residential and commercial flows typically correlate well with population and, as a result, the flows and loadings are evaluated and developed into a flow and pound per day per capita value. Domestic flow and loading rates were determined from the historical GBF and DPF daily data from January 2015 to December of 2018. This period was selected because it is a representative snapshot of the data to accurately depict the existing conditions and users within the service area. The domestic flows were calculated by subtracting measured Significant Industrial Users (SIUs) flows and HW (GBF only) volumes from the total observed flow and calculating the average. The average flows and loads for each plant were used to calculate the per capita values for future flow projections for the existing user population.

The NEW Water treatment facilities receive wastewater from several SIUs. These major industries are permitted through NEW Water's Pretreatment Program for flow and loadings. The flow comes into the facilities through the raw metro wastewater flow, the interplant force mains, or the direct industrial force main into the plants. At the GBF, Procter & Gamble and Green Bay Packaging flows enter the plant upstream of the screens while Sustana Fiber comes into the plant downstream of the primary clarifiers in the primary effluent flumes. At DPF, Sustana Fiber flows into the facility downstream of grit removal (with the exception of a portion of time during 2017 to 2019). It was assumed that all SIUs are discharging the average flows and loadings daily. To estimate the total pounds per day of loadings, the data for the average day were summed and are assumed to remain constant for future projections. The average flows and loads were subtracted from the total combined flow to estimate the domestic per capita day values for future flow and loading projections (including Sustana Fiber and Proctor & Gamble as the combined flow had included those values).

One new SIU, Green Bay Packaging, recently began contributing to the GBF flow in 2021. The estimated loading rates were provided by NEW Water from an evaluation completed by Jacobs Engineering. There is no growth anticipated for SIUs over the planning period; therefore, the future base loading rates have been included as constant values in future flow and loading estimates.

NEW Water's HW Program works with permitted haulers and serves as a waste disposal outlet for septage and industrial wastes. HW volumes vary greatly, therefore, using the average volume does not fully represent the potential of high-volume days. Additionally, when using the average of the HW volume, 50 percent of the time the volume is greater than the average from 2019. As a result of this variability, the maximum average from 2015 to 2019 was used to reserve daily volume in the treatment process for future flows.

The flow peaking factors for existing conditions at the GBF and DPF were determined based on the maximum average of each time period divided by the average daily value from 2014 to 2018. The flow peaking factors are indicative of a system with historical I/I impact. Therefore, an I/I evaluation was completed as recommended by the Wisconsin Department of Natural Resources and the Environmental Protection Agency (EPA). Flow and precipitation data from 2017, 2018, and from January to June 2019 were analyzed for both infiltration and inflow. For infiltration analysis, flow data collected during the high groundwater periods were used. The average dry weather (ADW) base flow was determined by analyzing a 1 to 2-week period during seasonal high water that was not influenced by rainfall. For the purpose of this analysis, a minimum of 7 consecutive dry days was evaluated year-round for the ADW base flow from May 2017 and June 2018. For infiltration analysis, the average wet weather (AWW) flow was estimated from flow data for a 1-week period where there was significant rain. In addition, high flow events were analyzed to determine the source of the high flow and include those data points in the infiltration analysis.

Results from the infiltration and inflow evaluation detailed in Appendix A (TM 2.1) concluded that infiltration was above the EPA threshold and deemed excessive for the GBF (137 gpcd), but not excessive for the DPF (119 gpcd). Inflow was above the EPA threshold and deemed excessive at both facilities with a flow of 473 gpcd for the GBF and 547 for the DPF.

### 2.1.2 Results - Projected Flows and Loadings

Future flows were estimated using the following two different methods and then compared: population growth and land use projections. The land used evaluation was completed using the 2040 Brown County Sewage Plan, which serves as the area’s Sewer Service Area (SSA) plan.

Flow calculated from population growth and flow from future land use projections (commercial and residential) were compared. The difference in flow projections range from 7.6 to 14.8 percent for the GBF and 6.9 to 18.0 percent for the DPF. The flow data calculated from the more current population estimates from the WDOA were used for future flow estimates for industrial and commercial flow because it was a larger value. Using the population data, it was assumed that the ratio of residential and commercial growth would remain constant, populations in residential locations would be accounted for during working hours at commercial or industrial locations, and future population growth and land use change would be sewered.

The projected flows and loadings for 2020, 2025, 2030, 2040, and 2070 are in Tables 2-1 and 2-2 for the GBF and the DPF, respectively. Flow growth factors (peaking factors) for future flow because of population growth were adapted from the Wisconsin Administrative Code (NR) 110.09(2)(j)4.b. and a new growth peak hour peaking factor of 2.5 was defined for all future growth scenarios. The 2.5 peaking factor was applied to the portion of flow associated with future growth while the portion associated with existing flow used the historical peaking factor of 4.52 for GBF and 6.64 for DPF. The historical loading peaking factors did not change because the per capita loadings are not expected to change with new growth. In addition, Figures 2-1 and 2-2 provide a visual summary of the average daily contributions to GBF and DPF, respectively. It is the assumption that all new growth will have lower I/I and thus should have a lower peaking factor (2.5) as provided in NR 110 for new interceptor sewers and sewage outfall designs. The projected flows and loadings include growth in residential and commercial flows and loadings because of future population growth. HW and SIU flows and loadings were assumed to remain constant for future projections with the exception of adding Green Bay Packaging flows and loads starting in 2025.

**Table 2-1 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 |
| | BOD (ppd) | 42,953 | 58,845 | 64,429 | 113,824 | --- |
| | TSS (ppd) | 54,551 | 76,372 | 117,831 | 288,031 | --- |
| | $NH_3$-N (ppd) | 3,972 | 5,085 | 5,919 | 17,558 | --- |
| | TKN (ppd) | 6,962 | 8,494 | 9,747 | 24,089 | --- |
| | TP (ppd) | 1,147 | 1,618 | 2,054 | 5,496 | --- |
| 2025 | Flow (mgd) | 42.0 | 59.8 | 69.4 | 101.3 | 143.0 |
| | BOD (ppd) | 60,908 | 83,443 | 91,361 | 161,405 | --- |
| | TSS (ppd) | 60,316 | 84,442 | 130,282 | 318,466 | --- |
| | $NH_3$-N (ppd) | 4,618 | 5,911 | 6,881 | 20,412 | --- |
| | TKN (ppd) | 7,763 | 9,471 | 10,868 | 26,860 | --- |
| | TP (ppd) | 1,382 | 1,949 | 2,475 | 6,622 | --- |
| 2030 | Flow (mgd) | 42.7 | 61.5 | 71.1 | 103.1 | 146.3 |
| | BOD (ppd) | 61,786 | 84,647 | 92,679 | 163,732 | --- |
| | TSS (ppd) | 62,122 | 86,971 | 134,183 | 328,003 | --- |
| | $NH_3$-N (ppd) | 4,715 | 6,035 | 7,025 | 20,839 | --- |
| | TKN (ppd) | 7,948 | 9,696 | 11,127 | 27,499 | --- |
| | TP (ppd) | 1,415 | 1,995 | 2,532 | 6,777 | --- |

| Year | Influent Parameter | Average Day | Maximum 30-day RA | Maximum 7-day RA | Maximum Day | Peak Hour |
|---|---|---|---|---|---|---|
| 2040 | Flow (mgd) | 43.2 | 62.8 | 72.5 | 104.4 | 148.8 |
| | BOD (ppd) | 62,471 | 85,586 | 93,707 | 165,549 | --- |
| | TSS (ppd) | 63,532 | 88,945 | 137,229 | 335,448 | --- |
| | $NH_3$-N (ppd) | 4,790 | 6,132 | 7,138 | 21,173 | --- |
| | TKN (ppd) | 8,092 | 9,872 | 11,328 | 27,997 | --- |
| | TP (ppd) | 1,440 | 2,030 | 2,577 | 6,897 | --- |
| 2070 | Flow (mgd) | 47.2 | 72.6 | 82.3 | 114.2 | 167.7 |
| | BOD (ppd) | 67,526 | 92,510 | 101,289 | 178,943 | --- |
| | TSS (ppd) | 73,927 | 103,498 | 159,682 | 390,335 | --- |
| | $NH_3$-N (ppd) | 5,347 | 6,844 | 7,967 | 23,634 | --- |
| | TKN (ppd) | 9,154 | 11,168 | 12,816 | 31,673 | --- |
| | TP (ppd) | 1,626 | 2,292 | 2,910 | 7,788 | --- |

ppd – Pounds Per Day

**Table 2-2 DPF Future Flow and Load Estimates Including Residential, Commercial, Light Industrial, SIUS, and I/I**

| 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 |
| | BOD (ppd) | 20,862 | 31,084 | 36,091 | 54,659 | --- |
| | TSS (ppd) | 17,256 | 35,203 | 45,556 | 81,261 | --- |
| | $NH_3$-N (ppd) | 1,479 | 2,263 | 2,559 | 3,830 | --- |
| | TKN (ppd) | 2,378 | 3,591 | 4,066 | 7,562 | --- |
| | TP (ppd) | 353 | 515 | 610 | 1,132 | --- |
| 2025 | Flow (mgd) | 9.8 | 15.4 | 18.4 | 35.0 | 54.3 |
| | BOD (ppd) | 22,291 | 33,213 | 38,563 | 58,402 | --- |
| | TSS (ppd) | 18,441 | 37,620 | 48,685 | 86,842 | --- |
| | $NH_3$-N (ppd) | 1,585 | 2,425 | 2,742 | 4,105 | --- |
| | TKN (ppd) | 2,555 | 3,858 | 4,369 | 8,126 | --- |
| | TP (ppd) | 374 | 546 | 647 | 1,201 | --- |

| Year | Influent Parameter | Average Day | Maximum 30-day RA | Maximum 7-day RA | Maximum Day | Peak Hour |
|---|---|---|---|---|---|---|
| 2030 | Flow (mgd) | 10.1 | 16.2 | 19.2 | 35.8 | 55.1 |
| | BOD (ppd) | 23,662 | 35,256 | 40,935 | 61,993 | --- |
| | TSS (ppd) | 19,578 | 39,939 | 51,686 | 92,195 | --- |
| | $NH_3$-N (ppd) | 1,687 | 2,581 | 2,918 | 4,369 | --- |
| | TKN (ppd) | 2,725 | 4,115 | 4,660 | 8,666 | --- |
| | TP (ppd) | 395 | 576 | 683 | 1,266 | --- |
| 2040 | Flow (mgd) | 11.0 | 18.4 | 21.4 | 38.0 | 57.3 |
| | BOD (ppd) | 27,442 | 40,889 | 47,475 | 71,899 | --- |
| | TSS (ppd) | 22,714 | 46,336 | 59,964 | 106,962 | --- |
| | $NH_3$-N (ppd) | 1,968 | 3,011 | 3,404 | 5,097 | --- |
| | TKN (ppd) | 3,194 | 4,823 | 5,462 | 10,157 | --- |
| | TP (ppd) | 451 | 735 | 780 | 1,448 | --- |
| 2070 | Flow (mgd) | 14.2 | 26.3 | 29.3 | 45.9 | 65.2 |
| | BOD (ppd) | 41,089 | 61,222 | 71,084 | 107,653 | --- |
| | TSS (ppd) | 34,032 | 69,426 | 89,845 | 160,261 | --- |
| | $NH_3$-N (ppd) | 2,982 | 4,562 | 5,158 | 7,723 | --- |
| | TKN (ppd) | 4,886 | 7,378 | 8,355 | 15,538 | --- |
| | TP (ppd) | 655 | 956 | 1,133 | 2,102 | --- |

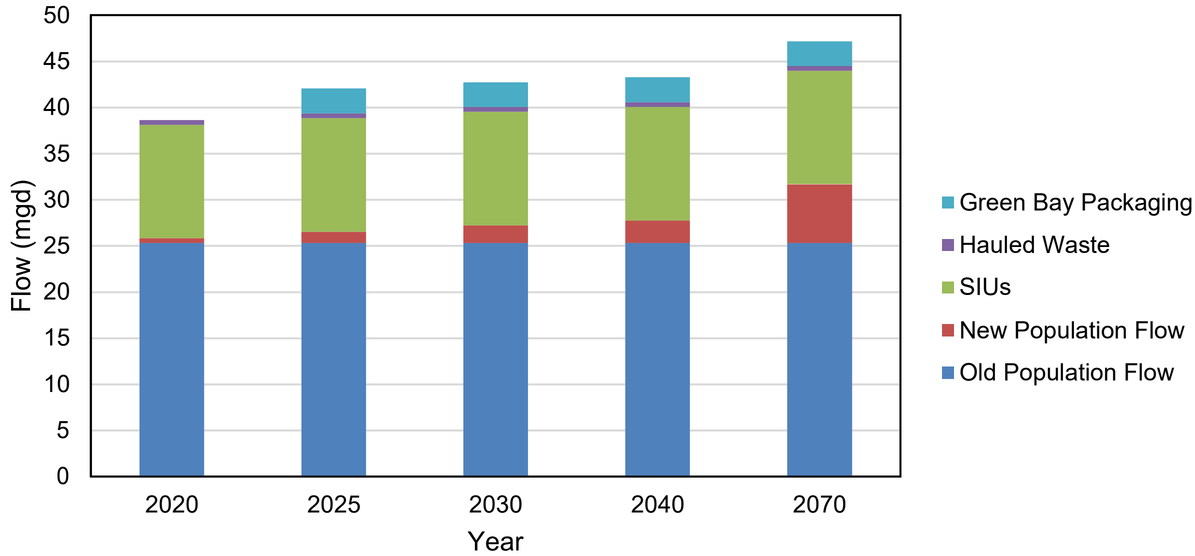


**Figure 2-1 Relative Future Flow Contributions from Each Source to the GBF**

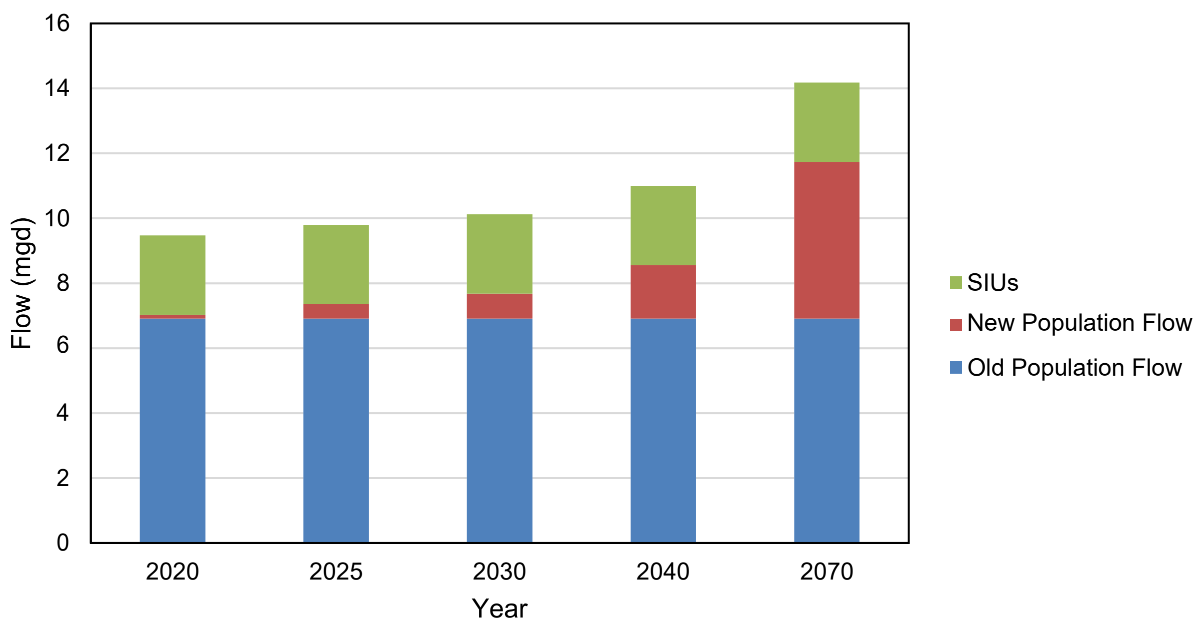


**Figure 2-2 Relative Future Flow Contributions from Each Source to the DPF**

## 2.2 Hydraulic Modeling and Analysis

For the purpose of this Facility Plan, the hydraulic model is a mathematical model of the surface water elevation of wastewater discharged at various flow rates into the NEW Water treatment facilities. The hydraulic models are used during this Facility Plan evaluation to identify process bottlenecks and assess future infrastructure improvements. **Appendix B – Hydraulic Modeling** presents additional detail on the development of the hydraulic model.

### 2.2.1 Methodology

The following three models were used to simulate each facilities' hydraulics: GBF North, GBF South, and DPF. The hydraulic models were developed to simulate flow paths through each facility, calculate hydraulic headloss, and predict water surface elevations at various flow scenarios Field verification was required to confirm that the structures were built as shown in the drawing sets and the flow paths were adjusted to match in the way the NEW Water staff currently operates the facilities.

The hydraulic models were initially created based on the sizes of existing tanks, channels, piping, weirs, and other structures and flow distributions found in existing record drawings. The models were developed in Microsoft Excel with the commonly used Manning's Equation and the Darcy-Weisbach Equation. Physical infrastructure, including pipes, channels, orifices, baffles, gates, weirs, valves, racks/screens, launders, bends, transitions, flow control structures, and any other pertinent hydraulic features are each represented by a calculation element in the model. Relevant headloss equations were applied to each type of element (e.g., the theoretical headloss through a pipe is calculated with different equations than headloss over a weir) to determine the most accurate headloss for each element.

After establishing the headloss calculation through each element, the compilation of all elements allows a user to calculate the hydraulic grade line (HGL), or surface water elevation, along the entire flow path. Models were developed from the most downstream point of each facility to the upstream end because the downstream elements influence the upstream water surface elevations. Theoretically, the energy grade line (EGL) at any element should be the EGL at the element just downstream, plus any losses at the element in question. Therefore, every element is linked to the element just downstream except for in locations of hydraulic breaks (e.g. pump or a weir with an overflow).

Following construction of the model from past drawings, flow scenarios were evaluated. Each flow scenario is represented by a single column in Excel allowing multiple columns, or flow scenarios, to be simulated at once and compared. The models were further refined during the calibration and validation steps using infrastructure verification, flow path verification, and observed operating conditions.

Calibration is the process in which model parameters are adjusted until the model predictions match the selected sets of measured performance data from the facility. The primary objective of calibration is to minimize error between the field measured dataset and model prediction. However, it is important to remember that the objective is not to achieve a perfect fit because the model is a simplified version of the real facility. Over-fitting to one dataset might reduce the total error for that dataset but could reduce the model's overall predictive power and increase error in other flow scenarios.

The goal of the model calibration was to assess the level of agreement between observed plant hydraulic profile and model predictions, determine where and why the model and field measurements do not correlate with a specific element, and then adjust the model accordingly.

It was requested that NEW Water staff gather field verification measurements at all hydraulically significant points for at least two high flow events. Two high flow event data sets are required so one dataset can be used in model calibration while the other data set can be use in model validation. A high flow event was defined as an event above 50 mgd at GBF and above 20 mgd at DPF. Plant staff collected three sets of high flow event measurements; each set provided a full profile of the actual water level through the facilities at the recorded flows. One set was used to calibrate the model while the remaining two sets were used to validate the model.

The model was adjusted by adding “calibration correction” elements to alter the headloss over an element and making note of the changes. It would be impossible to exactly calibrate the model so an accuracy threshold of 4 inches was established. Because of possible variations in measurements from plant conditions and human error (both measuring and modeling), it was assumed that if the model was within 4 inches of the value measured for an element, that element was within the calibration goals and did not require further adjustment. Once the model calibration is complete, at least one independent data set from each facility is required to validate the model and test its predictive power under an alternative flow condition. As previously stated, NEW Water staff returned three sets total, meaning that two sets could be used for validation. This provides additional accuracy for the final model.

### 2.2.2 Results

With all elements calibrated and validated, multiple flow scenarios for future flows can be simulated and evaluated. This will provide guidance on the impact of future flows and possible future projects to be considered to accommodate future flows.

Figure 2-3 depicts the measured water surface levels, compared against the calibrated model’s predicted water surface levels at GBF North at 76.0 mgd. Similarly, Figure 2-4 depicts measured water surface levels compared against the calibrated model’s predicted water surface levels at GBF South at 9.9 mgd, while Figure 2-5 depicts the measured water surface levels compared against the calibrated model’s predicted water surface levels at DPF at 19.3 mgd. Additional calibrations are presented in **Appendix B – Hydraulic Modeling**.

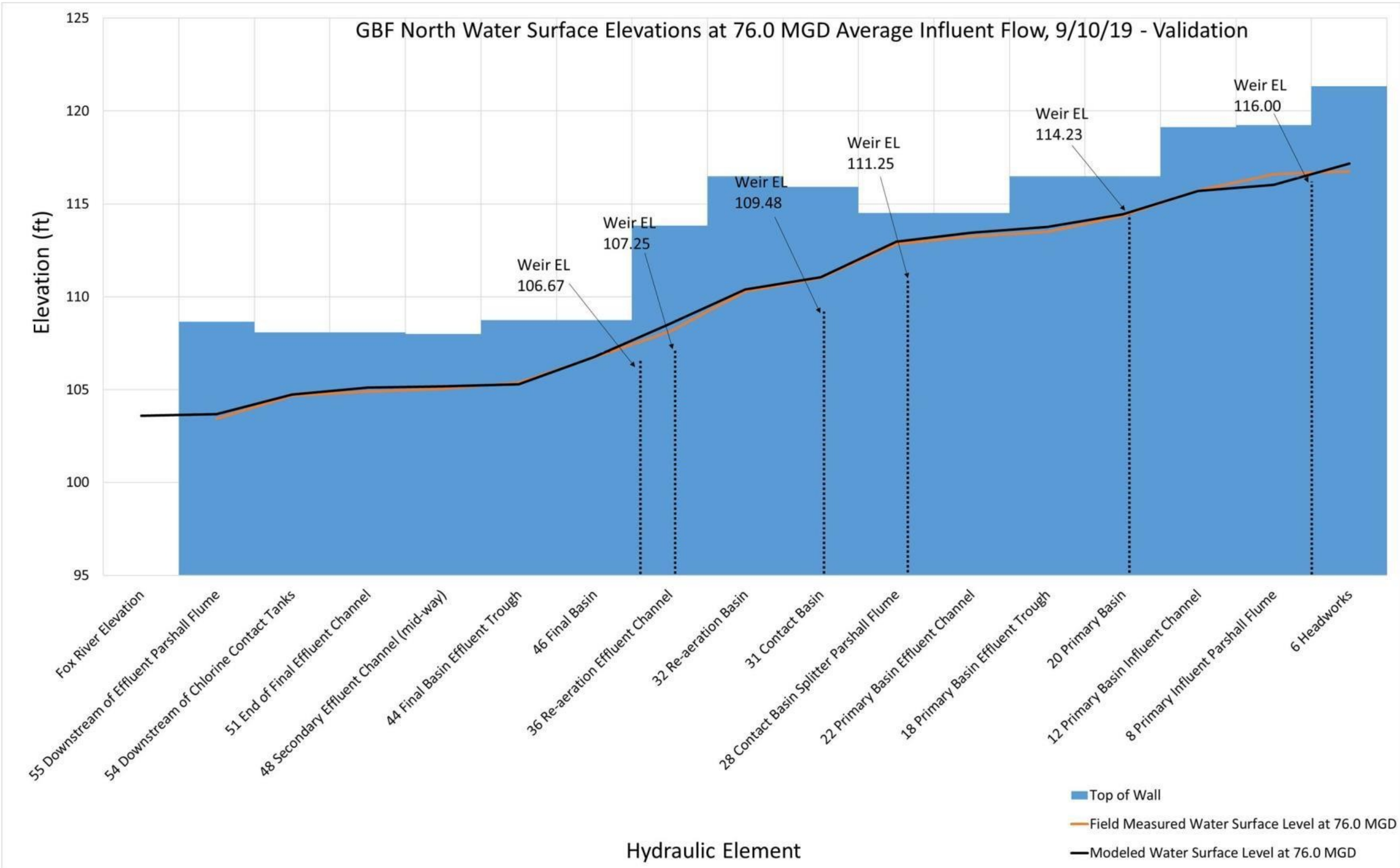


**Figure 2-3 GBF North Hydraulic Profile – Validation at 76.0 mgd**

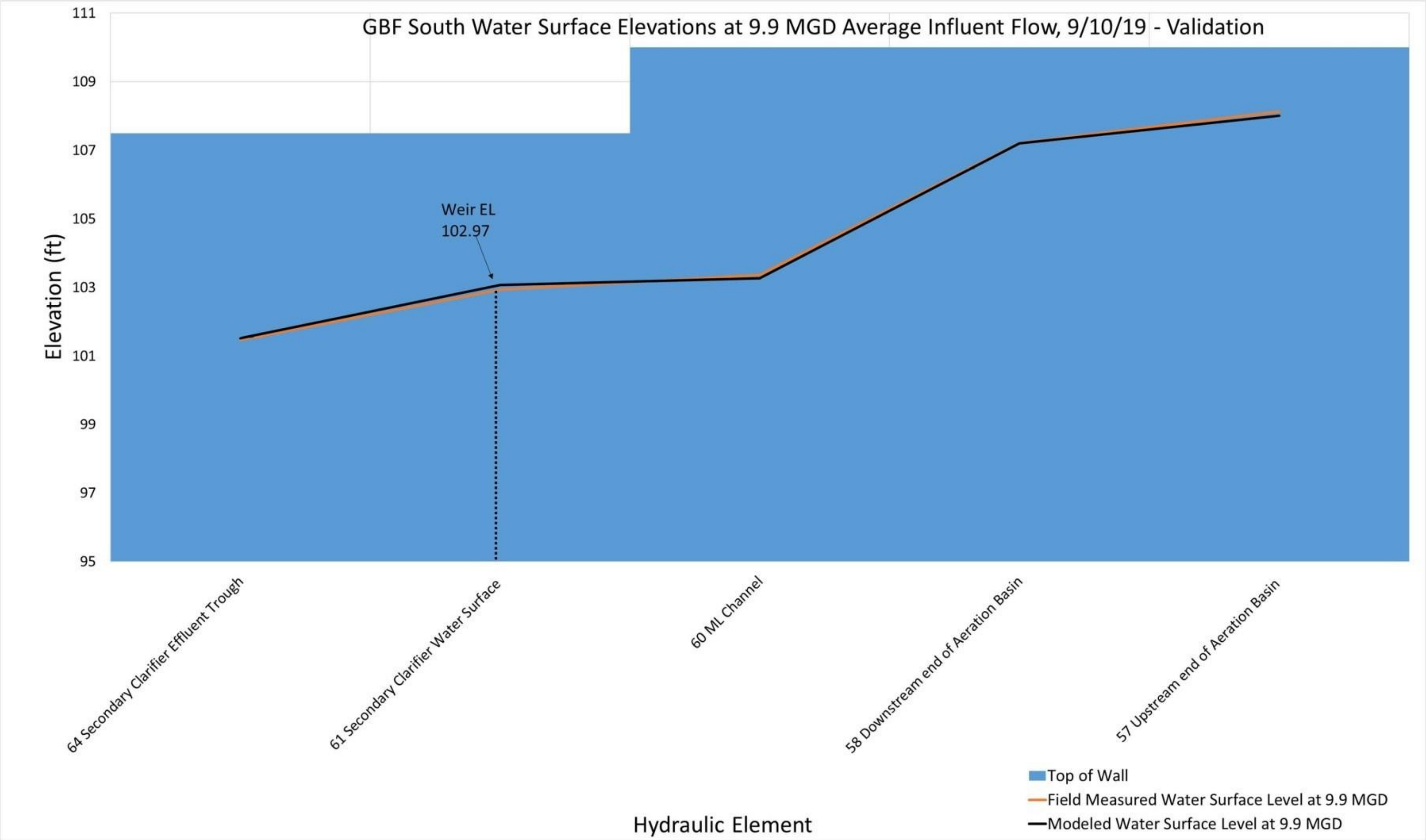


**Figure 2-4 GBF South Hydraulic Profile – Validation at 9.9 mgd**

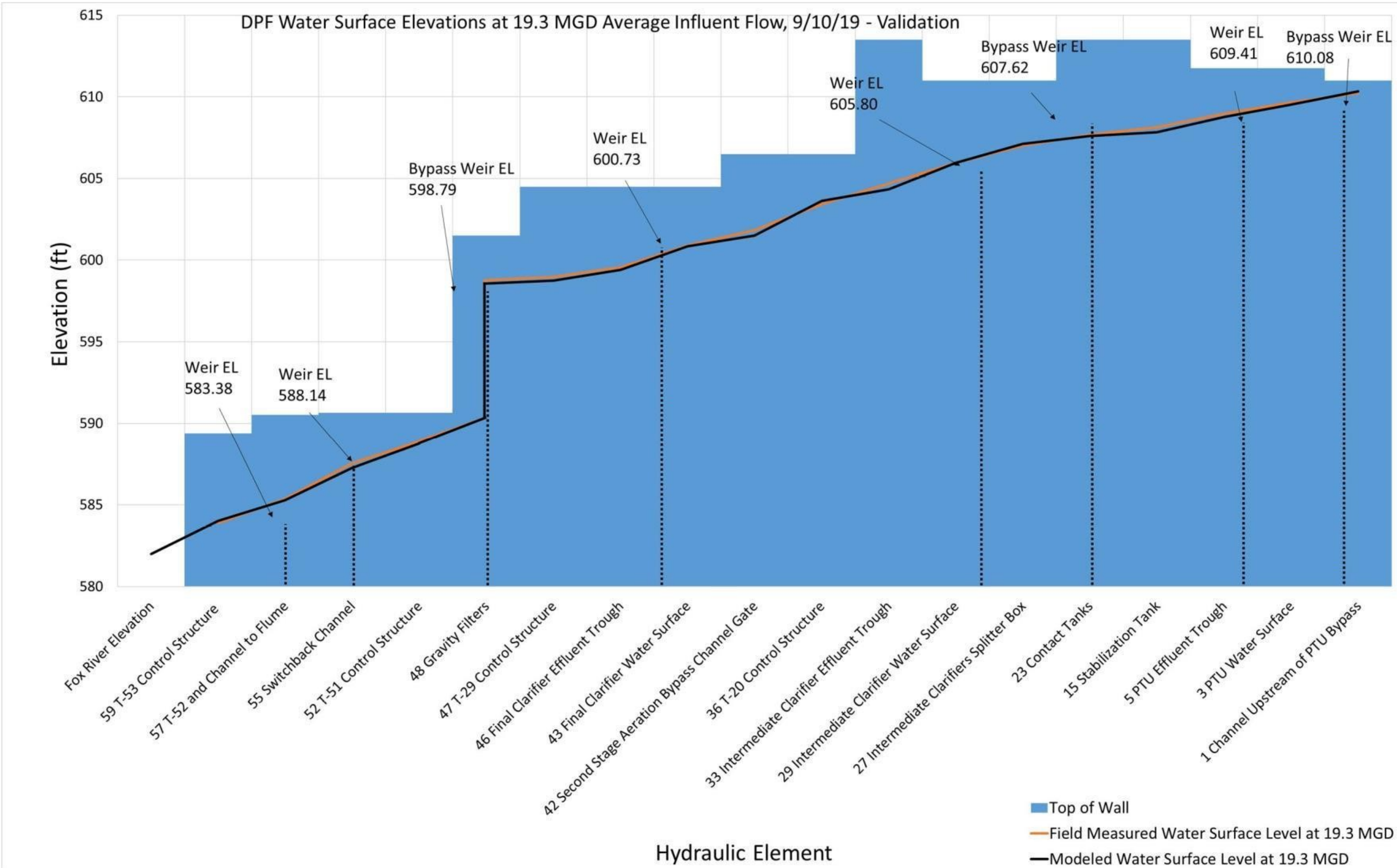


**Figure 2-5 DPF Hydraulic Profile – Validation at 19.3 mg**

### 2.2.3 Hydraulic Limitations

Hydraulic capacity was evaluated and discussed as part of the Infrastructure Gap Analysis TM 2.5. A summary of identified hydraulic limitations from TM 2.5 is shown in Table 2-3 and 2-4.

**Table 2-3 GBF Hydraulic Capacity Limitations Summary from Infrastructure Gap Analysis at Projected 2040 Peak Hour Flow of 148.8 MGD**

| Process | Hydraulic Limitation Description |
|---|---|
| Influent Pump Station Metro Pumps | Metro pumping system has a firm capacity of 120 mgd (with one unit out of service), which does not provide sufficient firm capacity for the projected 2040 peak hour flow of 148.8 mgd. |
| North Plant Primary Clarifiers | Flow through the influent piping of the primary clarifiers at the projected 2040 peak hourly flow of 148.8 mgd exceeds a velocity of 6.0 feet per second and causes a hydraulic bottleneck and risk of wastewater overtopping the influent flume channels. The model predicted any flows over 140 mgd would lead to overtopping of the influent flume channels. |

**Table 2-4 DPF Hydraulic Capacity Limitations Summary from Infrastructure Gap Analysis at Projected 2040 Peak Hour Flow of 57.3 MGD**

| Process | Hydraulic Limitation Description |
|---|---|
| Influent Screens | Configuration of screens and pump station wetwell causes bypassing over bypass weirs at flows above 40 mgd. |
| Influent Pump Station | Metro pumping system has a firm capacity of 40.4 mgd (with one unit out of service), which does not provide sufficient firm capacity for the projected 2040 peak hour flow of 57.3 mgd. |
| Preliminary Treatment Units | Units were originally designed for a peak flow capacity of 30 mgd. The model predicted any flows over 32 mgd would lead to overtopping of channels. |
| Intermediate Clarifiers | The clarifiers do not have sufficient hydraulic capacity. The model predicted the splitter box weirs would be submerged at flows over 32 mgd. |
| Tertiary Filters | Hydraulic capacity expansion is being addressed in current project. New disc filter system will be sized for peak flow of 57.3 mgd. |
| UV Disinfection | The disinfection system was originally designed to treat 25 mgd with a peak flow capacity of 30 mgd. Flow above 30 mgd must be diverted around the system using manually operated diversion gates. |

## 2.3 Process Model Development and Analysis

Development of a usable, reliable facility plan is highly dependent on having a firm understanding of existing conditions and the development of predictive tools for assessing infrastructure alternatives. One of the key predictive tools in a planning project is a process model. Development of a calibrated and validated process model provides key insights when evaluating infrastructure related to activated sludge aeration, biological nutrient removal, and whole plant energy and nutrient balancing. This section presents a summary of the process model selection and calibration. Additional process model details are presented in **Appendix C – Process Modeling**.

### 2.3.1 Process Model Selection

For this modeling effort, the pros and cons of several model simulation packages were considered prior to building the plant layout. Ultimately, the Sumo model platform – a product from Dynamita that is commercially available – was chosen for the following reasons:

- High flexibility for customization because of open-source models.
- Multiple influent characteristics possible.
- Fast simulation speed enables sensitivity analyses.
- Low cost compared to other simulation packages.

### 2.3.2 Process Model Development

The primary objective of this modeling effort was to develop a model that provides whole plant liquid stream treatment mass balances of both NEW Water facilities to enable process engineers to understand the interaction of unit processes and how the various loads move throughout the plants and affect unit processes. The model was built around the processes shown on Figure 1-1 and was used to support the following analysis:

1. Steady-state calibration and validation as well as dynamic validation simulation based on recent historical data.
2. Simulations to evaluate the existing aeration performance and inefficiencies.
3. Simulations of biological nutrient removal alternatives.
4. Simulations to understand whole plant energy and nutrient balances for evaluated alternatives.

For the purposes of this modeling effort, a "Level 3" calibration was considered suitable for a conceptual planning model. Level 3 (as defined in The Water Environment Research Foundation (WERF) report, "Methods for Wastewater Characterization in Activated Sludge Modeling" (2003) calibration supplements historical data with data collected during plant-specific sampling campaign. Modeling projects are generally designed to produce data that are accurate to ±10 to 15 percent. However, different model parameters can be expected to meet different levels of accuracy depending on several factors, including the level of detail, measurement method, dynamic nature of the parameter, and the quality of data.

Both NEW Water facilities were simulated in the same model, along with all the R2E2 infrastructure components. Five separate wastewater influents types were included to represent the various types of influent wastewater observed at the GBF and the DPF. Steady-state model calibration, steady-state model validation, and dynamic validation of the model were completed on three separate data sets. For each condition, a month of data were utilized. Special sampling related to influent chemical oxygen demand (COD) fractionation, influent metal concentration, digester performance, aeration basin performance, and recycle stream nutrients were all included in the model calibration and validation process.

### 2.3.3 Steady-State Calibration

The goal of the model calibration was to assess the level of agreement between observed plant process characteristics and performance (June 2019) and model predictions. The model calibrations generally exhibited a deviation range between predicted and observed performance that was consistent with a Level 3 calibration (i.e., ±10 to 15 percent).

Most of the calibration involved the influent fractions and developing the influent specific fractions required for the various NEW Water influents. Outside of the five influent fractionations, the following parameter adjustments were made:

- Global parameters:
  - Rate of aluminum hydroxide precipitation was adjusted to 0.5 $day^{-1}$ in an attempt to balance liquid stream phosphorus removal performance with observed digester soluble phosphorus.
- Digester-specific parameters:
  - Vivianite precipitation kinetics were adjusted in the digester-specific unit process for the same reason that aluminum kinetics were adjusted. The rate of vivianite precipitation was reduced to 0.001 grams per cubic meter per day ($g/m^3$-day) and the rate of dissolution was increased to 0.1 $g/m^3$-day.
  - Given the unique nature of the NEW Water influents, particularly the industrial influents, the decay of endogenous decay products becomes more critical. The rate of decay for endogenous decay products was increased to 0.07 $g/m^3$-day to match the volatile solids destruction in the anaerobic digester.

### 2.3.4 Steady-State Validation

Once the model calibration was complete, two independent data sets (August 2017 and February 2019) were used to validate the model to test its predictive power. Similar to the steady-state calibration, the steady-state validation results indicate good agreement for the liquid treatment parameters, but variation between modeled and measured values for the solids flow streams did exist. As discussed, it is not unusual for actual solids data to vary from modeled data because solids monitoring is suited for permit compliance and is often less robust for process model calibration. It should be noted that the data from 2017 were simulated in the whole plant model, which included the R2E2 improvements. This would not have a significant impact on overall aeration basin solids balance but would have impacts on nutrients and the net solids production from the facility. This approach was chosen because it is important to understand how the R2E2 facilities will have an impact at past loading conditions.

Key operational parameters and setpoints included the following:

- Two out of the four aeration basin trains in GBF North aeration basins were operating during this time.
- One out of the two aeration basin trains at the GBF South aeration basins were inoperation.

- All WAS flow from GBF and DPF was thickened via the thickening centrifuge.
- Primary sludge assumed to be thickened to a concentration of 4.3 percent.
- One hundred (100) percent of Sustana Fiber flow was processed at the DPF. When reviewing the calibration results, the following key considerations should be acknowledged:
- The model input is in terms of COD, total Kjeldahl nitrogen (TKN), and total phosphorus (TP), and the fractions determine the total suspended solids (TSS) and volatile suspended solids (VSS). The model fractions were not adjusted to best fit the TSS values in the influent, but rather to help understand how representative the fractions are across different time periods. The baseline fractions produce a slightly higher TSS than observed in 2017; however, the overall model results still provide a robust prediction of overall process performance.
- Hauled waste was highly variable, and thus the concentrations chosen to represent the best estimate based on special sampling.
- Primary effluent was well predicted with the model.

### 2.3.5 Dynamic Validation

Understanding dynamic responses of processes are a critical aspect when evaluating potential aeration and nutrient removal improvements. This is particularly important for system like NEW Water, where high variability in influent conditions from industrial sources can have significant dynamic impacts on performance. For dynamic simulations, the daily influent flow, BOD, TKN, and TP values from February 2019 were entered into the model. Key dynamic operational parameters like WAS pumping rates and return activated sludge (RAS) rates were also added on a daily basis to the process model.

Key operational parameters and setpoints include the following:

- Three of the four aeration basin trains in GBF North aeration basins were operating during this time.
- One of the two aeration basin trains at the GBF South aeration basins was in operation.
- All WAS flow from GBF and DPF was thickened via the thickening centrifuge.
- Primary sludge was assumed to be thickened to 4.3 percent.
- Sustana Fiber flow was adjusted to match the reduced flows noted at the DPF in February 2019.
- Based on the monthly ferric chloride added in February 2019, an average ferric chloride flow rate of 533 gpd was included at the GBF upstream of primary clarification. This was a high dosing rate as compared to typical operation for the GBF.

Overall, the dynamic simulation provides a meaningful indication of performance trends and variation. The major challenge with dynamic simulation is that rarely is every fractionation change captured, nor every operational change. The value of dynamic simulation is to provide insight into general trends and variability of the existing process and any potential alternatives.

In summary, the process model was calibrated and validated to the NEW Water specific conditions and is ready to be used for plant simulations.

# 3.0 Infrastructure Gap Analysis

## 3.1 Introduction

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 current capacity of the plant, and the understanding of the current equipment condition, it is not possible to effectively develop infrastructure CIPs. The purpose of the Infrastructure Gap Analysis is to summarize the infrastructure capacity, overall treatment capacity, and major infrastructure condition gaps for the NEW Water Facility Plan through the development of the Infrastructure Gap Analysis Tool, an Excel-based tool that summarizes the existing condition and capacity to treat future flows and loads. The Infrastructure Gap Analysis Tool is intended to be a legacy tool that NEW Water can continually use to track the condition of process equipment and assess its capacity in relation to future flows and loads. Additional detail and documentation, including the Excel tool, is presented in **Appendix D – Infrastructure Gap Analysis.**

The following are the specific objectives of the Infrastructure Gap Analysis:

- Assess the performance of the GBF and DPF, as well as individual unit processes under various future flow and loading conditions.
- Review and update process design capacities under current conditions for the GBF and DPF considering unit process sizing, rated capacities, performance characteristics, mass balance calculations, and applicable code interpretations.
- Review and summarize condition assessment data from NEW Water’s asset management program for the GBF and DPF to assess the condition of the facilities.
- Review the findings from the performance evaluation, capacity assessment, and condition assessment 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.

## 3.2 Infrastructure Gap Analysis Tool

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

- Influent Pump Station (influent pumps, GBF transfer pumps, and screens).
- Mill Waste Transfer.
- PTUs.
- Aeration Basins.
- Intermediate Clarifiers.
- Second Stage Aeration.
- Final Clarifiers.
- Tertiary Filters.
- Disinfection.

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

- Influent Pump Station.
- Headworks.
- Primary Clarifiers.
- NP Aeration Basin and Clarifier.
- SP Aeration Basin and Clarifier.
- Disinfection.
- Thickening.
- Anaerobic Digestion.
- Solids Handling.

### 3.2.1 Infrastructure Gap Summary - De Pere Facility

Table 3-1 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. The rated capacity depends on the unit process, which can be dictated by the process equipment capacity, the process requirement, or the hydraulic requirement.

**Table 3-1 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[2] | mgd | Peak Hour Flow |
| Influent Screens | 53.4 | 57.3 | 59.4 | mgd | Peak Hour Flow |
| PTUs[1] | 52.6 | 56.4 | 30.0 | mgd | Peak Hour Flow |
| Activated Sludge | 20,662 | 25,488 | 24,301 | 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/h | Peak Day Flow, SLR |
| RAS Pumping | 9.9 | 11.1 | 14.4[2] | mgd | Average Day |
| Final Clarifiers | 53 | 56 | 37 | mgd | Peak Hour Flow, SOR |
| Final Clarifiers Solids Loading Rate[3] | 58,370 | 64,317 | 53,689 | lb/h | Peak Day Flow, SLR |
| Tertiary Filters[4] | 53 | 56 | 18[5] | mgd | Peak Hour Flow |
| UV Disinfection | 53 | 56 | 30 | mgd | Peak Hour Flow |

1. Based on original design for peak flow of 30 mgd.
2. Firm capacity with largest unit out of service
3. Loadings are calculated assuming the intermediate clarifiers are off-line.
4. Existing gravity filters are currently in the design phase to be replaced with disc filters.
5. Rated capacity with one filter basin out of service and based on 5 gallons per minute per square foot (gpm/$ft^2$).

Figure 3-1 summarizes the utilization of each process. The limiting processes at the DPF appear to be the influent pumps, PTUs, activated sludge aeration tanks, intermediate clarifiers, final clarifiers, and UV disinfection. While the activated sludge unit process is not significantly above its capacity in 2040, there is no redundancy, even at current loading conditions. This provides a high-risk operating situation for the activated sludge process. Tertiary filtration was not included in the list because of the ongoing disc filter update project that will provide adequate future capacity. Most of the limiting factors are related to peak flow capacity issues.

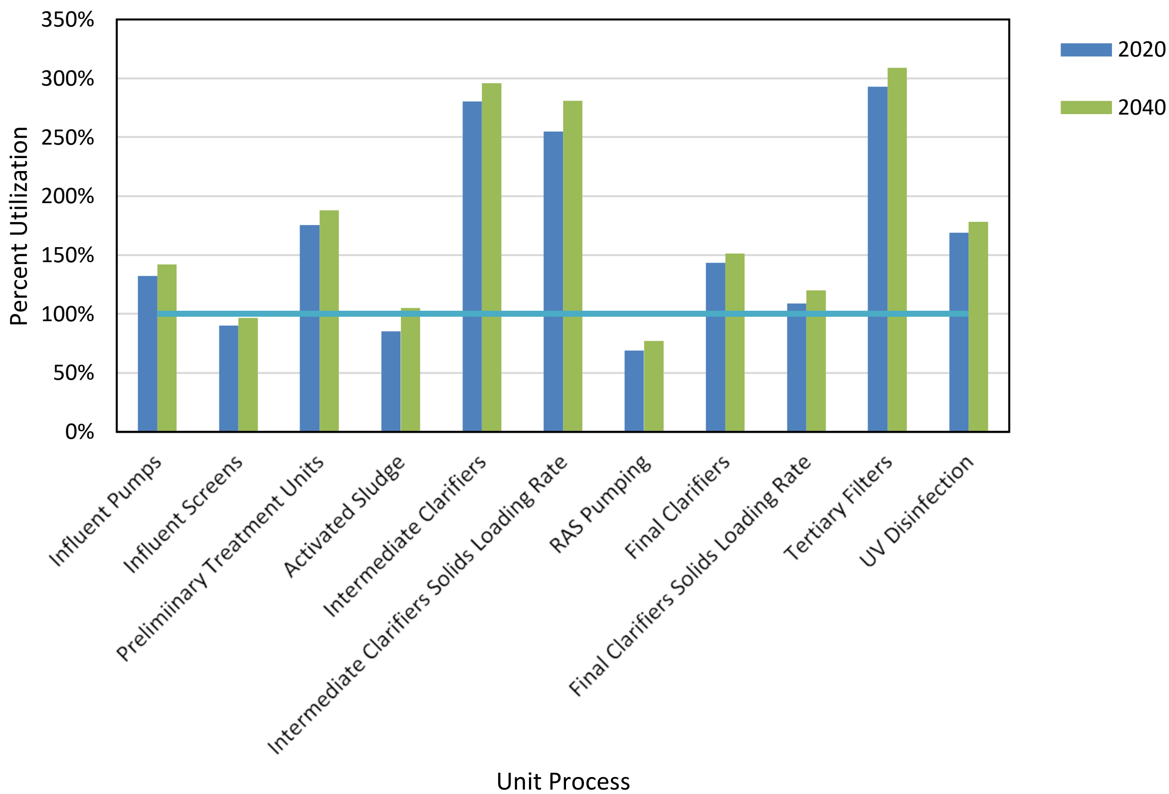


**Figure 3-1 DPF Unit Process Utilization Percent**

Most of the identified flow conditions for the DPF (Table 3-2) 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 on Figure 3-2. 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. If the bars are below the line, the capacity is insufficient to handle the flow. The capacity for the preliminary treatment units and UV disinfection process is shown by the orange line and represents the major limiting process. The overall gap of peak flow from the 2040 year (57.3 mgd) and the minimum limiting process (preliminary treatment units and UV disinfection) was 27.3 mgd (57.3 mgd peak flow minus 30 mgd capacity equals 27.3 mgd). This disregards the capacity limitation in the intermediate clarifiers because they can be bypassed to utilize the available final clarifier capacity. The tertiary filtration capacity is also ignored because this process is currently being upgraded as referenced earlier.

**Table 3-2 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 processes are the preliminary treatment units and UV disinfection capable of 30 mgd. | | | | | |

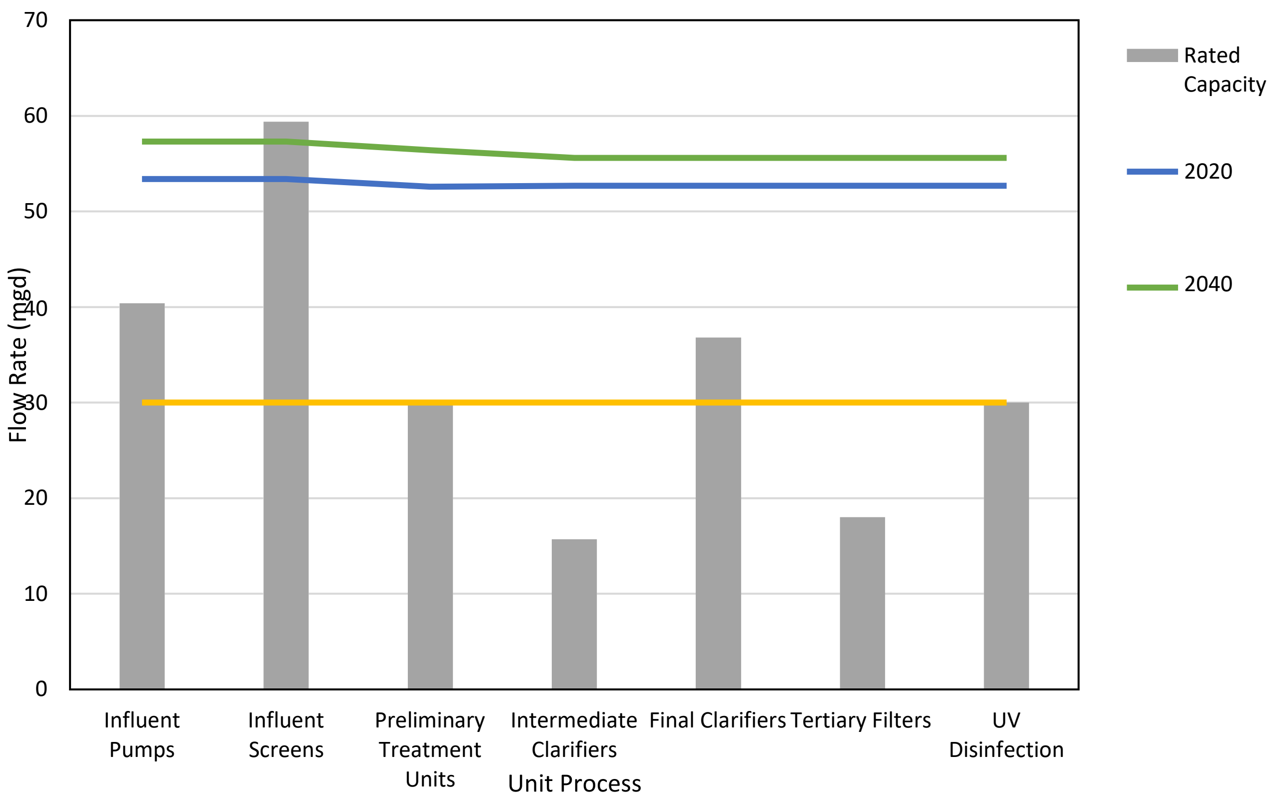


**Figure 3-2 DPF Unit Process Flow Rate Capacity**

The overall DPF infrastructure gaps are presented in Table 3-3 and include the capacity gaps discussed above as well the operations/maintenance gaps and the asset condition gap. Operations/maintenance gaps were assessed through on-site inspection and the asset condition gap was assessed through a combination of on-site inspection and the previously completed NEW Water asset assessment. These GBF gaps are carried into the analysis presented in subsequent chapters and help define the current infrastructure issues that the alternatives need to address.

**Table 3-3 DPF Infrastructure Gap Summary**

| Unit Process | Capacity Gap? | Operations / Maintenance Gap? | Asset / Condition Gap? |
|---|---|---|---|
| Influent Pump Station | Yes<br>Capacity for maximum day, but not peak hour | Yes<br>Have required rebuild in past | Yes Aged |
| Influent Screens | No | Yes<br>Performance is questionable and allow bypass during peak flow events | Yes<br>Poor condition |
| Mill Waste Pump Station | No | No | No |
| Preliminary Treatment Units | Yes<br>Capacity insufficient for maximum day or peak hour | Yes<br>Requires concrete rehabilitation, grit handling requires reevaluation, scum pumping clogs | Yes<br>Aged and unreliable |
| Activated Sludge | Yes<br>Aeration basin volume is undersized. | Yes<br>Operations has solids inventory management deficiency requiring MLSS or 6,000 mg/L for nitrification | Yes<br>Age related replacements will be required for aeration system blowers, control valves, meters, and probes |
| Intermediate Clarifiers | Yes Capacity limitations, undersized for SLR<br>and WAS pumping | Yes<br>Hydraulic limitations with submerged weirs at peak flows, clarifiers fail often and solids washout, RAS pumps | Yes<br>Equipment upgrades/improvements required, and RAS pumps require replacement |
| Final Clarifiers | Yes Undersized for SOR,<br>SLR, and WAS<br>Pumping | Yes<br>RAS, WAS, and scum pumping requires improvement | Yes<br>Requires overall rehabilitation |
| Tertiary Filters | Yes<br>Both process and hydraulic capacity limitations | No | Yes<br>Aged equipment |
| UV Disinfection | Yes<br>Both process and hydraulic capacity limitations | Yes<br>Manual gates require significant operations effort during peak events | No |

### 3.2.2 Infrastructure Gap Summary - Green Bay Facility

Table 3-4 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. The rated capacity depends on the unit process, which can be dictated by the process equipment capacity, the process requirement, or the hydraulic requirement.

**Table 3-4 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 | 120* | 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 | 135.8 | mgd | Peak Hour Flow |
| NP Aeration Basin | 25,837 | 37,754 | 89,412 | lb/d | Max 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/h | Peak Day Flow, SLR |
| NP RAS Pumps | 42 | 48 | 36* | mgd | Average Day Flow |
| SP Aeration Basin | 12,623 | 16,595 | 29,304 | lb/d | Max 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/h | 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 |
| Gravity Belt Thickeners | 710 | 893 | 1200* | gpm | Max Month Flow |
| Gravity Thickeners Loading Rate | 12 | 17 | 40 | $lb/ft^2$-d | Max Month TSS Loading |
| Gravity Thickeners Overflow Rate | 254 | 261 | 760 | gpd/ft2 | Max Month Flow |
| Dewatering Units | 139 | 174 | 260* | gpm | Max Month Flow |
| Anaerobic Digestion | 104 | 130 | 235 | lb VS/ 1000 cfd | Max Month VSS Loading |

Notes:
* Firm capacity with largest unit out of service.
** Facility operates under a disinfection variance for chlorine contact tank size.

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

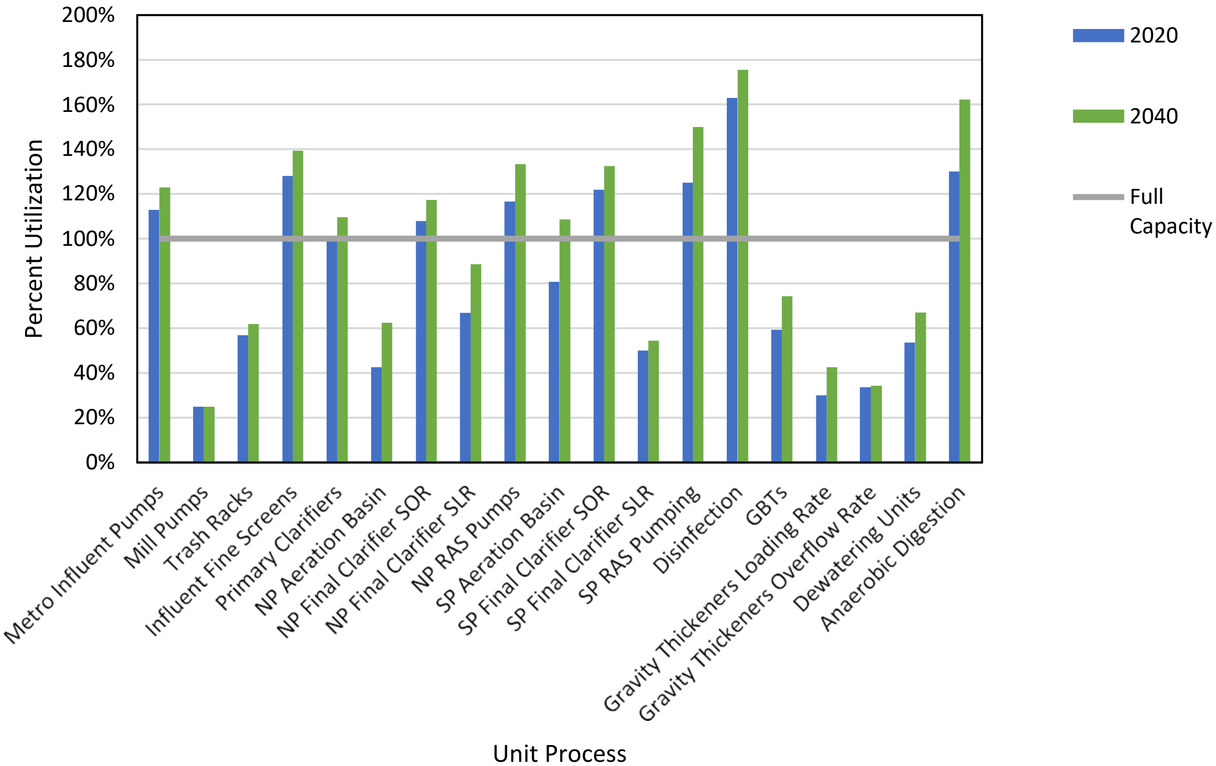


**Figure 3-3 GBF Unit Process Utilization Percent**

Many of the identified flow conditions (Table 3-5) 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 Table 3-6 and Figure 3-4. 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 fine screen capacity is shown by the yellow line and will represent the major limiting process. The overall gap of peak flow from the 2040 design year (148.8 mgd) and the limiting hydraulic capacity of the fine screens (110 mgd) is 38.8 mgd.

**Table 3-5 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 | Unit process limiting capacity is fine screens at 110 mgd. | | | | | |

**Table 3-6 GBF Forward Flow 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 | 135.8 | 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 |

Note: * Facility operates under a disinfection variance for chlorine contact tank size

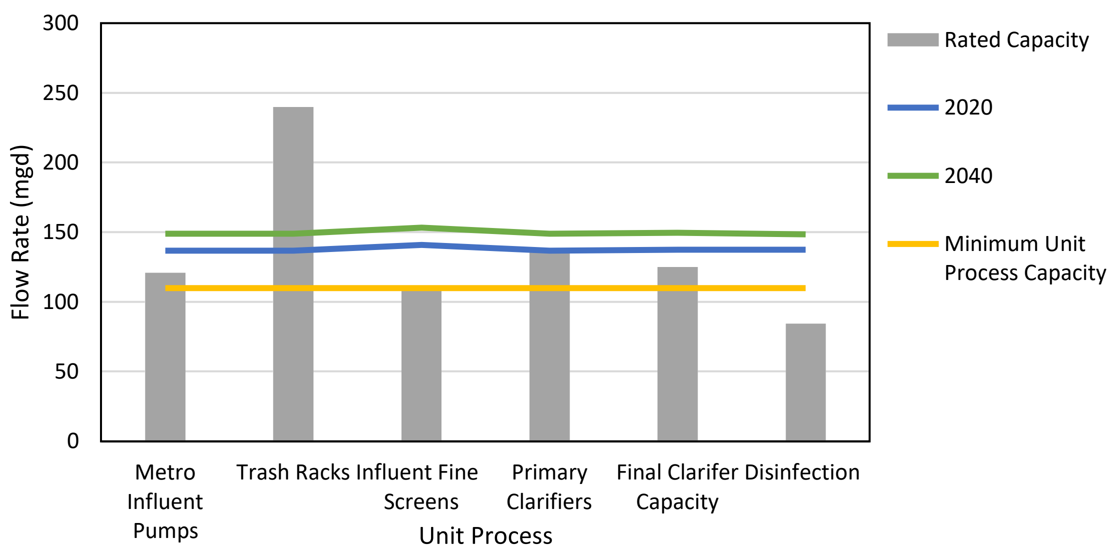


**Figure 3-4 GBF Unit Process Flow Rate Capacity**

The overall GBF infrastructure gaps are presented in Table 3-7, including the operations/maintenance gaps and the asset condition gaps. These GBF gaps are carried into the analysis presented in subsequent chapters and help define the current infrastructure issues that the alternatives need to address.

### Table 3-7 GBF Infrastructure Gap Summary

| Unit Process | Capacity Gap? | Operations / Maintenance Gap? | Asset / Condition Gap? |
|---|---|---|---|
| Influent Pump Station | Yes<br>Pumps undersized for 2040 design year peak hour flow | Yes<br>Leaking piping and unreliable performance | Yes<br>Aged and deteriorating infrastructure |
| Headworks | Yes<br>Fine screens undersized with poor performance TeaCups® undersized for design year peak day | Yes<br>Screens and grit removal require additional maintenance via clogging and pump deterioration | Yes<br>Aged and deteriorating infrastructure |
| Primary Clarifiers | Yes<br>Peak hour capacity at current and future conditions | No | Yes<br>Aged and condition of mechanisms and launders is of concern |
| NP Aeration Basins and Clarifiers | Yes<br>SLR to Clarifiers and operating SVI/Settleability in Clarifiers | Yes<br>Leaking aeration piping and requires improved settleability to optimize NP performance | Yes<br>Aged and deteriorating infrastructure, clarifiers require substantial Rehabilitation |
| SP Aeration Basins and Clarifiers | No | Yes Settleability required improvement | Yes<br>Aged and deteriorating infrastructure |
| Disinfection | Yes<br>Undersized for peak day capacity | No | Yes<br>Aged |
| Thickening | Yes<br>Undersized for intended operating modes at future maximum month conditions | Yes<br>Poor performance and maintenance issues | Yes<br>Aged and deteriorating infrastructure |
| Sludge Storage | Yes<br>Off-line aeration tanks are used for WAS storage when incinerator is off | Yes<br>Significant manual operations effort required for storing WAS in off-line aeration tanks | No |
| Anaerobic Digestion | Yes<br>Only if solids are not thickened sufficiently | No | No |

# 4.0 Achieving NEW Water's 50-Year Vision

NEW Water's vision of "Protecting our most valuable resource, water" is achieved through their work as a "Water resource utility serving Northeast Wisconsin through pollution prevention, operational innovation, and community outreach".

Chapter 3 concluded with specific infrastructure gaps for the GBF and the DPF that the Facility Plan needs to address. While those gaps represent the minimum investments needed to replace aging equipment, improve difficult operations, or meet increased capacity needs, addressing those gaps by themselves will not necessarily meet NEW Water's 50-Year Vision. This chapter summarizes possible future regulatory requirements and other risks and opportunities for NEW Water that this Facility Plan needs to address to help achieve NEW Water's vision.

## 4.1 Expected Future Regulatory Conditions

An important aspect of NEW Water's planning efforts is to be positioned to comply with future regulatory requirements. Table 4-1 summarizes likely regulatory drivers in the next 5 years, 10 years, and long-term. The 5-year and 10-year drivers that will be more significant drivers in this Facility Plan are summarized below.

**Table 4-1 Expected Regulatory Drivers**

| Regulatory Driver | 5-Year Consideration | 10-Year Consideration | Long-Term Consideration |
|---|---|---|---|
| Phosphorus | X | | |
| Suspended Solids | X | | |
| Total Nitrogen | | X | |
| Microconstituents | | | X |
| Microplastics | | | X |
| Water Reuse | | X | |
| Radium | | | X |
| E. Coli | X | | |
| Ash/Biosolids Metal Content (Incineration) | | | X |
| PFAS/PFOA/PFOS | X | | |
| Peak Flows | X | | |
| Thermal Rules | X (NEW Water has ten years to study) | | |
| Chlorides/TDS | | X | |

### 4.1.1 Phosphorous and TSS

NEW Water has invested significantly in planning for lower effluent TP and TSS limits through its efforts on adaptive management an alternative compliance option where improvements are made in urban and agricultural areas of the watershed to reduce TP and TSS in the Sustana and its tributaries. For the Facility Plan, the previously established mass loadings are considered, acknowledging that previously developed plans for tertiary treatment will be required if watershed-based approaches are not successful.

### 4.1.2 Total Nitrogen

To date, no state regulation for total nitrogen concentration limits in wastewater effluent has been set. A key aspect of the NEW Water Facility Plan is identifying a long-term plan for total nitrogen removal. As part of the Facility Plan, solutions to achieve effluent total nitrogen limits of 10, 6, and 3 milligrams per liter (mg/L), acknowledging that a 3 mg/L effluent limit would likely require tertiary treatment or membrane filtration.

### 4.1.3 Water Reuse

Water reuse regulations will not be a major driver for NEW Water. However, improvements related to TP, TSS, and nitrogen removal do have an overall influence on the readiness of effluent water for reuse.

### 4.1.4 PFAS/PFOA/PFOS

Emerging contaminants such as per- and polyfluoroalkyl substances, or PFAS are always a concern for wastewater utilities. Many of these types of compounds require advanced oxidation and adsorptive tertiary processes for true removal from the liquids stream. It is prudent to keep these tertiary facilities in mind for long-term considerations, but likely not justifiable to invest significantly in developing a plan at this point. For biosolids, this is a concern for land application, but not likely a large concern for ash disposal as practiced at NEW Water. NEW Water will continue to monitor the development of the science and regulations around PFAS.

### 4.1.5 Peak Flows

On the EPA's National Pollutant Discharge Elimination System (NPDES)/Municipal Wastewater website, the "…EPA announced in the Federal Register that the EPA is inviting the public to provide input for a new rulemaking related to the management of peak wet weather flows at Publicly Owned Treatment Works (POTWs) treatment plants with separate sanitary sewer systems." This rule would directly apply to NEW Water and considerations for the facility's management of peak flows during wet weather events should be evaluated against the rule determination. All alternatives developed for the facility plan will provide for peak flow treatment by secondary treatment processes.

### 4.1.6 E Coli

The EPA has changed disinfection from fecal coliform to E coli as a measurement for disinfection. The State of Wisconsin has subsequently adopted this requirement and the next WPDES permit will include a requirement for E coli during its disinfection period.

## 4.2 Strategic Plan as Context for the Facility Plan

Meeting likely future regulatory requirements is a necessary part meeting NEW Water's 50-Year Vision, but its vision extends beyond regulatory requirements. NEW Water has a 2019 to 2021 Strategic Plan that guides its actions. The Strategic Plan has its foundations in NEW Water's Organizational Culture.

NEW Water's Cultural Attributes are summarized in Table 4-2 along with the implications for the Facility Plan.

**Table 4-2 NEW Water Cultural Attributes and Relation to the Facility Plan**

| Strategic Plan Cultural Attributes | Implication for the Facility Plan |
|---|---|
| Safety is our most important value. | Safety is a foundational goal and all alternatives that were developed met this goal. |
| We respect and value diverse individuals and values. | All alternatives that were developed were vetted through numerous workshops with a broad cross section of NEW Water staff. |
| One team that communicates openly and honestly while encouraging and supporting one another in achieving common goals. | Alternative screening was done as a collaborative process where multiple viewpoints were articulated and discussed. Customer meetings were held to help educate NEW Water's partners on the value of the Facility Plan and implications for future capital investment. |
| Leaders in the environment are always looking beyond compliance. | Alternatives were developed that assess ways to increase treatment removals, nutrient recovery, and energy savings beyond permit limits. |

The 2019 to 2021 Strategic Plan builds on its cultural attributes with five strategic plan pillars that guide its decision making and investments. These five pillars are shown on Figure 4-1. Each of these strategic plan pillars has strategic goals which were considered in the MUA criteria development (Chapter 5).


**Figure 4-1 The Five Pillars of the NEW Water Strategic Plan (Source: newwater.us/)**

## 4.3 Building on the Strategic Plan

Through May, June, and early July of 2020, a series of four workshops were completed with NEW Water staff,

Dr. James Barnard of Black & Veatch, Dr. Glen Daigger of the University of Michigan, Dr. George Wells of Northwestern University, and the consulting team to further evaluate NEW Water's 50-Year Vision, and risks and opportunities associated with that vision. **Appendix E – Visioning Workshop Materials** presents the workshop materials. The workshops focused on the following materials:

- Workshop No. 1 focused on reviewing the current infrastructure at NEW Water, discussing approaches to long-term planning and future goals for NEW Water.
- Workshop No. 2 discussed the criteria for evaluating the long-term vision for De Pere; some of these criteria were appropriate for the overall Facility Plan MUA criteria.
- Workshop No. 3 discussed the types of alternatives and the approach for evaluating.
- Workshop No. 4 discussed a specific MUA criteria and 50-year vision to identify paths forward for each area.

The risks and opportunities associated with the 50-Year Vision are presented in Table 4-3. These risks and opportunities were considered as part of every alternative infrastructure package to ensure that the current facility plan positioning NEW Water for a range of future scenarios. The risks were specifically evaluated through the MUA process as described in Chapter 5.

**Table 4-3 Long-Term Risks and Opportunities**

| Risk Category | Risk | Likely Response | Facility Plan Opportunity |
|---|---|---|---|
| Regulatory | New effluent compounds | Tertiary treatment/ membrane filtration | Maintain site footprint, consider as part of DPF improvements |
| | Effluent nitrogen limits | Aeration basin modifications | Develop plan for basin modifications |
| | Microplastics | Tertiary treatment/ membrane filtration | Maintain site footprint, consider as part of DPF improvements |
| | GHG emissions regulations | Reduce use of non-renewable energy | Prioritize alternatives that reduce net energy use |
| | New pathogen categories | Elimination of blending; multi-phase disinfection | Maintain flexibility for multi-barrier disinfection |
| | Chlorides/TDS limitations | Source reduction; advanced filtration | Maintain site footprint, consider as part of DPF improvements |

| Risk Category | Risk | Likely Response | Facility Plan Opportunity |
|---|---|---|---|
| Aging Infrastructure | Concrete failure | Repair and maintain | Plan for concrete rehabilitation in all projects |
| Shift in industry/ demographics | Significant reduction in organic loading | Reduction in dry weather hydraulic capacity needs | Phased implementation of organic loading projects |
| | Decreased water usage from conservation | Optimization of basin operation | Identify alternatives the provide operational flexibility |
| | Rapid population growth | Expansion of facilities | Maintain expansion flexibility |
| | Shift to residential wastewater flows | Reduced organic strength of wastewater | Phased implementation of organic loading projects |
| Climate change | Intense weather patterns | Increased wet weather flow treatment | Prioritize improvements that improve wet weather treatment |
| Community changes | Increased demand for reuse water | Tertiary treatment/ membrane filtration | Maintain site footprint, consider as part of DPF improvements |
| | Neighbor impacts, gentrification | More odor control, less noise, | Maintain site footprints |
| Workforce | Workforce availability (technical skill set) | Alternatives that provide simplified operation | Focus on human intervention requirements of alternatives |
| | | Reduced human interaction | |

# 5.0 Multi-Attribute Utility Analysis

One of the Facility Plan objectives noted in Chapter 1 was to use an MUA to evaluate alternatives. An MUA is an evaluation tool that allows for considerations of a variety of criteria in evaluating alternatives so that alternatives are selected that best incorporate principles of the NEW Water Strategic Plan and best address the risk and opportunities described in Chapter 4. NEW Water has used MUAs for both planning level and design decisions over the past several years. This chapter presents how the MUA was developed to support alternative evaluation for this Facility Plan.

**Appendix F – Multi-Attribute Utility Analysis** presents a more detailed discussion of how the MUA was developed.

## 5.1 Supporting Information for the MUA

MUA criteria need to be based on the long-term vision and overall strategic direction and values of an organization. Thus, they allow alternatives to be evaluated in the context of that vision and strategic direction. The following three sources of information were considered in developing the MUA criteria for the Facility Plan:

- NEW Water's 2019 to 2021 Strategic Plan, discussed in Chapter4.
- The series of vison workshops and the analysis of long-term risks and opportunities held as part of this project, also discussed in Chapter 4.
- MUA criteria developed as part of previous projects (the R2E2 Project and the Clarifier Improvements Project).

## 5.2 Development of Multi-Attribute Utility Analysis for the Facility Plan

Based on the workshop discussions and other sources of information described, the five MUA categories (Financial, Operational, Environmental, Community, and Knowledge/Information) were developed as shown in Table 5-1. Then in discussions with NEW Water, category weights were established to reflect the relative priority associated with each category. Finally, criteria were established for each category to help consistently score each alternative. The MUA tool is used evaluate alternatives in the rest of the Facility Plan.

**Table 5-1 MUA Categories, Category Weights, and Criteria**

| Category | Category Weights | Criteria | Criteria Weights |
|---|---|---|---|
| Financial | 30% | Capital cost rank (5 - low, 1 - high) | 60% |
| | | Is the cashflow requirement dispersed over time? (5 - phased implementation, 1 - front-end loaded) | 40% |
| | | **Criteria weighted sum** | **100%** |
| Operational | 25% | Human Intervention - Operations (5 - low, 1 - high) | 50% |
| | | Human Intervention – Maintenance (5 - low, 1 - high) | 50% |
| | | **Criteria weighted sum** | **100%** |
| Environmental | 25% | New opportunities for resource recovery (5 - high, 1 - low) | 20% |
| | | Dependency on External Resources (chemicals, polymers, additives). (5 - low, 1 - high) | 10% |
| | | Net Impact on Energy Consumption. (5 - low, 1 - high) | 10% |
| | | Potential Impact on Nutrient Reduction | 60% |
| | | **Criteria weighted sum** | **100%** |
| Community | 10% | Relinquished assets (5-low, 1 high) | 40% |
| | | Socio-economic community benefits or cost | 30% |
| | | Socio-economic NEW Water benefits or costs | 30% |
| | | **Criteria weighted sum** | **100%** |
| Knowledge/ Information | 10% | Opportunity for demonstration/pilot testing (5 - high, 1 - low) | 25% |
| | | Opportunity for operational innovation and adaptation | 25% |
| | | Ability to Operate in a Single Shift. | 50% |
| | | **Criteria weighted sum** | **100%** |

The following is a short summary of the intent for each category:

- **Financial**. This category is intended to focus on the financial impacts of the alternative being considered, both capital and operational financial costs, and maps back to the Organizational Optimization Pillar on Figure 4-1. This criterium will also consider cash flow, meaning the alternative requires immediate capital or capital spread out over time.
- **Operational.** This category is intended to focus more narrowly on the operational efficiency of an alternative as it relates to the need for operational and maintenance staff. The criteria in this category map back to the Organizational Optimization and Team Pillars on Figure 4-1. It will consider the complexity of operations, the uniqueness of the equipment, and the amount of specialty operations and maintenance efforts required.

- **Environmental**. This category relates back directly to NEW Water's Strategic Plan Water Quality Improvements, Innovation, and Operational Optimization Pillars on Figure 4-1 and is based on quantifying the amount of energy saved, nutrients and TSS loadings reduced, and other recourses recovered as part of proposed alternatives. The energy savings serves as a reflection of the Greenhouse Gas (GHG) emissions impacts of alternatives.
- **Community**. NEW Water's Strategic Plan speaks to the importance of providing for regional partnerships and continuing to improve the NEW Water brand with the Community Outreach Pillar shown on Figure 4-1. The goal of the community assessment is to identify whether there are any key differentiating components for alternatives related to community benefits. The implementation of a community outreach program and stakeholder engagement is an action item and approach that will be adopted for the recommended alternatives but would not differentiate between alternatives.
- **Knowledge/Information**. NEW Water's Strategic Plan also speaks to the importance of innovating, collaborating with industry leaders, providing more professional growth opportunities for its workforce, and attracting and retaining a dedicated workforce. This category will provide for the evaluation of each alternative through the perspective of NEW Water's human capital.

The MUA criteria and foundational requirements will serve as the key tools for evaluating recommended technical solutions and alternatives in the different infrastructure areas for the NEW Water facilities. In addition to the MUA criteria, six foundational requirements were established for the Facility Plan. These requirements should be viewed as non-negotiable for future NEW Water projects and all alternatives are expected to meet them. The six foundation requirements identified are as follows:

- Instill a culture of safety.
- Streamlined, efficient operations and maintenance.
- Resilience to changes in current and future regulations and loadings.
- Proven, effective technologies that embrace innovation.
- Provide opportunities for efficient resource use and recovery.
- Provide benefits to the community and stakeholders.

# 6.0 Long-Range Plan for De Pere

## 6.1 Need for a Long-Term Plan for the De Pere Facility

Before alternatives can be developed around the infrastructure gaps determined in Chapter 3 and the long-term risks and opportunities developed in Chapter 4 for the DPF and GBF, a decision needs to be made on whether to keep the DPF in operation or convert it to what would be called the De Pere Pump Station and then treat all flows at the GBF. The purpose of this chapter is to evaluate these two options and make a recommendation for the future vision of the DPF using the MUA tool presented in Chapter 5. **Appendix G – Long-Range Plan for De Pere** presents additional supporting detail and cost estimates for this chapter.

The following are several key drivers summarized in Chapter 3 concerning the existing operations of the DPF:

- Capacity requirements: the existing aeration basins have limited capacity to achieve the targeted nitrification treatment performance, and the intermediate clarifiers create an operational limitation.
- Aging infrastructure: aging equipment presents reliability issues, as well as high maintenance requirements.
- Operational complexity: dry weather flow operation is stable, but wet weather periods create challenging operational conditions.

Addressing these drivers will need to begin soon for the DPF and identifying the long-term vision of continuing to invest in two facilities, or combining the two facilities, is needed to develop and enhanced capital improvements plant for NEW Water for the coming decade.

## 6.2 Alternatives for the Future of the De Pere Facility

Broadly, there are two alternatives for the future of the DPF, as identified during the Vision Workshops in 2020:

- Alternative 1: Maintain and Improve the DPF - Continued investment in the existing DPF to maintain and expand treatment facilities and at the same time improve itsoperations.
- Alternative 2: Build a De Pere Pump Station: Decommission the DPF treatment processes and regionalize treatment at the GBF.

Deferring capital investment in the DPF will only exacerbate the current and future capacity limitations and reliability concerns due to aging infrastructure. Because of this, maintaining the status-quo at the De Pere Facility is not a viable alternative.

### 6.2.1 Alternative 1 – Maintain and Improve the De Pere Facility

Continued investment in the DPF will require a vision that moves the facility toward long-term simplification of operation and increased robustness of unit processes. This alternative focuses on the capacity improvements required to meet future flow projections presented in Chapter 2, address aging infrastructure needs and reduce maintenance requirements presented in Chapter 3, and align the DPF closer to the 50-Year Vision (Chapter 4). Key aspects of the Alternative 1 improvements at the DPF need to include the following:

- Upgrading the screening and grit removal facilities, eliminating the PTUs.
- Addition of 2 million gallons (MG) of peak flow equalization, limiting the peak hour flow to 40 mgd.
- Addition of a new aeration basin to reduce mixed liquor suspended solids (MLSS) volatility and provide increased redundancy, along with step feed facilities for wet weather operation.
- Elimination of the intermediate clarifiers.
- Upgrades to the existing final clarifiers (no additional clarifiers required because of peak flow equalization).

At the same time, there are improvements that need to be made to the GBF to account for the capacity limitations and other infrastructure gaps presented in Chapters 2 and 3. Table 6-1 summarizes each unit process improvement that is recommended at the DPF and at the GBF for Alternative 1. Major assumptions and notes are provided in the table, with additional details provided in **Appendix G – Long-Range Plan for De Pere**. Site plans for the DPF and GBF improvements are included on Figures 6-1 and 6-2 with potential phasing indicate by number at each facility.

**Table 6-1 Alternative 1 Unit Process Improvements Summary**

| Unit Process | DPF | GBF | Assumptions and Notes |
|---|---|---|---|
| Influent Pump Station | Increase capacity to 57 mgd | Increase capacity to 148 mgd | See Appendix G – Long- Range Plan for De Pere, for evaluation and summary |
| Headworks | Improve existing headworks and add new grit removal equipment; abandon PTUs | Improve existing headworks Add sludge screens | See Appendix G – Long- Range Plan for De Pere, for evaluation and summary |
| Equalization | Construct a 2 MG equalization basin for peak flows | No equalization basin required | Reduce DPF peak flow capacity requirements to 40 mgd with new EQ downstream of headworks to mitigate peak hour requirements<br>Consider use of second stage aeration for EQ |
| Primary Clarifiers | NA | Peak flow primary clarifier diversion Mechanism rehabilitation | Primary treatment of peak hour flows, diversion is approximately 28 mgd<br>Rehabilitation summarized in Clarifier Rehabilitation Study Engineering Alternatives |

| Unit Process | DPF | GBF | Assumptions and Notes |
|---|---|---|---|
| Aeration Basins | One new aeration basin | Blower and aeration control improvements | Aeration basin capacity limits assumes nitrogen removal for organic loading rate (25 lbs BOD/1,000 $ft^3$-d) DPF aeration basin addition because of organic loading rate and clarifier solids loading limitations. Assumed 4 MG duplication of existing basins |
| Final Clarifiers | Clarifier rehabilitation<br><br>New RAS pumps and piping | Mechanism rehabilitation | Rehabilitation summarized in previous Clarification Rehabilitation Study<br>Abandon intermediate clarifiers |
| South Effluent Pump Station | | No changes | |
| Filtration | Filtration improvements | NA | DPF filter Improvements are underway |
| Disinfection | UV expansion to 40 mgd | New 140 mgd UV disinfection facility | DPF UV capacity expansion based on projected peak flows<br>GBF new UV disinfection and abandonment of existing facilities |
| Thickening | NA | Facility rehabilitation | Thickening facility improvements summarized in<br>Appendix H – Headworks and Screening |
| Anaerobic Digestion and Solids Handling | NA | No changes | |


**Figure 6-1 Alternative 1 De Pere Facility Recommended Improvements**


**Figure 6-2 Alternative 1 Green Bay Facility Recommended Improvements**

## 6.3 Alternative 2 – Combine Green Bay Facility and De Pere Facility Flows

Alternative 2 for the long-term DPF vision transfers DPF unit treatment processes to the GBF via a transfer pump station located at the DPF. This alternative focuses on co-locating treatment facilities at the GBF as an effort to reduce maintenance and operation of two separate facilities. Peak flow equalization is combined with the pump station to limit the pump station to 30 mgd, reducing the pump station capital cost as well as decreasing the wet weather expansion requirements at the GBF. But even with peak flow equalization, diverting flows from the DPF to the GBF will create capacity limitations in all the unit processes at the GBF. The capacity impacts of combining the flows at GBF on capacity requirements are summarized in Table 6-2.

**Table 6-2 Alternative 2 Unit Process Improvements Summary**

| Unit Process | De Pere Facility | Green Bay Facility | Assumptions and Notes |
|---|---|---|---|
| Influent Pump Station | New 30 mgd transfer lift station and pipeline (assumes equalization is installed) | Increase capacity to 178.8 mgd | See Appendix G – Long-Range Plan for De Pere, for evaluation and summary of GBF<br>Initial lift station and pipeline routing to determine capital costs |
| Headworks | No headworks, coarse screens included with influent lift station<br>Decommission and demolition existing basins | Improve existing GBF headworks<br>Addition of sludge screens<br>New 30 mgd DPF headworks at GBF | See Appendix G – Long-Range Plan for De Pere, for evaluation and summary |
| Equalization | Construct 10 MG equalization basin for peak flows | No equalization basin | Reduce DPF lift station transfer capacity to 30 mgd with addition of on-site equalization<br>New equalization at DPF parallel to proposed transfer lift station |
| Primary Clarifiers | NA | Existing clarifier mechanism rehabilitation<br>Addition of two new primary clarifiers | GBF north plant clarifier mechanism rehabilitation<br>GBF south plant addition of two 90 ft diameter, 14 ft SWD primary clarifiers |
| Aeration Basins | Decommission and demolition existing basins | One new aeration basin<br>Blower and aeration control improvements | Aeration basin capacity limits assumes nitrogen removal<br>GBF south plant addition of one aeration basin configured similar to existing |

| Unit Process | De Pere Facility | Green Bay Facility | Assumptions and Notes |
|---|---|---|---|
| Final Clarifiers | Decommission and demolition existing basins | Existing clarifier mechanism rehabilitation<br>Addition of two new secondary clarifiers at south plant | GBF existing clarifier rehabilitation summarized in Clarification Rehabilitation Study<br>Engineering Alternatives Report<br>GBF south plant addition of two new clarifiers 130 ft diameter, 15 ft SWD<br><br>GBF south plant RAS and WAS pump station expansion |
| South Effluent Pump Station | NA | Expand to 50 mgd | Current facility is 18 mgd firm capacity; addition of pumps to meet 50 mgd firm capacity<br>No pipeline nor wet well improvements assumed |
| Filtration | Decommission and demolition existing basins | No changes | No GBF filters assumed because of adaptive management approach to TP and TSS Compliance |
| Disinfection | Decommission and demolition existing basins | New 170 mgd UV disinfection facility | GBF new UV disinfection and abandonment of existing disinfection |
| Thickening | NA | Facility rehabilitation | Thickening facility improvements summarized in Appendix H – Headworks and Screening |
| Anaerobic Digestion and Solids Handling | NA | No changes | |

Alternative 2 addresses primary concerns related to maintenance of the DPF aging infrastructure because it will be abandoned and replaced with a transfer pump station and on-site equalization. On-site equalization and pumping capacities were optimized to reduce significant infrastructure upgrades at the GBF. A site plan for the DPF and GBF improvements are included on Figures 6-3 and Figure 6-4, with potential phasing indicated by number at each facility.

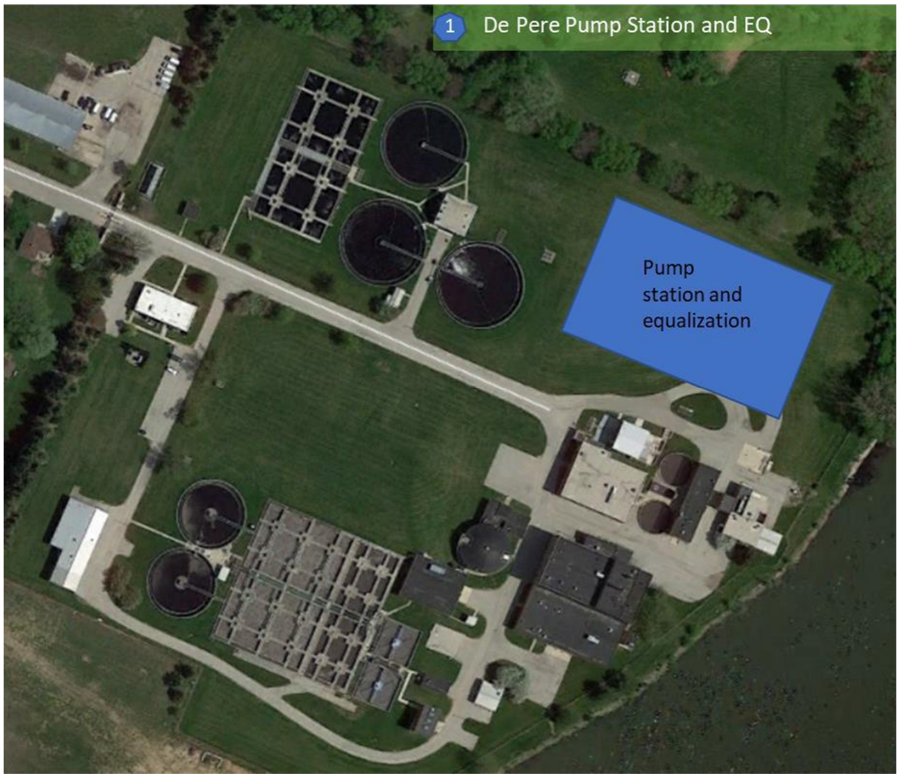


**Figure 6-3 Alternative 2 De Pere Facility Improvements**


**Figure 6-4 Alternative 2 Green Bay Facility Recommended Improvements**

An important impact if the DPF and GBF are combined is that no tertiary filtration will be in place for any portion of the NEW Water flows. This has an impact on the overall NEW Water discharge of TP and TSS. Based on the following assumptions, the impacts on TP and TSS mass discharge at NEW Water were estimated:

- GBF parameters (10-year average values):
  - Average flow: 28.5 mgd.
  - Phosphorus discharge: 0.35 mg/L.
  - TSS discharge: 5.8 mg/L.
- DPF parameters (10-year average values):
  - Average flow: 7.8 mgd.
  - Phosphorus discharge: 0.18 mg/L.
  - TSS discharge: 2.0 mg/L. Based on these values, moving toward a single discharge at the GBF (without filtration) would increase the annual phosphorus discharge by approximately 40,000 pounds and the annual TSS discharge by approximately 89,000 pounds. This represents a 12 percent increase in phosphorus discharge and a 16 percent increase in TSS. These impacts would have to be considered as part of the overall adaptive management plan when identifying target watersheds for non-point discharge management. These increases are considered in the MUA in this chapter.

### 6.3.1 Life-Cycle Cost Estimates

Estimated life-cycle costs (LCCs) were developed based on total capital costs for each alternative, along with major operating costs for major equipment operation. Capital phasing was not considered as a part of the LCC but are considered as part of the MUA later in this chapter.

Construction costs were calculated utilizing construction costs from previous projects completed, similar construction projects completed elsewhere in the past 2 years, typical installed costs observed from past project experience, pricing for the main process equipment, and previous estimates completed for NEW Water. Construction cost estimates for each alternative are summarized in Table 6-3. Additional cost estimate details are included in **Appendix G – Long-Range Plan for De Pere**.

**Table 6-3 Total Construction Costs for Alternatives 1 and 2**

| Unit Process | Alternative 1 – Simplify and Expand DPF | Alternative 2 – Build De Pere Pump Station and Decommission Treatment Facility | Assumptions and Notes |
|---|---|---|---|
| GBF - Influent Pump Station | $15,000,000 | $15,000,000 | Costs included from Appendix G – Long-Range Plan for De Pere |
| GBF - Headworks | $22,000,000 | $53,000,000 | Costs included from Appendix G – Long-Range Plan for De Pere<br>Alt 2 – 30 mgd Headworks for DPF Flow |
| DPF - Influent Pump Station and Headworks | $20,000,000 | $35,000,000 | Costs included from Appendix G – Long-Range Plan for De Pere<br>Alt 2 – 30 mgd Pump Station |
| DPF - Equalization | $7,500,000 | $38,000,000 | Alt 1 – 2 MG Basin<br>Alt 2 – 10 MG Basin<br>$2 per gallon for basic basin without mechanical/electrical/ installation |
| GBF - Primary Clarifiers | $5,900,000 | $16,000,000 | Rehabilitation costs from Clarifier Rehabilitation Study prepared by Donohue in 2019<br>Alt 1 – 28 mgd bypass around primary clarifiers Alt 2 – Two new 0.67 MG clarifiers, $2.75 per gallon |
| GBF - Aeration Basins | $4,300,000 | $20,000,000 | Blower and Control improvements costs from CIP<br>Alt 2 – 3 MG basin, $1.50 per gallon |
| DPF - Aeration Basins | $20,000,000 | - | 4 MG basin, $1.50 per gallon |
| GBF - Final Clarifiers | $20,000,000 | $48,000,000 | Rehabilitation costs from Clarifier Rehabilitation Study prepared by Donohue in 2019<br>Alt 2 – Two 1.49 MG clarifiers, $2.75 per gallon |
| DPF - Final Clarifiers | $7,200,000 | - | Rehabilitation costs from Clarifier Rehabilitation Study prepared by Donohue in 2019 |
| GBF - South Effluent Pump Station | -- | $2,300,000 | Expand to 50 mgd |
| DPF - Filtration | $8,000,000 | -- | Costs from CIP |

| Unit Process | Alternative 1 – Simplify and Expand DPF | Alternative 2 – Build De Pere Pump Station and Decommission Treatment Facility | Assumptions and Notes |
|---|---|---|---|
| GBF - Disinfection | $47,000,000 | $56,000,000 | Alt 1 – 140 mgd UV Facility<br>Alt 2 – 170 mgd UV Facility |
| DPF - Disinfection | $2,900,000 | -- | Expand facility to 40 mgd |
| GBF - Thickening | $9,900,000 | $9,900,000 | Costs included from Appendix H – Headworks and Screening |
| Total Construction Cost | $190,000,000 | $290,000,000 | -- |

Total capital costs were determined by adding 25 percent to the construction costs to account for design, construction services, and administrative costs. The potential cost range shown in Table 6-4 represents the range of project costs as defined for a Class 4 cost estimate (AACE International Recommended Practice No. 18R-97), with the range representing 85 percent to 125 percent of that most probable capital cost.

**Table 6-4 Total Capital Cost Estimates for Alternatives**

| Infrastructure Package | Potential Capital Cost Range | Most Probable Capital Cost |
|---|---|---|
| Alternative 1 | $200M to $300M | $240M |
| Alternative 2 | $310M to $450M | $360M |

The analysis between the two alternatives based on annual operating cost was based on the following major operating parameters and assumptions:

- Total system aeration energy:
  - Energy estimates made using existing aeration systems, with the assumption that blowers operate to meet airflow demands and based on oxygen demand outputs at average day conditions generated from the calibrated process model.
  - New blower systems at the GBF may decrease the overall energy for aeration, but this was not considered for this level of evaluation.
- Total system pumping:
  - Alternative 1: Influent DPF pumping and DPF solids pumping were considered.
  - Alternative 2: De Pere Pump Station pumping to convey flows to the GBF included.
- Biogas energy:
  - Assumed full utilization of produced biogas for energy production.
  - Based on current energy recovered per biogas produced.

- Operator costs:
  - Assumed that no additional operators were required to operate and maintain the improvements at the GBF.
  - Assumed that six additional operators would be required to maintain the improved DPF.

These factors, while not fully encompassing operational costs, were viewed as the major differentiators for annual operating costs. They should be considered indicative operating costs, enabling a decision between the two alternatives for NEW Water. These indicative operating costs are summarized in Table 6-5.

**Table 6-5 Indicative Operating Costs for Decision Making Related to Alternative 1 and 2**

| | Alternative 1 | Alternative 2 |
|---|---|---|
| Average Aeration Energy (kWh/d) | 18,000 | 15,000 |
| Annual Aeration Cost ($/y) | 325,000 | 266,000 |
| Average Pumping Energy (kWh/d) | 4,000 | 13,000 |
| Annual Pumping Cost ($/y) | 65,000 | 245,000 |
| Average Biogas Energy Production (kWh/d) | -12,000 | -13,000 |
| Annual Biogas Value ($/y) | -210,569 | -240,900 |
| Net Energy Impact (kWh/d) | 10,000 | 15,000 |
| Annual Net Energy Cost ($/y) | 181,000 | 270,000 |
| Annual Cost of Incremental Operating Labor ($/y) | 450,0000 | 0 |

For both alternatives, the 20-year LCCs were estimated. The LCC was based on total construction costs, the indicative operational costs, a 3 percent interest rate, and a 20-year operating period. The LCCs are summarized on Figure 6-5.

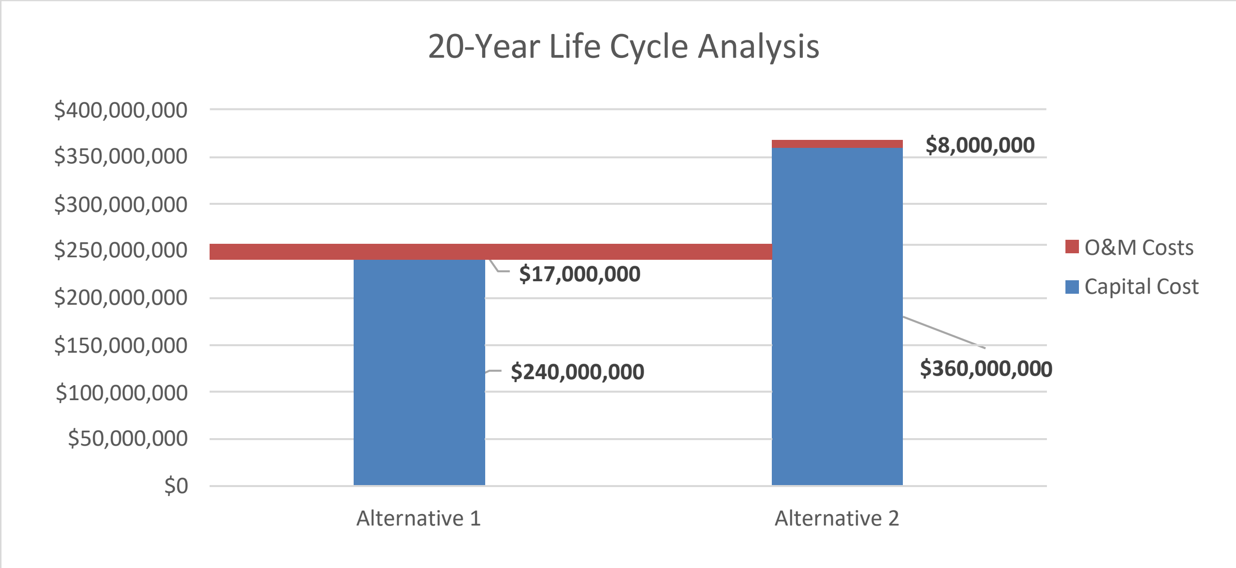


**Figure 6-5 Life Cycle Comparison Costs for Future DPF Alternatives**

### 6.3.2 Alternative Comparison with Multi-Attribute Utility Analysis

Consistent with the overall intent of the Facility Plan to evaluate alternatives with an MUA, Alternatives 1 and 2 were evaluated with an MUA. Chapter 4 established five main categories and then quantitative criteria within each category for the MUA. Scores were developed for both alternatives based on these criteria. Preliminary scores and notes for each category and criteria are provided in Table 6-6, along with the initial category weights and criterion weights.

**Table 6-6 MUA Criteria Scores and Notes for the Two DPF Long-Term Vision Alternatives**

| MUA Category (in Bold) and Criteria | Alternative 1 – Simplify and Expand the De Pere Facility | Alternative 2 – Build De Pere Pump Station and Decommission Treatment Facility |
|---|---|---|
| **Financial (30%)** | | |
| LCC rank (5 - low, 1 - high) (60%) | Score: 4<br>Notes: Lowest LCC | Score: 2<br>Notes: Highest LCC |
| Is the cashflow requirement dispersed over time?<br>(5 - phased implementation, 1 - front-end loaded) (40%) | Score: 5<br>Notes: Allows for the distributed investment in improvements at the DPF and GBF based on need and budget | Score: 3<br>Notes: Requires significant upfront investment first in the GBF expansion and in the DPF pump station |

| MUA Category (in Bold) and Criteria | Alternative 1 – Simplify and Expand the De Pere Facility | Alternative 2 – Build De Pere Pump Station and Decommission Treatment Facility |
|---|---|---|
| **Operational (25%)** | | |
| Human intervention requirements (operation)<br>(5 - low, 1 - high) (50%) | Score: 2<br>Notes: Simplifies DPF operations, particularly during wet weather, but maintains two facilities.<br>Simplification comes from eliminating intermediate clarifiers, expanding aeration basins, adding filtration capacity, and improving headworks | Score: 5<br>Notes: Reduces treatment operations to one facility |
| Human intervention requirements (maintenance)<br>(5 - low, 1 - high) (50%) | Score: 2<br>Notes: Similar maintenance requirements as current system | Score: 5<br>Notes: Maintenance reduced to one facility |
| **Environmental (25%)** | | |
| New opportunities for resource recovery<br>(5 - high, 1 - low) (20%) | Score: 3<br>Notes: No major differences in solids produced or resource mass flows | Score: 3<br>Notes: No major differences in solids produced or resource mass flows |
| Dependency on external resources (chemicals, polymers, additives)<br>(5 - low, 1 - high) (10%) | Score: 3<br>Notes: No major differences related to polymer dosing, chemical addition for treatment, or external additives | Score: 3<br>Notes: No major differences related to polymer dosing, chemical addition for treatment, or external additives |
| Net impact on energy consumption (kWh/y)<br>(5 - 5 lowest net energy,<br>1 - highest net energy) (10%) | Score: 3<br>Notes: Similar to current energy use for both facilities. | Score: 1<br>Notes: Increased energy use (pumping) |
| Potential impact on nutrient/TSS reduction (pounds/year)<br>(5 - increased removal, 3 - neutral,<br>1 - increased discharge) (60%) | Score: 3<br>Notes: Similar to current discharge | Score: 1<br>Notes: Increased phosphorus and TSS discharge |

| MUA Category (in Bold) and Criteria | Alternative 1 – Simplify and Expand the De Pere Facility | Alternative 2 – Build De Pere Pump Station and Decommission Treatment Facility |
|---|---|---|
| **Community (10%)** | | |
| Relinquished assets (5 - low, 1 - high) (40%) | Score: 4<br>Notes: Abandons existing intermediate clarifiers | Score: 1<br>Notes: Decommissions the majority of assets at DPF and represents a "walk away" of assets of significant value |
| Socio-economic community benefits or cost (5 - high community benefit, 1 - high community cost) (30%) | Score: 3<br>Notes: Limits need for expansion near GBF and so allowing existing land owned by NEW Water to be used for other purposes | Score: 4<br>Notes: Potential re-purposing of DPF land, centralized odor and noise production at GBF, risk of detrimental impact because of pipeline easements between DPF and GBF |
| Socio-economic NEW Water benefits or cost (5 - high NEW Water benefit,<br>1 - high NEW Water cost) (30%) | Score: 4<br>Notes: Preserves more land for future expansion, increased resilience, maintains 40 mgd of tertiary filtration capacity | Score: 3<br>Notes: Limits expandability of facilities in the future, no tertiary filtration is maintained, simplifies operations and maintenance |
| **Knowledge/ Information (10%)** | | |
| Opportunity for demonstration such as pilot testing (5 - high, 1 - low) (25%) | Score: 4<br>Notes: Phased implementation provides benefits to testing of innovative technologies before implementation | Score: 2<br>Notes: Significant up-front investment limits ability to test new technologies and approaches |
| Opportunity for operational innovation and adaptation (5 - high, 1 - low) (25%) | Score: 3<br>Notes: No major differences | Score: 3<br>Notes: No major differences |
| Ability to operate in a single-shift operations paradigm<br>(5 - high, 1 - low) (50%) | Score: 2<br>Notes: Two facilities increase the need for multiple shifts across both plants | Score: 4<br>Notes: One facility provides the ability for a reduced single-shift staff |

Based on the preliminary MUA weighting, Alternative 1 (Simplify and Expand the DPF) has a higher score than Alternative 2 (graphic summary provided on Figure 6-6, with additional information provided in **Appendix G – Long-Range Plan for De Pere**). Alternative 2 scores much stronger than Alternative 1 in the operations category, but similar or lower in all other categories. When the category weights are shifted to focus heavily on a financial focus or an environmental focus, a similar outcome is seen for Alternative 1.

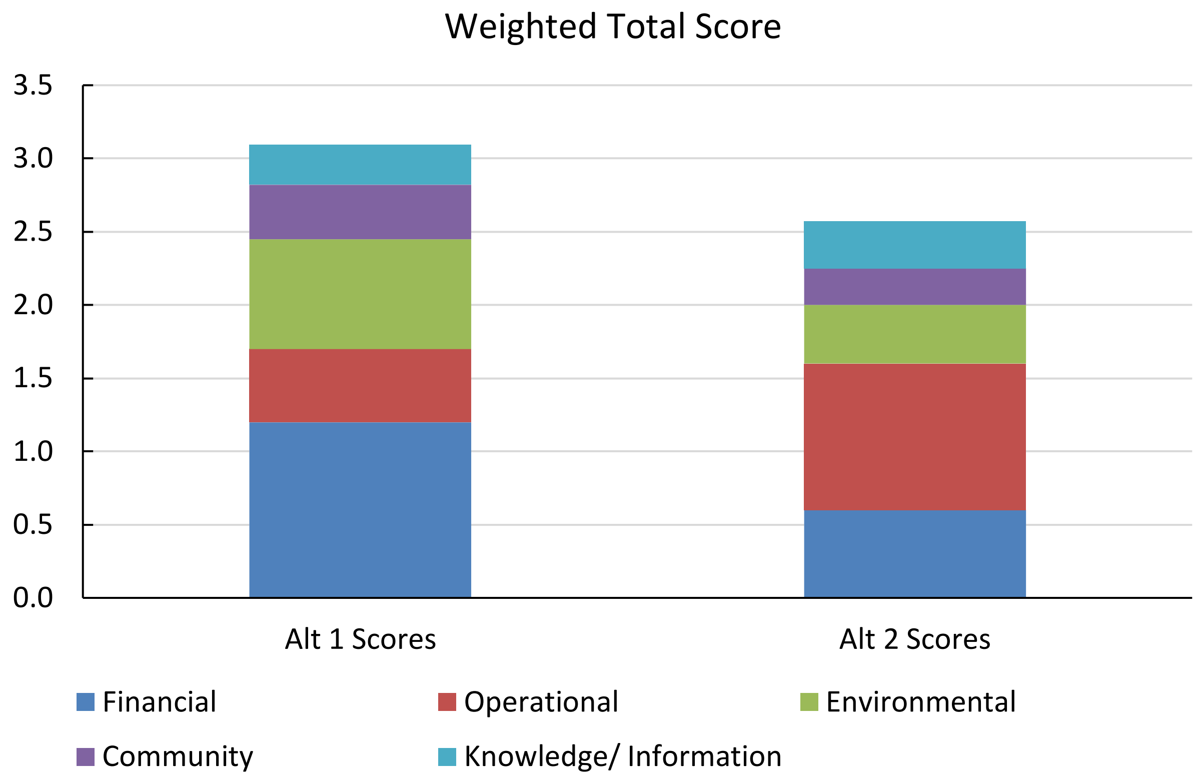


**Figure 6-6 Baseline Weighted Scores for Alternative 1 and 2**

## 6.4 Alternative Recommendation

Deferment of capital investment in the DPF will only exacerbate the current and future capacity limitations and reliability concerns due to aging infrastructure. Because of this, maintaining the status-quo at the De Pere Facility is not a viable alternative.

Two alternatives were developed for the future of the DPF. Both alternatives addressed the gaps identified in Chapter 3. The alternatives were evaluated against the MUA presented in Chapter 5 to assess which alternative would best meet NEW Water’s long-term vision by addressing potential risks and realizing potential opportunities. Alternative 1, which is to keep the DPF as an operating treatment facility, scores significantly better than Alternative 2, which is to convert the DPF to a pumping station. Based on this analysis, the rest of this Facility Plan is based on keeping the DPF as an operating plant.

While Chapter 6 describes general improvements to the GBF and the DPF for the purpose to compare either consolidating the two plants or maintaining operations at each plant, Chapters 7 and 8 will provide a more detailed analysis and recommendations for improvements at each plant.

# 7.0 Infrastructure Evaluations

As described in Chapter 1, the approach of this Facility Plan was to assess the GBF and DPF through different infrastructure packages and make recommendations for each package. The following five TMs were completed to evaluate different parts of the GBF and DPF:

- Headworks and Screening – Appendix H.
- Thickening – Appendix I.
- Aeration and Nutrient Control – Appendix J.
- Whole Plant Odor Control – Appendix K.
- Energy/Nutrients – Appendix L.

This chapter provides a high-level summary of each TM by providing a summary of the following:

- Infrastructure Drivers – Is the future investment being driven by the need to replace aging equipment, provide future capacity, and/or improve the operations?
- Approach and evaluation used to assess the various processes.
- Recommendations and cost.

The focus of this chapter is to summarize the recommendations, which were carried forward into the CIP Development (Chapter 8) and Applied Research Plan (Chapter 9). The Technical Memorandums in the appendices present the full range of options (termed infrastructure packages) that were developed and the reasons for which various options were not carried forward as recommendations.

## 7.1 Headworks Screening and Grit Removal

### 7.1.1 Infrastructure Drivers

Proper function of screening and grit removal in the headworks is essential for the operation of downstream treatment processes. The following are several drivers for headworks screening and grit removal improvements at both facilities:

- Industrial user growth at the GBF: Expansion of Green Bay Packaging has been completed and has increased influent flows and solids production by 2025.
- Equipment age and condition: The existing influent pumps, screens, and grit removal are over 20 to 45 years old and lack adequate treatment capacity and reliability.
- Operational limitations: The screening and grit removal systems have proved to have operational issues by allowing debris and grit through the headworks causing downstream issues in the solids and liquids stream, requiring equipment updates for more reliable performance.
- Peak flow management and limitation within the existing headworks allows for screening material bypass during wet weather flow events.
- Growth in the DPF service area: Residential growth will be occurring in the DPF service area over the next 10 to 20 years, increasing influent flows and loadings.

### 7.1.2 Approach and Evaluation

Improvements were developed to provide NEW Water with increased flexibility, improved screening, and the required capacity for the next 20 years. Several process configurations were developed, and the evaluation consisted of the following:

- ✓ Setting design criteria. Flows and loads were set for the future average and peak hourly 2040 projected flow rates based on the flows and loads analysis presented previously. Process design criteria for the influent bar screens, influent fine screens, and grit removal were collected from the Water Environment Federation (WEF) Manual of Practice No. 8 (MOP 8) Sixth Edition (WEF, 2018).
- ✓ Identifying possible process options for screening and grit removal equipment. **Appendix H – Headworks and Screening** presents a summary of a wide variety of process options.
- ✓ Developing four different configurations for the GBF to ensure complete liquids and solids flow screening and grit removal. All four configurations included new influent pumps and bar screens. Four different configurations were also developed for the DPF.
- ✓ Evaluating equipment solutions and capital costs to provide required capacity that are flexible and maintainable. The combined solution for NEW Water needed to consider whole system improvements to address screening and grit management challenges at both the GBF and the DPF. In general, two types of solutions were developed as shown on Table 7-1. One focused on rehabilitation of the existing headworks and the other focused on replacement of the headworks with new facilities. These two packages were identified because they fully address all of the liquid stream and solid stream screening and grit accumulation challenges at GBF and DPF.

**Table 7-1 Potential Package Combinations to Address Screening and Grit Management Challenges for NEW Water**

| Description | infrastructure Packages | Capital Cost Range | Most Probable Cost |
|---|---|---|---|
| Option 1. New headworks for full liquids and solids screening and grit management | GBF Baseline + GBF 1 + DPF 1 | $97.3 to $143.1M | $115M |
| Option 2. Rehabilitated and expanded headworks for peak flow liquids and solids, screening and grit management | GBF Baseline + GBF 2B + DPF 4 | $67.6 to $99.4M | $80M |

### 7.1.3 Recommendations

Multiple review workshops were held with NEW Water to discuss possible solutions. MUA scoring was used in the evaluation. Based on the MUA, the difference in capital cost, identified priorities, and construction phasing flexibility, it was recommended to rehabilitate and expand the headworks for peak flow liquids and solids, screening, and grit management (Option 2).

The GBF improvements will include the following:

- Five Influent Pumps
- Two Trash Racks
- Six Influent Fine Screens
- Four Primary Sludge (PS) Grit Removal Systems
- Grit Handling
- Two PS Screens
- Two WAS Screens

The DPF improvements will include:

- Two New Fine Screens
- Four New Influent Pumps
- Two New Grit Removal Systems Retrofitted into PTUs
- Two New Grit Handling Systems

Figure 7-1 shows a summary of the recommended improvements for the GBF influent pumps and bar screens. Figure 7-2 shows a conceptual layout for the replacement of existing fine screens at the GBF. Figure 7-3 shows the recommended replacements to the primary sludge degritting and grit handling system at the GBF.

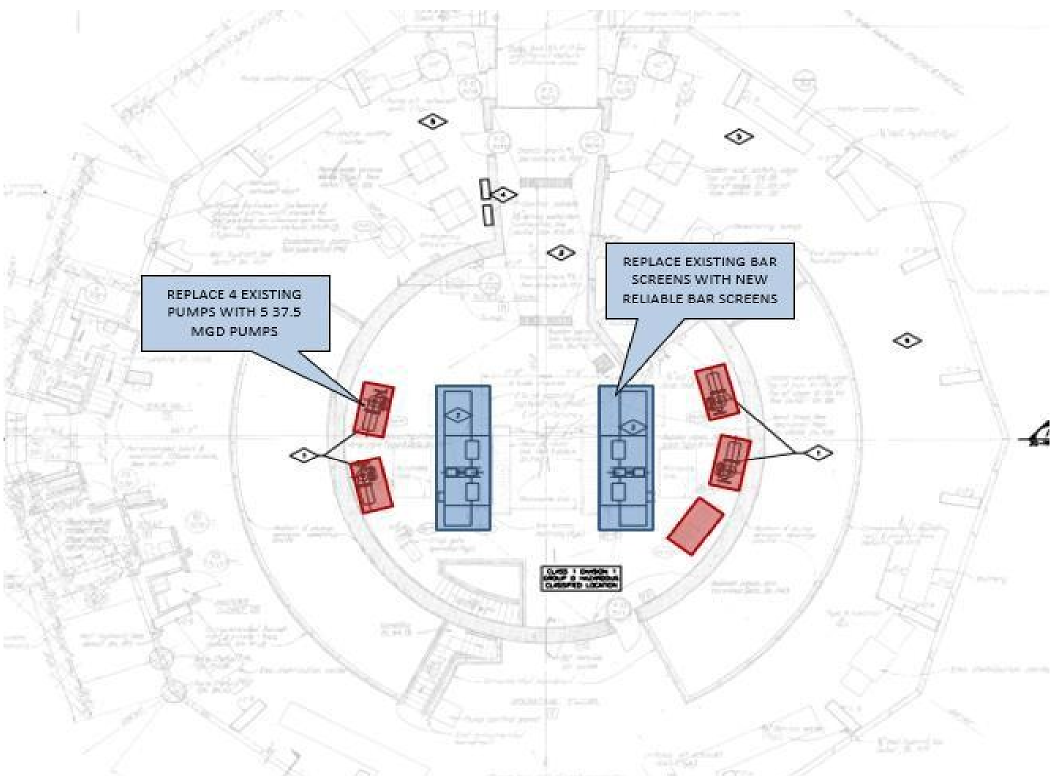


**Figure 7-1 Recommended Improvements for the GBF Influent Pumps and BarScreens**

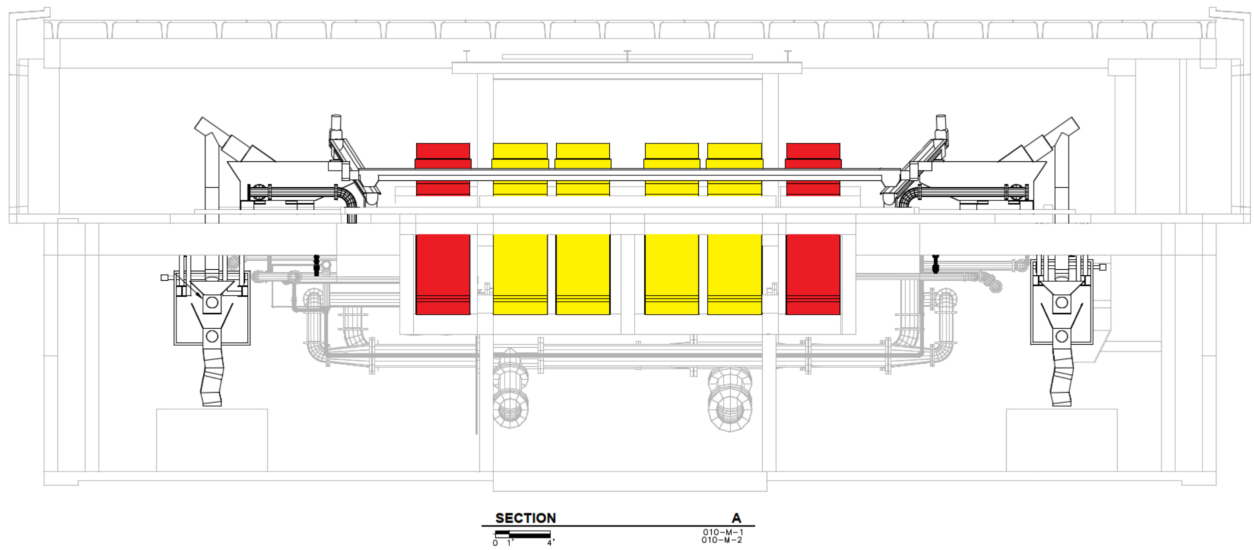


Figure 7-2 Headworks Fine Screen Channels with New Screens and Two New Channels at the GBF

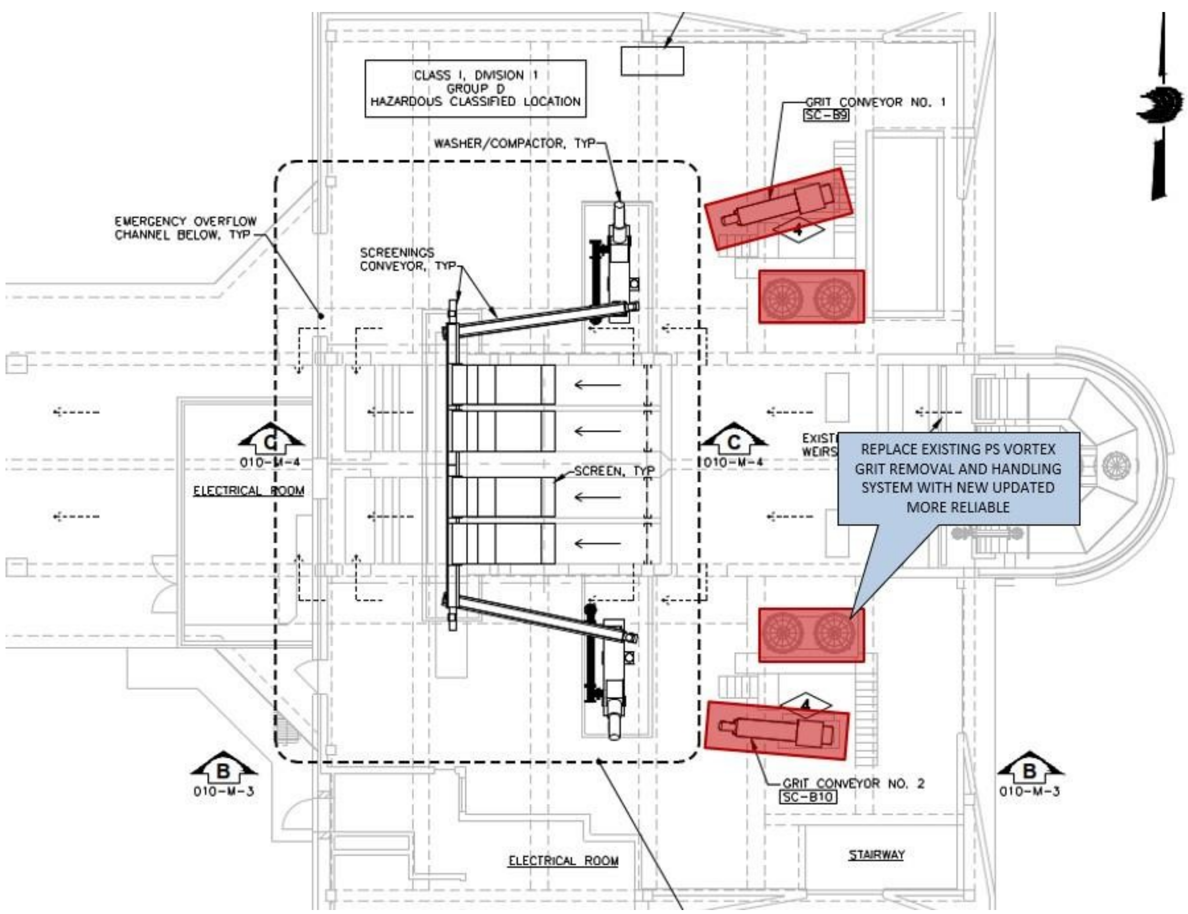


Figure 7-3 Replace Existing Primary Sludge Degritting and Grit Handling System at the GBF

The high initial capital cost (Table 7-1) requires a phasing plan, which is summarized in Table 7-2. Phasing projects included thickening, headworks, screening impact assessment, degritting, and sludge screening. Additional details on project phasing are presented in Chapter 8.

**Table 7-2 Potential Phasing for the Headworks Screening and Grit Removal**

| Project | Phasing Description | Capital Cost |
|---|---|---|
| Project 1: Thickening | See Section 7.2 | |
| Project 2: DPF Influent Pumping and Headworks | Address DPF capacity, maintenance, operations, and performance concerns<br>Address DPF WAS quality of R2E2 | $24.7M |
| Project 3: GBF Influent Pumping and Headworks | Plan for capacity increase, continue to evaluate during preliminary design rehab package based on applied research | $35.0M |
| Applied Research 1: Screening Impact | Assess impacts of DPF and GBF screening, pilot sludge screens<br>Are sludge screens required? | $150,000 |
| Project 4: GBF Degritting | Address aging infrastructure | $9.3M |
| Project 5: Sludge Screens | Plan farther in the future after assessing impacts of GBF Project 3 | $10.4M |

## 7.2 Thickening

### 7.2.1 Infrastructure Drivers

The GBF primary sludge, GBF WAS, and DPF WAS are all thickened prior to digestion. During the planning horizon of the Facility Plan, the following are several major drivers for pre-digestion solids thickening improvements:

- Industrial user growth at the GBF: Expansion of Green Bay Packaging has been completed and has increased influent flows and solids production.
- Aging equipment: The existing gravity belt thickeners (GBTs) used for WAS thickening and the primary sludge gravity thickeners are over 20 years old and lack adequate odor mitigation components.
- Operational limitations: The centrifuge installed as part of the recent solids expansion for primary sludge thickening has proved to be operationally challenging with long repair part lead times. Due to operational issues, the centrifuge has been used for WAS thickening only, thus reducing operational flexibility.
- Growth in the DPF service area: Residential growth will be occurring in the DPF service area over the next 10 to 20 years, increasing solids production rates.
- R2E2 operation: To achieve the energy targets for the R2E2 facilities, a net thickened solids concentration of 6 percent is required. This has not been achieved with current equipment.

- Nutrient harvesting: Current coagulant loadings from industrial users to the GBF and DPF have limited enhanced biological phosphorous removal performance, and thus limit the extractability of phosphorus in the struvite harvesting system; simplifying operations to avoid thickening prior to P-release in the future would be beneficial.

### 7.2.2 Approach and Evaluation

An evaluation of the thickening process was completed to provide NEW Water with increased flexibility, as well as required capacity, for the next 20 years. Several process configurations options were developed, along with required thickening components for each infrastructure option. The evaluation of the thickening processes consisted of the following:

1. Identifying possible process configurations for thickening operation. The three main process configurations are as follows:
    a. Current operation: Primary sludge thickened separately, GBF, and DPF WAS combined (configurations 1a/1b).
    b. Separate sludge streams: All three sludge streams managed separately (configurations 2a/2b).
    c. Co-thickening: All sludge streams combined prior to mechanical thickening (configurations 3a/3b).
2. Projecting future solids production for each configuration in terms of flow rate (gpm) and mass load (ppd).
3. Evaluating equipment solutions to provide required capacity and flexibility. Three primary mechanical thickener technologies were evaluated – GBTs and Rotary Drum Thickeners (RDTs) – and are summarized as follows:
    a. GBTs:
        - Technology requires the most footprint per unit of capacity of the three technologies considered.
        - Ability to thicken all flow streams (WAS, PS, Co-Thickening); one unit could act as a swing unit for both WAS and PS redundancy, although this is not common for GBTs.
        - Equipment is familiar to both operations and maintenance staff.
        - Least adaptable to odor control required for primary sludge and/or co- thickening.
            - Units can be covered with a plexiglass cover to improve odor control performance (assumption used for cost estimates) but this limits visibility of sludge consistency.
        - Equal to or the highest polymer requirements for equivalent thickening of the three technologies considered.

b. RDT:

- Relatively small footprint requirement per unit capacity of the three technologies considered.
- Ability to thicken all flow streams (WAS, PS, Co-Thickening); one unit could act as a swing unit for both WAS and PS redundancy.
- Equipment is odor control ready as a base package and fully enclosed, reducing odor emissions.
- Equal to or the highest polymer requirements for equivalent thickening of the three technologies considered.

c. Centrifuges:

- Were also evaluated but were not considered cost effective compared to GBTs and RDTs. Also, the existing centrifuge has had significant operational and maintenance challenges.

4. Developing capital costs for full infrastructure packages. The capital costs were based on the number of units estimated for each configuration to handle the expected future solids production as shown on Figure 7-4.

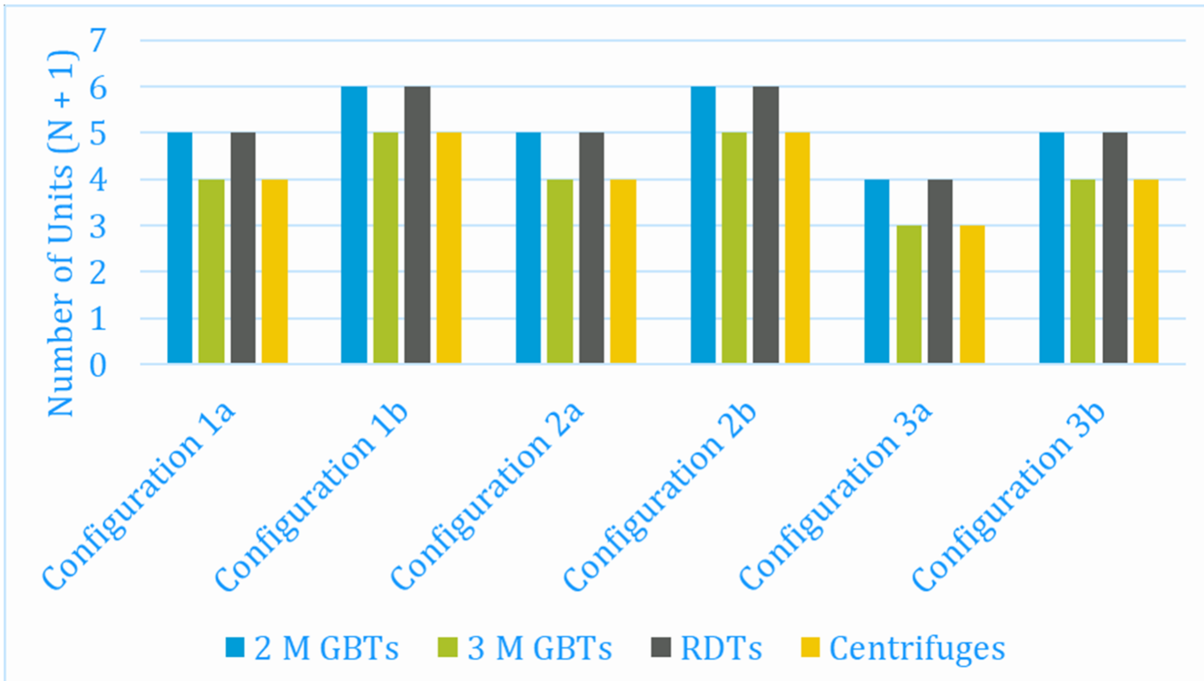


**Figure 7-4 Number of Unit Processes Estimated for Each Thickening Process Option**

### 7.2.3 Recommendations

The overall recommended thickening infrastructure package includes five new thickeners that would be placed within the existing thickening building. NEW Water does not have experience with RDTs so it is recommended that this technology be pilot tested before a final selection is made between GBTs and RDTs. Through discussion with plant operations and maintenance personnel, it was agreed that the existing gravity thickeners play an important role in providing more robust treatment and providing for additional scum removal and that rehabilitation of four existing gravity thickeners would be included in the overall thickening recommendation. Finally, based on the ongoing operational challenges of the equipment in the Infrastructure Gap Analysis (Chapter 3), it was agreed that modifications to the thickened sludge wetwell and pumping should be included. As shown in Table 7-3, this Total Thickening Infrastructure Package has a capital cost range of $14.1M to $20.6M, with a most probable cost of $16.6M.

**Table 7-3 Recommended Thickening Infrastructure Package**

| Infrastructure Package | Major Infrastructure | Potential Capital Cost Range | Most Probable Capital Cost |
|---|---|---|---|
| Infrastructure Package 1 | Five or six GBTs or RDTs<br>Required platforms and piping<br>Thickened sludge feed pumps<br>Odor mitigation | $5.7M to $8.3M | $6.7M |
| Additional Package 2 | Rehabilitate four GTs, with associated pumping and piping | $7.1M to $10.4M | $8.4M |
| Additional Package 3 | Thickened wet well and pumping improvements | $1.2M to $1.8M | $1.4M |
| Applied Research: RDT pilot testing | | $75,000 to $100,000 | $0.1M |
| Total Thickening Infrastructure Package | | $14.1M to $20.6M | $16.6M |

## 7.3 Aeration and Nutrient Removal

### 7.3.1 Infrastructure Drivers

Aeration provides the foundation of wastewater treatment for BOD and nutrient removal. Improvements to the aeration basins at both the GBF and DPF were evaluated in this Facility Plan, as well as improvements to the blower/compressor system at the GBF. The following are five key drivers for these improvements:

- **Aging Equipment:** The aeration blowers/compressors at the GBF are over 40 years old as discussed in Chapter 3.
- **Energy Efficiency:** The aging blowers/compressors at the GBF are well maintained and do not cause major maintenance issues, but they are oversized. The result is a significant limitation in terms of operational turndown and energy efficient operation.
- **Operational Limitations:** Sludge settleability has been a major issue at the GBF, with average sludge volume index (SVI) values over 200 milliliters per gram (mL/g). This limits the performance of final clarifiers and hinders efforts to achieve stable, low-level effluent TSS and phosphorus concentrations.
- **Future Effluent Performance:** In addition to identifying operational limitations that impact the stability of phosphorus removal, a path forward to achieve future total nitrogen (TN) limits in the range of 3 to 10 mg/L needs to be identified. This analysis used a target of less than 8 mg/l.
- **Capacity:** The aeration basin capacity at the DPF is a driver for projects, and a third aeration basin was recommended as part of the Long-Term Vision for the DPF in Chapter 6.

### 7.3.2 Approach and Evaluations

Using the flows and loads projections, the calibrated process modes, and the regulatory requirements all identified in Chapter 2, and the improvements at the DPF identified in Chapter 6, a series of process improvements were developed and evaluated. These evaluations consist of the following:

- ✓ Three optional process configurations for the GBF aeration basins – the existing Anaerobic-Oxic (AO) configuration, modified Ludzack-Ettinger (MLE), and Anaerobic-Anoxic-Oxic (A2O) – for the purposes of achieving better sludge settleability and lower effluent nitrogen levels.
- Reconfiguration of the diffusors in the GBF aeration basins to achieve more efficient aeration.
- An evaluation of several side stream treatment processes for the digester side stream to further reduce effluent nitrogen levels.
- Potential GBF blower reconfigurations using newer blowers to more efficiently deliver air to the aeration basins.
- A new process configuration for the DPF aeration basins to help achieve lower effluent nitrogen levels and additional aeration basin volume at the DPF.

### 7.3.3 GBF Aeration Basin Process Reconfigurations and Low Dissolved Oxygen Operations

Of the three process modifications evaluated for the GBF aeration basins, A2O modification is recommended. Relatively minor modifications converting the aeration process to the A2O can result in effluent nitrogen below 8 mg/L, effluent TP below 0.4 mg/L, and improved stability related to sludge settleability and SVI. These modifications will cost-effectively allow NEW Water to meet likely future regulatory requirements.

Figure 7-5 shows a summary of the proposed changes to the aeration basins. Before conversion of all the aeration basins, it is recommended that one of the South Plant aeration basins be converted first to a demonstration basin to enable testing of the A2O configuration, low dissolved oxygen (DO) operation, and stable solids residence time (SRT) operation in the near-term to better inform future design and operational strategies. The cost of the demonstration basin construction is estimated to be $1M. Assuming that is successful, the rest of the North Plan and South Plant aeration basins should then be converted.

As described in **Appendix J – Aeration and Nutrient Control**, the aeration basin modifications should include elimination of some excess diffusors, and reconfiguration of operations using low DO setpoints to improve performance and energy efficiency.

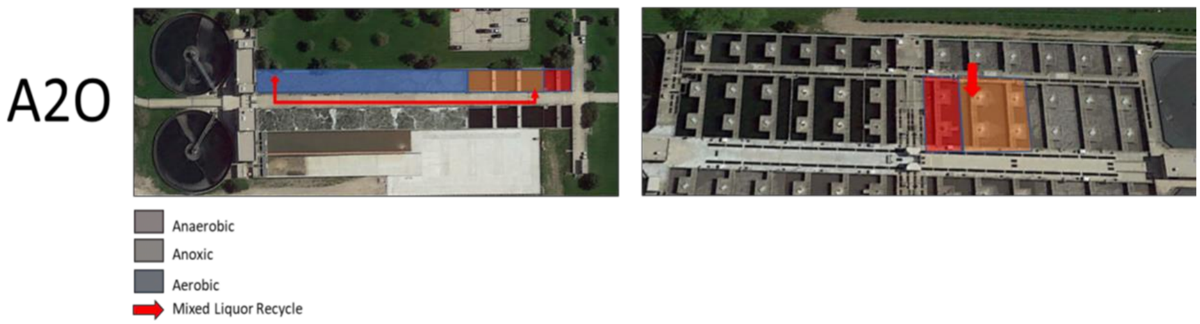


**Figure 7-5 Overview of the A2O Conversion for the GBF North Plant and South Plant Aeration Basins**

### 7.3.4 Side Stream Treatment Recommendation

The characteristics of low volume, high concentration recycle streams from anaerobic digestion create opportunities for alternative means of treatment for nutrient management. Side stream treatment will improve stability for both nitrogen and phosphorus removal. Several side stream treatments options were evaluated as described in **Appendix J – Aeration and Nutrient Control**, and the recommendation was made for Anita Mox as the most feasible side stream treatment process option. Implementation of side stream treatment is considered a longer-term action and it should be preceded by additional applied research as described in Chapter 9. In addition, if soluble phosphorus should increase in the anaerobic digester and the recycle streams, the phosphorus harvesting system should be recommissioned.

### 7.3.5 Recommendation for Blower Replacement

GBF blower replacement has the potential to reduce aeration basin energy by up to 58 percent and increase the percentage of produced power from R2E2 from 40 percent to 50 percent of the NEW Water electricity use. For capital planning, the full capital cost will be considered. However, a phased implementation approach was developed where two new blowers could be installed in the first phase to realize the majority of the energy savings (see Chapter 8 for additional phasing detail). The remaining three blowers could be installed when capital is available in the overall CIP.

### 7.3.6 DPF Aeration Basin Improvements

As discussed in Chapter 6, the major aeration basin capital cost for the DPF will be the addition of a third aeration basin in the future. Based on simulations at the GBF, a modification to the selector zones to include anoxic volume in an A2O configuration would be beneficial in the existing aeration basins, as well as the future aeration basin. A layout of A2O for the DPF is shown on Figure 7-6. The anaerobic selector could be split in half in a serpentine pattern to achieve the anaerobic and anoxic volumes. The aeration volume could also be divided with a new baffle wall to create two tanks-in-series, which would improve operational control. MLR could be transferred from the second aeration basin to the anoxic selector zone volume. MLR would be 250 percent of influent average day flow, resulting in a MLR pump with 6.5 mgd capacity in each basin.


**Figure 7-6 Potential A2O Layout for the DPF Aeration Basins**

Table 7-4 presents a summary of the capital costs associated with the GBF and DPF aeration basin modifications and improvements.

**Table 7-4 Capital Cost for the Green Bay Facility and De Pere Facility Aeration Basin Improvements**

| Infrastructure Package | Most Probable Cost | Impacts | Implementation Drivers |
|---|---|---|---|
| Package 1 GBF– A2O Modification | $4.7M<br>(potential early investment of<br>$950,000 for a single aeration basin) | Improved settleability stability<br>Effluent total nitrogen removal<br>Enables tapered low DO operation and energy savings | Operational limitations<br>Effluent performance<br>Energy efficiency |
| Package 2 – GBF Low DO<br>Instrumentation and Control | $0.5M | Tapered low DO for energy savings<br>Requires diffuser density modifications with diffuser plugging<br>Potential valving and piping changes | Operational limitations<br>Effluent performance<br>Energy efficiency |
| Package 4 – Anita MOX | $15.2M | Sidestream nitrogen removal provides improved effluent phosphorus stability and future total nitrogen removal improvements<br>Anita MOX was the lowest capital and the lowest complexity for operation | Effluent performance |
| Package 7 – Five new larger blowers | $26.4M | Significant energy savings potential, particularly after Package 1 and 2 are implemented<br>Phased implementation is possible, depending on capital planning | Ageing infrastructure<br>Energy efficiency |
| Package 9 – DPF Aeration Basin Modifications | $1.6M | Effluent total nitrogen removal<br>Potential improvements to sludge settling and performance stability | Operational limitations<br>Effluent performance DPF capacity<br>Likely implemented in conjunction with Package 10 |
| Package 10 – DPF New Aeration Basin and New Blowers for the DPF | $28M | Improves DPF capacity and operational stability<br>Future total nitrogen removal | Operational limitations<br>Effluent performance DPF capacity |

## 7.4 Whole Plant Odor Control

### 7.4.1 Infrastructure Drivers

Currently, NEW Water has very few off-site odor complaints at either the GBF or the DPF. It is recognized that some processes do generate odors and that future process expansions could increase odor generation. It is also recognized that NEW Water does not currently have a systemwide approach to proactive odor control. Managing odors is important so that NEW Water continues to be recognized as a responsible community partner.

### 7.4.2 Approach and Evaluations

The overarching objective for odor control in this Facility Plan is to develop a roadmap to guide odor mitigation efforts and costs, focusing on short-term needs and long-term drivers. Building upon and expanding on previous odor studies, gaps between conditions and goals are identified along with recommended actions to address the gaps. Table 7-5 provides a summary of the approach and evaluations used for whole plant odor control evaluation.

**Table 7-5 Evaluations Done as Part of the Whole Plant Odor Control Analysis**

| Element | Description of Work |
|---|---|
| NEW Water Vision for Odor Control | • Define overall and facility-specific targets |
| Odor Generation Considerations | • Discuss factors that influence odor<br>• Describe key odorants that impact odor generations and guide treatment options |
| Existing Odor Control Needs | • Provide overview of existing odor control systems and odor concerns at each facility<br>• Identify gaps between current conditions and NEW Water vision<br>• Recommend actions to address gaps from current conditions |
| Process Expansion Impacts on Future Odor Control Needs | • Identify process modifications that may impact odor generation and create gaps between the future conditions and the NEW Water vision<br>• Recommend actions to address gaps from process improvements |
| Odor Control Roadmap | • Provide odor control recommendations for existing and near-term facilities<br>• Identify considerations for addressing odor control for future facility improvements |

### 7.4.3 Recommendations

By considering facility needs and identifying potential gaps for odor mitigation in the short term and long term, an odor control roadmap was developed to prioritize actions and odor control improvements. In the short term (over the next 5 years), prioritization of improvements should focus on fixing existing odor control system issues with the existing biotrickling filters, in the interceptor system, and assessing odor control for uncontrolled sources through completion of an Odor Control Study. The study should include establishing systemwide quantifiable odor goals, sampling to assess existing odor concentrations, a dispersion model to predict odor impacts, and an odor complaint procedure in the near term that will also help guide odor management for proposed future facilities. The cost of an Odor Control Study is estimated to be $250,000. Figure 7-7 illustrates the identified needs and recommended actions that comprise the roadmap for an odor control strategy at the GBF and DPF.

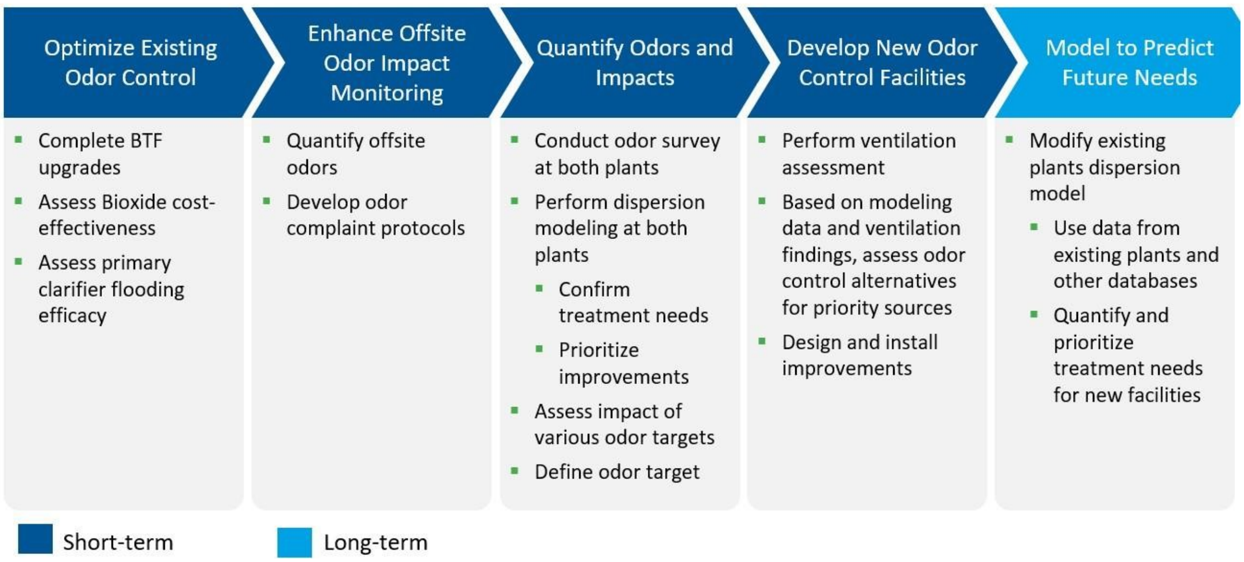


**Figure 7-7 Odor Control Roadmap**

This odor control roadmap will also set the context for support the longer-term improvements recommended in this Facility Plan. As improvements are considered, dispersion modeling can be performed (relying on data from NEW Water sources with expected similar emissions characteristics or databases for new processes). Dispersion modeling should be repeated to quantify the effects of these changes on the plants' odor profiles and findings should be incorporated into the design of future facilities.

As planning efforts advance, public outreach and notifying the public of upcoming projects can help stakeholders feel informed, particularly as development encroaches upon the facility sites. By remaining proactive in their approach to odor management, NEW Water can continue to be a good neighbor while maintaining and upgrading the facilities as necessary to ensure that capacity and treatment needs are being met in alignment with their long-term vision.

## 7.5 Energy and Nutrients

### 7.5.1 Infrastructure Drivers

NEW Water has recently made major investments in its biosolids processing capabilities through the R2E2 project. Unlike the liquids side of the GBF and DPF facilities, a condition assessment of the R2E2 facilities was beyond the scope of this Facility Plan and equipment mortality was generally not considered because the equipment is still relatively new. NEW Water did recognize the importance of evaluating the overall plant facilities for future capacity and operational improvements as part of achieving its vision for future energy and resource recovery, thus the infrastructure drivers for energy and nutrients were as follows:

- Assessing the ability of the biosolids processing equipment to provide treatment for the future flows and loads presented in Chapter 2.
- Help improve operational challenges associated with the biosolids processing equipment, especially related to the challenges of conveying sludge with a “sticky” characteristic.
- Identify other possible resource and energy recovery process options.

### 7.5.2 Approach and Evaluation

The approach used to address these drivers consisted of the following:

- Assessing the future solids processing capacity needs of the GBF based on the projected future flow and loads. If existing installed capacity is not sufficient, describe what projects need to be considered in the future to address the capacity needs.
- Evaluating cost-effective options for biosolids storage. Currently, solids occasionally need to be stored in the GBF aeration tanks when adequate solids processing is not available and landfilling of biosolids is not available or desired. To mitigate this operational challenge, biosolid storage options were evaluated.
- Considering opportunities for additional energy recovery. When solids cannot be processed in R2E2, they are hauled to a landfill and the plant cannot produce energy from those solids.
- Additional technologies were evaluated to extract still more energy from the biosolids. These technologies would have the combined benefit of reducing solids loading to the existing dryer and fluidized bed incinerator.
- Identifying potential technologies to explore future resource recovery.

### 7.5.3 Recommendations

#### 7.5.3.1 Recommendations for Future Solids Processing Capacity

Figure 7-8 presents a summary of estimated solids process capacities downstream of the anaerobic digesters for the sludge produced at the GBF and DPF for the 2025 Annual Average (AA), 2040 AA, 2040 Maximum Month (MM) based on operating the incinerator 5 days a week and 2040 MM based on operating the incinerator 7 days a week. These estimates assume that the anaerobic digesters will have 6 percent solids loading (see previous Section 7.2 on thickening improvements), 45 percent Volatile Solids Removal (VSR) and the dewatering centrifuges will produce cake at 21 percent solids. As shown on Figure 7-8, the dewatering, drying, and incineration processes have enough capacity to handle municipal sludges from GBF and DPF under 2025 AA and 2040 AA conditions operating 5 days a week.

Under 2040 MM conditions, the system may need to be operated 7 days a week for the incinerator to handle the solids throughput. Based on discussions with NEW Water operations staff, it is not likely that the incinerator can be operated 7 days a week for an extended period of time due to the need for ongoing maintenance requirements.

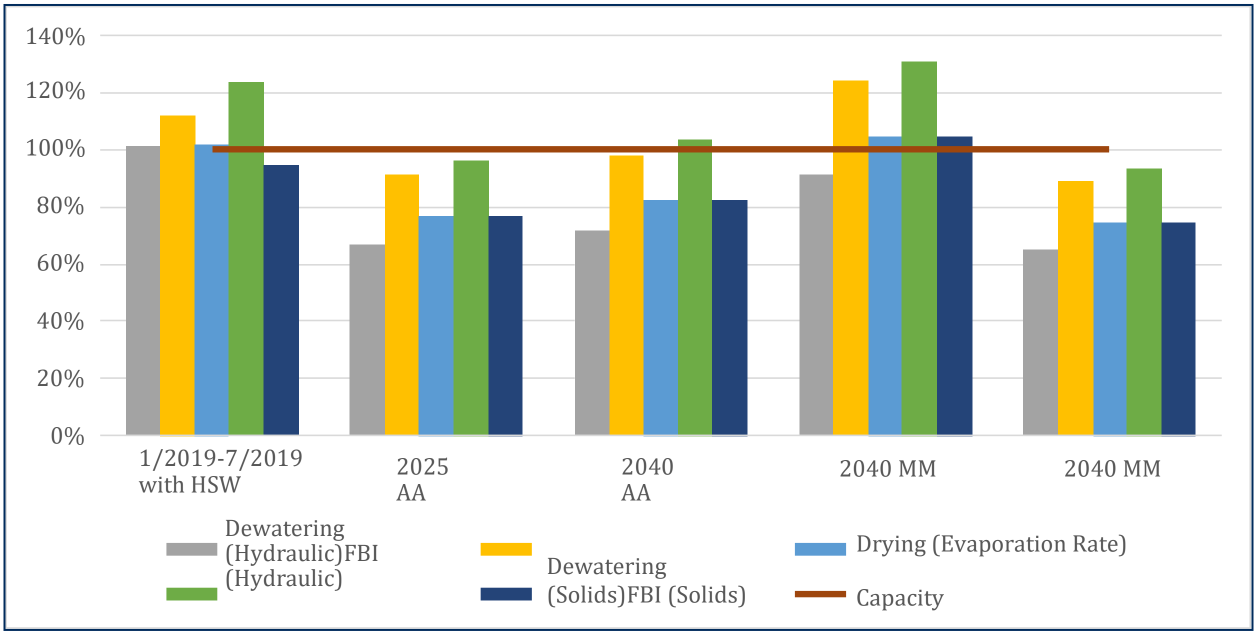


**Figure 7-8 Capacity Evaluation of Existing Solids Processes Assuming Thickened Sludge at 6 Percent TS and Dewatered Cake at 21 Percent TS**

The evaluations show that there will also be some capacity available to process HSW within the R2E2 system as the incinerator will be at approximately 80 percent of its solids throughput capacity or below. However, the solids processing system will be able to handle less HSW as the capacity requirements for the municipal sludge start to increase.

There are currently several challenges with the performance of the existing dewatering centrifuges and the conveyance of the dewatered cake to the downstream processes due to the “stickiness” of the sludge. If the dewatering process cannot get to the design performance requirement of 21 percent total solids because of material handling issues, the dryer will be the bottleneck for the R2E2 system. When the dryer feed is between 19 to 20 percent solids, the evaporation capacity of the dryer will be exhausted to remove additional water from the digested sludge cake. Therefore, the incinerator will have to be operated at a lower solids throughput than design conditions. As shown on Figure 7-9, the system will be limited by the dryer capacity under all future projected conditions unless system is operated longer than 5 days a week. Further, there will not be any additional capacity available for HSW co-digestion. Therefore, understanding and finding a resolution to the current material conveying issues related to the digested sludge cake is important to determine future capacity constraints.

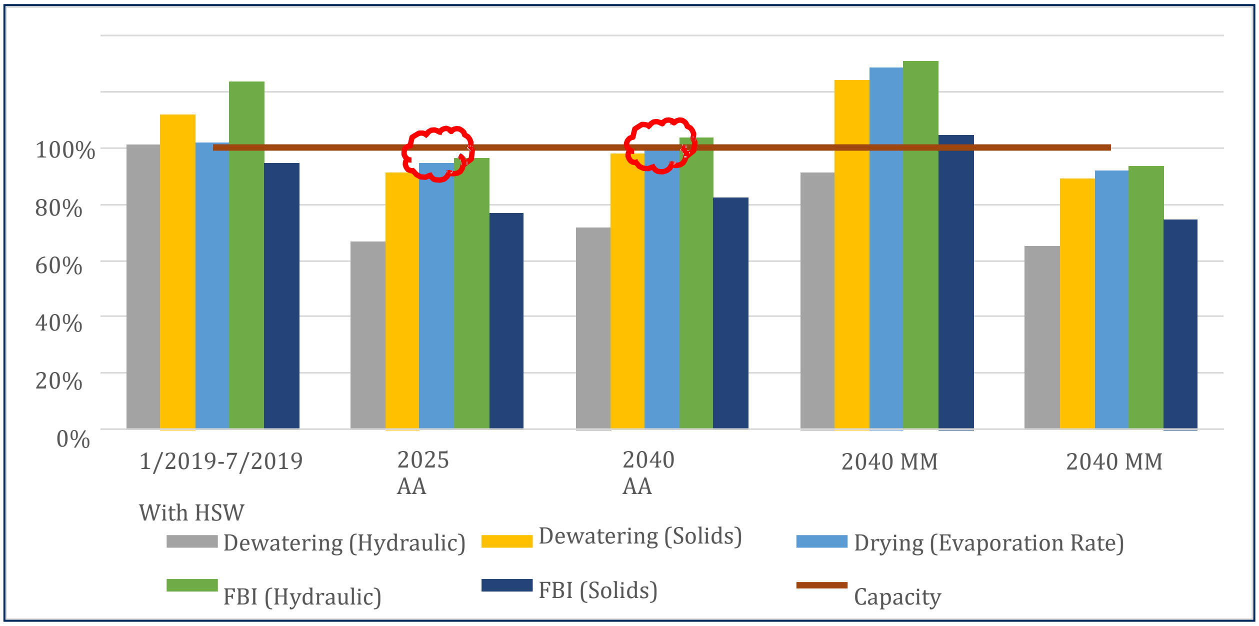


**Figure 7-9** **Capacity Evaluation of Existing Solids Processes Assuming Thickened Sludge at 6 Percent TS and Dewatered Cake at 19 Percent TS**

Given the potential capacity limitations for processing municipal sludge and near certain capacity limitations for processing HWS, future actions are needed to create an option for biosolids storage and/or increase the biosolids processing capacity. These recommendations are addressed in the following sections.

#### 7.5.3.2 Recommendations for Biosolids Storage

Additional biosolids storage would be advantageous to NEW Water to help address the increasing capacity demands on the biosolids processing equipment previously described and to provide storage for when the biosolids processing equipment is down because of required maintenance. There are no raw sludge storage tanks at the GBF. Therefore, the solids produced at the NEW Water facilities are fed continuously to the digesters post thickening. There are two dewatering feed tanks that are located downstream of the digesters, and they provide 2 to 3 days' storage for digested sludge before the sludge is dewatered and incinerated. The storage time in these tanks will drop below 2 days under the projected 2040conditions.

When the incinerator is down for maintenance, this limited sludge storage upstream of incineration necessitates NEW Water to store either solids in the activated sludge process by minimizing sludge withdrawal, store solids in available basins, or landfilling of solids. If solids are stored in the activated sludge process, this inconsistent wasting leads to large fluctuations in the MLSS concentration in the aeration basins, negatively impacting sludge settleability, nutrient removal performance, and wet weather treatment. Details concerning the impacts on aeration basin operation are included in **Appendix J – Aeration and Nutrient Control**.

To minimize the effect of solids processes on liquid treatment and the number of hauling events to landfill, extra storage capacity upstream and downstream of digestion and dewatering process was evaluated. There are limited options for storing liquid sludge upstream of the digestion. One option is to use the currently unused two decant tanks and unused equalization tank. Based on the tanks total volume and average day WAS production rates, these tanks could provide 1.3 days of WAS storage. NEW Water concluded that the associated operational challenges of using the existing tanks did not justify the relatively small incremental benefit and liquid sludge storage was not considered further.

For the purposes of projecting benefits and cost of additional solids storage after digestion and dewatering, a representative incineration shutdown condition was assessed. Based on a 5-day per week operation schedule for centrifuge dewatering and incineration, including scalping dryer, Figure 7-10 presents 2040 AA digested sludge cake production of 42.1 dtpd during a 5-day shutdown. During this period, a cake storage capacity of 211 dry tons would be needed, and it would take approximately 13 days for the FBI to catch up with the daily solids production. This storage need equates to 1,700 cubic yards (cy) of storage capacity to be provided.

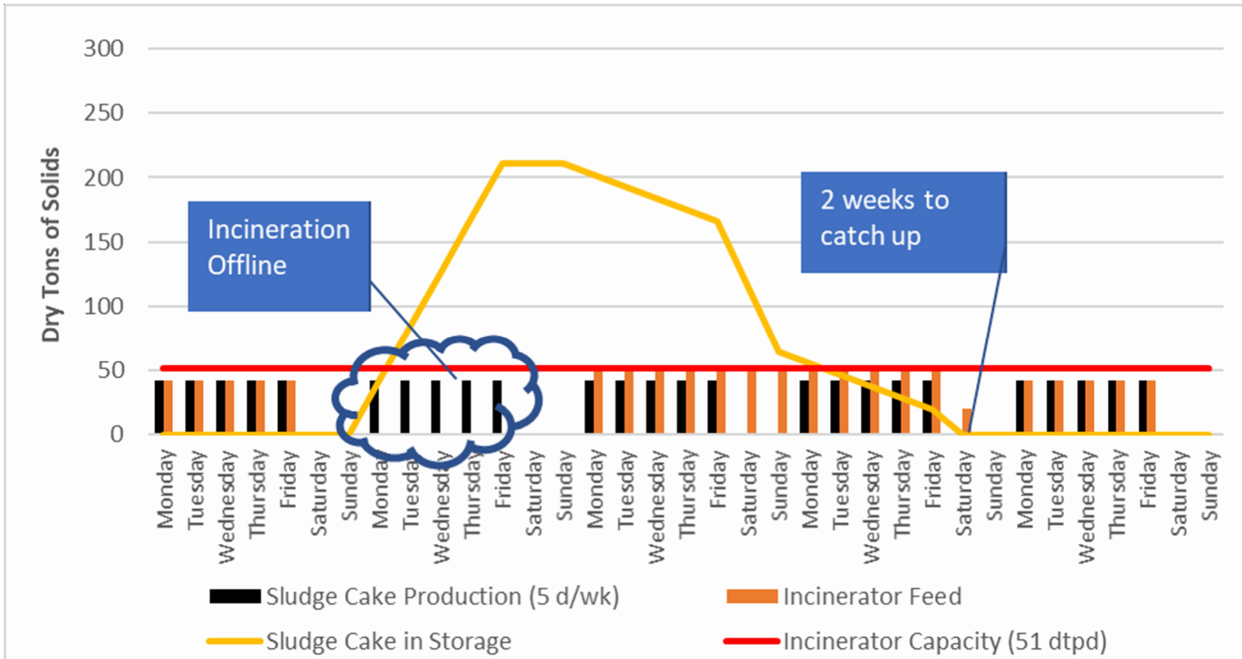


**Figure 7-10 Digested Sludge Storage Requirement in 2040**

A sliding frame silo type cake storage was assumed for this evaluation. At a volume of 425 cy per silo, a total of four silos would be needed. The cylinder section of each silo would be 25 feet high with an inner diameter of 25 feet. These silos would be located north of the Solids Facility so the existing cake pumps could be utilized to convey dewatered digested sludge to a silo. There would be one cake pump installed under each silo to feed sludge cake back into the scalping dryer when the incinerator is put back online. Figure 7-11 shows the proposed location for four sludge cake silos with 25-foot diameters. It is expected that the foul air from these silos will be exhausted to an odor control system when the silos are storing cake. The estimated cost for the storage facilities is $15 million. Given the operational and maintenance requirements for the R2E2 process equipment and the increasing capacity demands that the equipment will need handle in the future, it is recommended that a biosolids storage facility be further studied and implemented. The biosolids storage facility will reduce the need for landfilling by helping optimize the capacity of the biosolids processing equipment and have the additional benefit of avoiding the practice of storing solids in the activated sludge system.


**Figure 7-11 Proposed Location for Dewatered Sludge Cake Silos**

### 7.5.3.3 Options for Additional Energy Recovery

An evaluation of the capacity of the existing R2E2 processes concluded that there is currently enough capacity to process municipal solids from the GBF and DPF for the projected future loading conditions; however, there are operational limits that prevent NEW Water from achieving its R2E2 targets. One of these targets is to thermally oxidize all solids in the FBI to produce heat and minimize landfilling biosolids. As discussed above, NEW Water staff noted several challenges with the existing incineration process to achieve this goal.

One alternative is to install a second FBI unit to provide full redundancy; however, this option is prohibitively expensive. The costs are summarized at the end of this section.

Another option is for NEW Water to consider a variety of evolving advanced digestion technologies for additional sludge reduction and energy recovery. Although the digesters have the capacity to process HSW and generate more biogas, the overall capacity is limited because of lower than projected VSR. Improving VSR in digestion will increase biogas production to be used in the existing combined heat and power (CHP) engines and reduce solids going into the downstream processes. **Appendix L – Energy/Nutrients** provides a high-level discussion of digestion enhancement technologies that are currently available in the market to achieve better VSR in the digestion process and may improve dewaterability of digested sludge. In summary, these technologies are as follows:

- ✓ Thermal Hydrolysis Process (THP) for all the sludge.
- ✓ THP for the WAS.
- ✓ Post Digestion Thermal Hydrolysis.

These potential technologies could help NEW Water increase its electrical energy production beyond the current 40 percent and further reducing the solids load to incineration. The cost of these facilities would range from $50 million to $70 million. While they bring improvements to energy management and capacity flexibility, many of these technologies will add complexity and additional assets to operate. It is recommended that the overall costs, impacts, and benefits should be considered as part of a large biosolids management planning project as described below.

#### 7.5.3.4 Recommendation for Additional Resource Recovery

There are currently no available cost-effective options for additional liquid or solids resource recovery (except for nutrients, which was discussed in Section 7.3), but the technologies should be tracked as they develop. As described in **Appendix L – Energy/Nutrients**, many technologies for recovering resources from wastewater liquids and biosolids are being developed. For example, there are appreciable precious metals in the influent to DPF and GBF. NEW Water estimates there is a total value of about $4.6 million/year in gold in the combined influent from both facilities. About 45 percent of the gold is captured in the ash from the biosolids. Currently, cost-effective technologies do not exist to extract gold from the influent or ash. The recommendation for additional resource recovery is to continue to monitor the developing technologies until these technologies reach commercial viability.

#### 7.5.3.5 Summary of Energy and Resource Recovery

In view of the conclusions and recommendations made above, the following summary is provided:

1. The thickening improvements outlined in Section 7.2 would alleviate many of the critical limitations of the R2E2 infrastructure by increasing SRT in the digesters and, potentially, improving VSR. Better VSR and lower digested sludge flow rate would lower the hydraulic and solids throughput to the centrifuges, essentially lowering the loads to the dryer and incinerator.
2. The greatest short-term biosolids processing challenge is the overall sludge handling characteristics. The “stickiness” of the sludge limits R2E2 capacity and creates operational challenges. It is recommended that NEW Water complete an optimization study for the R2E2 processes to evaluate the following:
    a. Digester Performance – Since the anaerobic digestion process does not achieve the design VSR values, more solids are being processed by the downstream equipment. For example, the dewatering centrifuges appear to be overloaded with solids when co- digesting HSW under current and projected future loads although hydraulic throughput is below design values. NEW Water should consider assessing current digester performance with and without HSW and evaluating applicability of any of the digestion enhancement technologies presented in this TM to increase VSR.
    b. Centrifuge Performance – To increase the solids content in the sludge cake and address the “sticky” sludge noted by the staff, a dewatering performance optimization study should be undertaken to evaluate and identify operational and process parameters (including polymer type and dose) that could be implemented. Increasing solids content will reduce the load on the dryer and lower the number of trucks to landfill when incineration is not operational.
    c. FBI Performance – The incineration system, including the dryer, should be assessed in detail to address the current operational issues. It is also recommended to evaluate options to achieve autogenous combustion of solids. This evaluation may include separate ultimate analysis of digester feed sludge to identify whether any of the sludges or HSW has lower than expected heating value, improving dryer

performance to achieve 40 percent solids on a consistent basis, and considering options to install a system that will preheat the fluidization air. It should be noted that increasing cake solids out of the dryer also depends on the dewatering centrifuge performance to increase cake solids.

d. Overall R2E2 Asset Evaluation – Many of the R2E2 components have a lack of redundancy, which results in increased downtime when an individual component or system fails. Some of these components are relatively easy to address. For example, biogas treatment skids may need a redundant blower to feed biogas to the CHP engines when one of the duty engines fail. Other components, such as the thermal oil system, are more complicated. Therefore, it is recommended that NEW Water evaluate the assets on the R2E2 system between the digesters and the ash basins and develop a strategy to increase the uptime of the system through processes such as Criticality Path Analysis and Failure Modes Effects and Criticality Analysis.

The cost of this study is expected to be approximately $0.5M.

3. Assuming the study described above can improve the sludge handling characteristics, a further evaluation and implementation of the biosolids storage system is recommended for providing a wide-spot between the dewatering centrifuges and incinerator. The cost of providing additional storage for dewatered biosolids is estimated to be $15 million.

4. If a solution cannot be found for the sludge handling characteristics, it is likely that NEW Water will either need to achieve future required capacity through consideration of advanced digestion processes or through adding capacity to its existing R2E2 processes. Figure 7-12 summarizes the sequences of these recommendations.

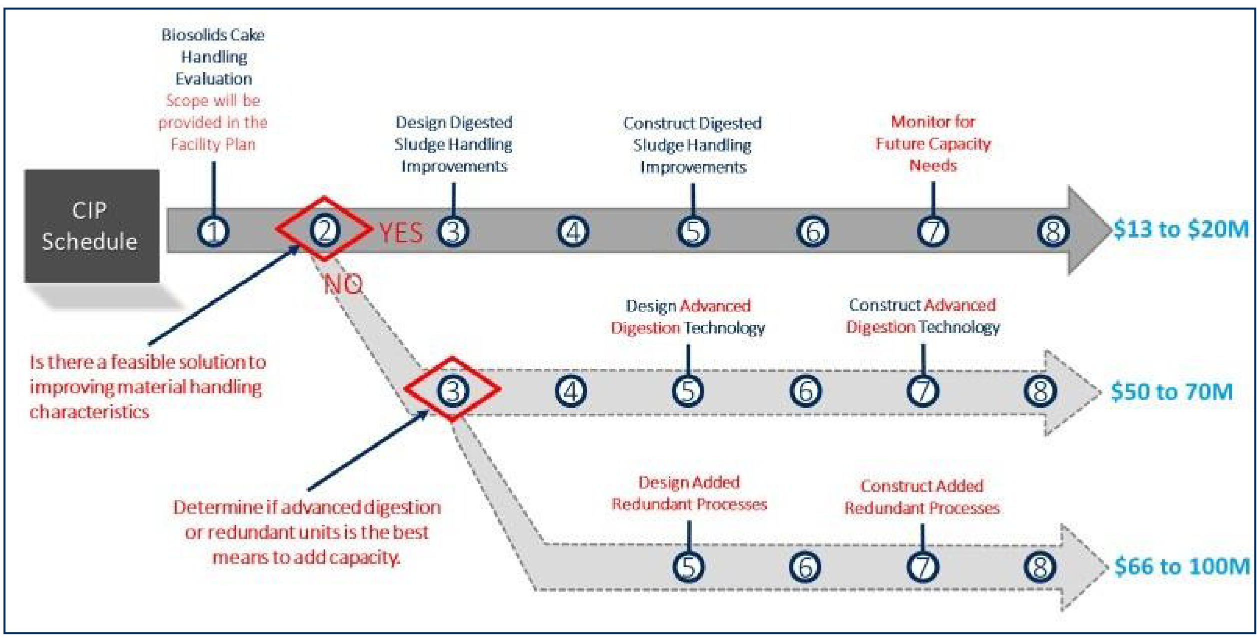


**Figure 7-12 Roadmap for R2E2 Debottlenecking**

It typically takes multiple years to plan, design, and construct a new process such as digestion enhancements; however, NEW Water should consider planning for these studies within the next 5 years.

## 7.6 Summary of Project and Study Recommendations

There are three separate sources of project recommendations that were developed as part of the Facility Plan. The first are projects recommended for the coming 20 years as the result of the analysis summarized in Chapters 6 and 7. These projects along with their primary drivers and estimated capital cost are shown in Table 7-6 and are considered as the basis for the 20-year Facility Plan as they are projects that have a high degree of certainty as needing to occur. The CIP Planning presented in Chapter 8 needs to account for these projects.

**Table 7-6 Projects Based on Facility Plan Analysis**

| Project Recommendations | Facility | Primary Driver(s) | Estimated Total Project Cost in 2021 $M | Source |
|---|---|---|---|---|
| **DPF Wet Weather Management** | | | | |
| UV Disinfection | DPF | Capacity | $3 | Table 6.3 (Previous Project) |
| Equalization | DPF | Capacity | $9 | Table 6.3 |
| **Headworks Screening and Grit Removal** | | | | |
| Mill Pumps | GBF | Capacity | $2 | Table 7.2 |
| Pumping and Headworks | GBF | Capacity | $35 | Table 7.2 |
| Primary Sludge Degritting | GBF | Capacity | $9 | Table 7.2 |
| Sludge Screening | GBF | Capacity | $10 | Table 7.2 |
| Pumping and Headworks at DPF | DPF | Capacity | $25 | Table 7.2 |
| **GBF Thickening Improvements** | | | | |
| Thickening Improvements | GBF | Capacity | $17 | Table 7.3 |
| **Aeration and Nutrient Improvements** | | | | |
| Aeration Basin Improvements (Packages 1 and 2) | GBF | Energy Efficiency | $5 | Table 7.4 |
| Primary Clarifier Improvements | GBF | Asset Replacement | $16 | Table 6.3, Clarifier Rehabilitation Study Engineering Alternatives Report |
| Blowers | GBF | Energy Efficiency | $26 | Table 7.4 |
| North Final Clarifiers | GBF | Asset Replacement | $25 | Table 6.3, Previous Clarifier Rehabilitation Study Engineering Alternatives Report |

| Project Recommendations | Facility | Primary Driver(s) | Estimated Total Project Cost in 2021 $M | Source |
|---|---|---|---|---|
| South Final Clarifiers | GBF | Asset Replacement | $9 | Table 6.3, Previous Clarifier Rehabilitation project |
| Aeration Basin Modifications Expansion | DPF | Capacity | $28 | Table 7.4 |
| Final Clarifiers and RAS | DPF | Asset Replacement | $9 | Table 6.3, Previous Clarifier Rehabilitation Study<br>Engineering Alternatives Report |
| **Energy and Resource Recovery Improvements** | | | | |
| Additional Biosolids Handling and Storage Facilities | GBF | Capacity | $15 | Section 7.5.3.2 |
| Maintenance Building | GBF | Capacity | $3 | NEW Water previous capital improvement planning |
| Total Cost of Projects | | | $243 | |

The second set of projects, which are summarized in Table 7-7, were also developed from the Facility Plan analysis. However, these projects are not likely to be needed in the next 20-years but could be required depending external triggers such as new regulations or increased flows and loadings. The CIP Planning presented in Chapter 8 needs to account for the possibility that some of these projects will likely required in the next 20 years. It is highly unlikely that all these projects would be required and so a total cost of all these projects is not presented.

**Table 7-7 Projects Based on Facility Plan Analysis but Requiring ExternalTriggers**

| Project Recommendations | Facility | Project Trigger | Estimated Total Project Cost in 2021$M | Source |
|---|---|---|---|---|
| Disinfection Improvements | GBF | Investment will be needed if existing disinfection technology cannot meet 2022 discharge permit requirements. | $50 | Table 6.3 |
| Anita MOX Sidestream Nitrogen | GBF | Effluent total nitrogen regulations are implemented | $15 | Table 7.4 |
| Parallel Solids Treatment | GBF | New biosolids regulations and/or loading increase exceeds R2E2 capacity | $80 | Figure 7-2 |
| Tertiary Filtration/High-Rate Treatment | GBF | Lower phosphorus limits and/or a change in the feasibility of adaptive management | $48[1] | NEW Water Phosphorus Compliance Plan |
| South Plant Expansion | GBF | Increased flows and loads at GBF | $40 | Table 6.3 |

(1) Based on midpoint average of the Phosphorous Compliance Action Plan.

The last grouping of projects shown on Table 7-8 are major equipment replacement projects that were identified by NEW Water to be included in the CIP. These projects were not developed as part of the Facility Plan analysis but are projects considered by NEW Water as likely needing to occur in the 2030 to 2040 time period based on the expected end-of-life for various pieces of equipment. Many of the projects shown on Table 7-8 represent replacing equipment associated with the R2E2 project, which will be approaching 20 years old in 2035. The projects do represent an additional capital outlay that should be considered as the long-term CIP projections are developed.

Table 7-8 Projects Estimated by NEW Water for Expected EquipmentReplacement

| Project Recommendations | Facility | Replacement Year | Estimated Total Project Cost in 2021 $M |
|---|---|---|---|
| Air Pollution Control Equipment Renewal (wet electrostatic precipitator (, scrubber, granular activated carbon, continuous emission monitoring) | GBF | 2035 | $8 |
| Dewatering/Drying Equipment Renewal | GBF | 2035 | $2.0 |
| Biogas Generator Replacement | GBF | 2040 | $5 |
| Biogas Collection and Conditioning Equipment Renewal | GBF | 2040 | $4 |
| Heat Exchanger/Thermal Oil System Renewal | GBF | 2040 | $2 |
| Ash Handling System Renewal | GBF | 2035 | $01 |
| Incinerator Sludge Feed Equipment Renewal | GBF | 2035 | $2 |
| RAS/WAS, SEP Pumping Systems | GBF | 2035 | $3 |
| Phosphorus Control - Chemical Feed System | GBF | 2035 | $1 |
| Odor Control Equipment Renewal | GBF | 2040 | $3 |
| Septage Receiving Equipment Renewal | GBF | 2035 | $1 |
| Digester Mixing, Heating, Gas Recovery Renewal | GBF | 2040 | $3 |
| Electrical Distribution System Renewal | GBF | 2050 | $4 |
| Basin Mixer Replacement (30) | GBF | 2040 | $2 |
| Compressor Upgrades | DPF | 2025 | $2 |
| Sludge Storage Tank/Chemical Building Demolition | DPF | 2050 | $1 |
| Electrical Distribution System Renewal | DPF | 2050 | $4 |
| Basin Mixer Replacement (8) | DPF | 2040 | $1 |
| **Total** | | | **$32** |

# 8.0 Capital Improvement Plan Development

Chapters 1 through 7 primarily addressed identifying capital needs. Chapter 8 describes the methodology by which the projects were prioritized and integrated into a CIP. CIPs need to dynamically address the uncertainties associated with future growth in flows and loads, the uncertainties regarding when future regulations may be promulgated, changes in the expected life of equipment, and the amount of money NEW Water and its customers may be willing to spend each year. The goal of this project was to develop a CIP that not only addresses existing and anticipated capital needs but also accounts for those future uncertainties and allows NEW Water to make appropriate CIP adjustments. To accomplish this goal, a financial model was developed that predicts the affordability of planned projects based on existing debt, available new revenue, availability of grant funding, and interest rates. The CIP financial model is a separate deliverable that accompanies this Facility Plan. It is important to note that NEW Water's interceptor-related capital is included in the CIP financial model because it is an important aspect of NEW Water's financial drivers that are outside of this Facility Plan.

## 8.1 CIP Financial Model Development Methodology

Tables 7-6, 7-7, and 7-8 in Chapter 7 collectively show the projects NEW Water expects to implement over the next 20 years as well as additional projects it may be required to implement to respond to new regulations or increased flows and loads. Table 8-1 summarizes the three groups of projects listed in Chapter 7 and the estimated cost of each project. The projects listed on Table 8-1 are early in the planning process, and their actual costs will likely vary from the estimates; therefore, a cost range is also provided.

To understand the financial impact of the CIP, a financial model was developed. The CIP financial model is built around the following four major steps, which are discussed in more detail in the paragraphs below:

1. Initially prioritize projects and establish a target completion year for each project.
2. Perform a MUA to reflect the "benefits" of each project.
3. Develop a formula for the affordability of funding new projects.
4. Execute model scenarios that determine the timing of projects within affordability assumptions.

To develop the CIP financial model, NEW Water first performed an initial analysis of the target completion year to determine when it would be preferable to implement each project (shown on Table 8-1). The target completion year dates do not consider affordability but are simply a preliminary completion date. The target completion year initial prioritization considered the age of equipment, its operational and maintenance challenges, existing or future capacity limitations, and the importance of the project in maintaining permit compliance. The target completion year shown on Table 8-1 is the year that NEW Water needs to start recovering revenue for that project from its customers.

The second step in developing the CIP financial model was to perform a MUA for each project. The MUA results are presented on Figure 8-1. In developing the CIP, the MUA was used to assess a group of projects all scheduled for the same year. The project that provided the greatest benefit to NEW Water would thus get a higher priority for completion in that year. The top set of bars on Figure 8-1 shows the MUA score for the projects using the criteria weighting from the Facility Plan analysis. The projects were evaluated on the operational, environmental, community, and knowledge/information criteria described in Chapter 5. The bottom two sets of bars show the sensitivity of MUA scores to indicate how the MUA scores might reflect an operational or environmental focus project rating. The top set of bars was used in the CIP analysis.

Table 8-2 summarizes the MUA scores and ranks the projects from highest to lowest MUA score. Table 8-2 also shows the MUA ranking when an operational or environmental focus is considered. Table 8-2 indicates that the prioritization does not significantly change with an operational or environmental focused rating.

**Table 8-1 Summary of Projects Recommended for the CIP**

| Facility | Project | Target Completion Year | Estimated Total Project Cost (2021 $M) | Estimated Cost Range (Low/High) (2021 $M) |
|---|---|---|---|---|
| **Near-Term Projects** | | | | |
| DPF | Pumping and Headworks | 2024 | $25 | $21-31 |
| GBF | North Final Clarifiers | 2024 | $25 | $21-31 |
| GBF | Primary Clarifier Improvements | 2024 | $16 | $14-20 |
| GBF | Pumping and Headworks | 2025 | $35 | $30-44 |
| GBF | Thickening Improvements | 2022 | $17 | $14-21 |
| GBF | Biosolids Handling and Storage | 2025 | $15 | $13-19 |
| GBF | Mill Pumps | 2026 | $2 | $2-3 |
| GBF | Primary Sludge Degritting | 2023 | $9 | $8-10 |
| GBF | Blowers | 2029 | $26 | $22-33 |
| DPF | Final Clarifiers and RAS | 2025 | $9 | $8-11 |
| DPF | UV Disinfection | 2027 | $3 | $3-4 |
| GBF | Maintenance Building | 2027 | $3 | $3-4 |
| GBF | South Final Clarifiers | 2029 | $9 | $8-11 |
| DPF | Aeration Basin Improvements | 2026 | $28 | $24-34 |
| DPF | Equalization | 2027 | $9 | $8-12 |
| GBF | Aeration Basin Improvements | 2029 | $5 | $4-6 |
| GBF | Sludge Screening | 2030 | $10 | $9-13 |

| Facility | Project | Target Completion Year | Estimated Total Project Cost (2021 $M) | Estimated Cost Range (Low/High) (2021 $M) |
|---|---|---|---|---|
| **New Regulations and Increased Future Capacity Projects[1]** | | | | |
| GBF | Anita MOX Sidestream Nitrogen | Beyond Planning Period | $15 | $13-19 |
| GBF | UV Disinfection | Beyond Planning Period | $50 | $40-60 |
| GBF | Parallel Solids Treatment Train | Beyond Planning Period | $80 | $66-100 |
| GBF | South Plant Expansion | Beyond Planning Period | $40 | $34-50 |
| GBF | Tertiary Filtration/High-Rate Treatment | Beyond Planning Period | $48 | $41-60 |
| **Future Equipment Replacement Projects[2]** | | | | |
| DPF | Compressor Upgrades | 2025 | $2 | NA |
| GBF | Air Pollution Control Equipment Renewal (wet electrostatic precipitator, scrubber, granular activated carbon, continuous emissions monitoring) | 2035 | $8 | NA |
| GBF | Ash Handling System Renewal | 2035 | $1 | NA |
| GBF | Dewatering/Drying Equipment Renewal | 2035 | $2 | NA |
| GBF | Incinerator Sludge Feed Equipment Renewal | 2035 | $2 | NA |
| GBF | Phosphorus Control - Chemical Feed System | 2035 | $1 | NA |
| GBF | RAS/WAS, SEP Pumping Systems | 2035 | $3 | NA |
| GBF | Septage Receiving Equipment Renewal | 2035 | $1 | NA |
| DPF | Basin Mixer Replacement (8) | 2040 | $1 | NA |
| GBF | Basin Mixer Replacement (30) | 2040 | $2 | NA |
| GBF | Biogas Collection and Conditioning Equipment Renewal | 2040 | $4 | NA |
| GBF | Biogas Generator Replacement | 2040 | $5 | NA |
| GBF | Digester Mixing, Heating, Gas Recovery Renewal | 2040 | $3 | NA |

| Facility | Project | Target Completion Year | Estimated Total Project Cost (2021 $M) | Estimated Cost Range (Low/High) (2021 $M) |
|---|---|---|---|---|
| GBF | Heat Exchanger/Thermal Oil System Renewal | 2040 | $2 | NA |
| GBF | Odor Control Equipment Renewal | 2040 | $3 | NA |
| DPF | Electrical Distribution System Renewal[1] | Beyond Planning Period | $3 | NA |
| DPF | Sludge Storage Tank/Chemical Building Demolition[1] | Beyond Planning Period | $1 | NA |
| GBF | Electrical Distribution System Renewal[1] | Beyond Planning Period | $4 | NA |

Notes:

1. The anticipated project timing is beyond the planning period for this Facility Plan. If an external driver such as a new regulation or increased flow and load occurs, these projects will be pulled forward to the appropriate year.
2. Expected projects are based on projected end of life for the equipment.

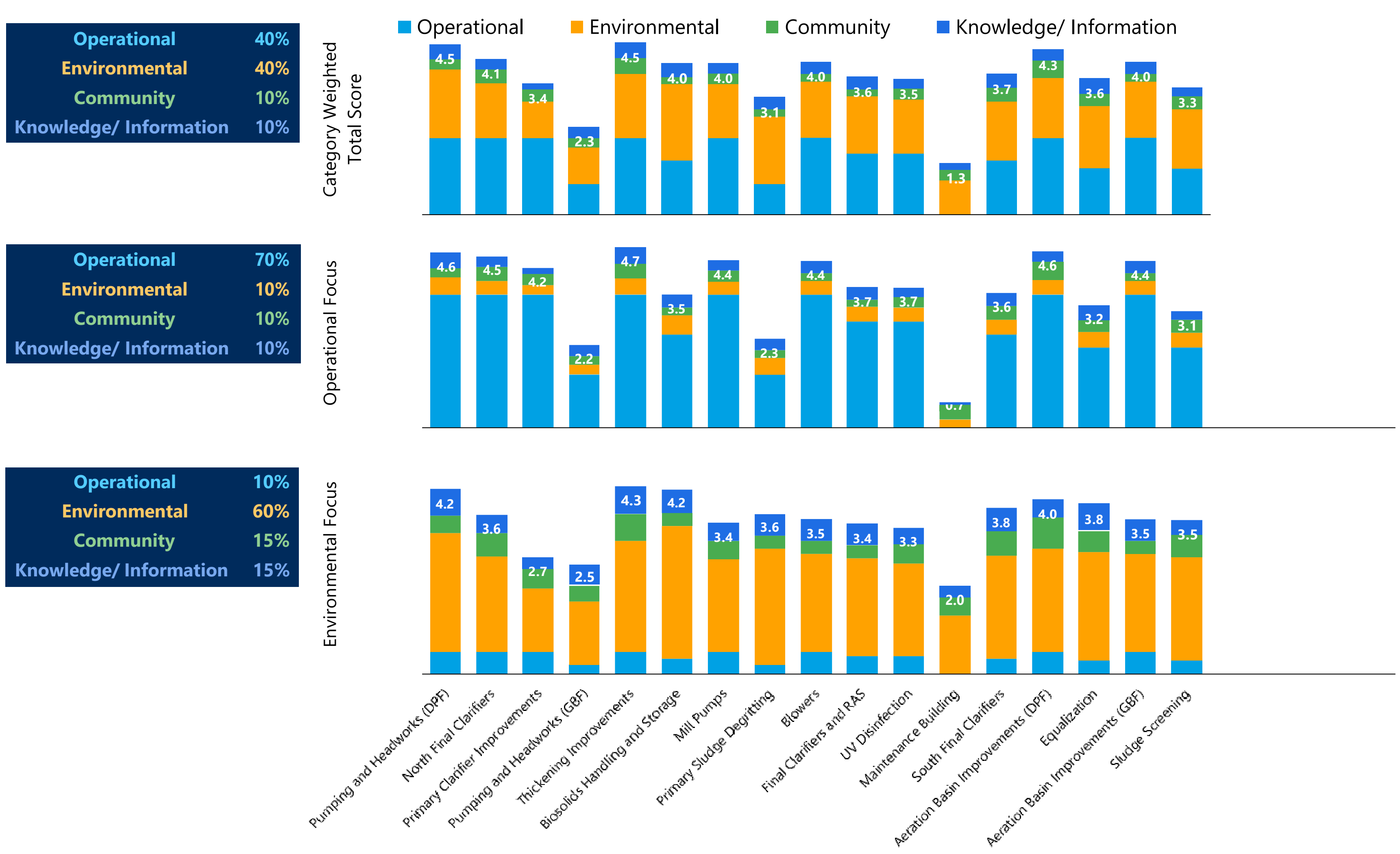


**Figure 8-1** **MUA Scores for Each Project and MUA Sensitivity Analysis**

**Table 8-2 Ranking of CIP Projects by MUA Score**

| Facility | Name | Category Weighted Total Score | Operational Focus Score | Environmental Focus Score |
|---|---|---|---|---|
| GBF | Thickening Improvements | 4.5 | 4.7 | 4.3 |
| DPF | Pumping and Headworks (DPF) | 4.5 | 4.6 | 4.2 |
| DPF | Aeration Basin Improvements (DPF) | 4.3 | 4.6 | 4.0 |
| GBF | North Final Clarifiers | 4.1 | 4.5 | 3.6 |
| GBF | Blowers | 4.0 | 4.4 | 3.5 |
| GBF | Aeration Basin Improvements (GBF) | 4.0 | 4.4 | 3.5 |
| GBF | Mill Pumps | 4.0 | 4.4 | 3.4 |
| GBF | South Final Clarifiers | 3.7 | 3.6 | 3.8 |
| DPF | Final Clarifiers and RAS | 3.6 | 3.7 | 3.4 |
| DPF | Equalization | 3.6 | 3.2 | 3.8 |
| DPF | UV Disinfection | 3.5 | 3.7 | 3.3 |
| GBF | Sludge Screening | 3.3 | 3.1 | 3.5 |
| GBF | Primary Sludge Degritting | 3.1 | 2.3 | 3.6 |
| GBF | Primary Clarifier Improvements | 3.4 | 4.2 | 2.7 |
| GBF | Biosolids Handling and Storage | 4.0 | 3.5 | 4.2 |
| GBF | Pumping and Headworks (GBF) | 2.3 | 2.2 | 2.5 |
| GBF | Maintenance Building | 1.3 | 0.7 | 2.0 |

Each project has an estimated capital cost (Table 8-1), MUA score (Figure 8-1 and Table 8-2), and project driver. Figure 8-2 presents a matrix comparing the cost of projects to the MUA score and primary project driver. This graphic helps illustrate the relative range in project cost, MUA scores, and primary project driver. Figure 8-2 shows that most projects have capacity as their project driver and that the most expansive projects are associated with expanding capacity.

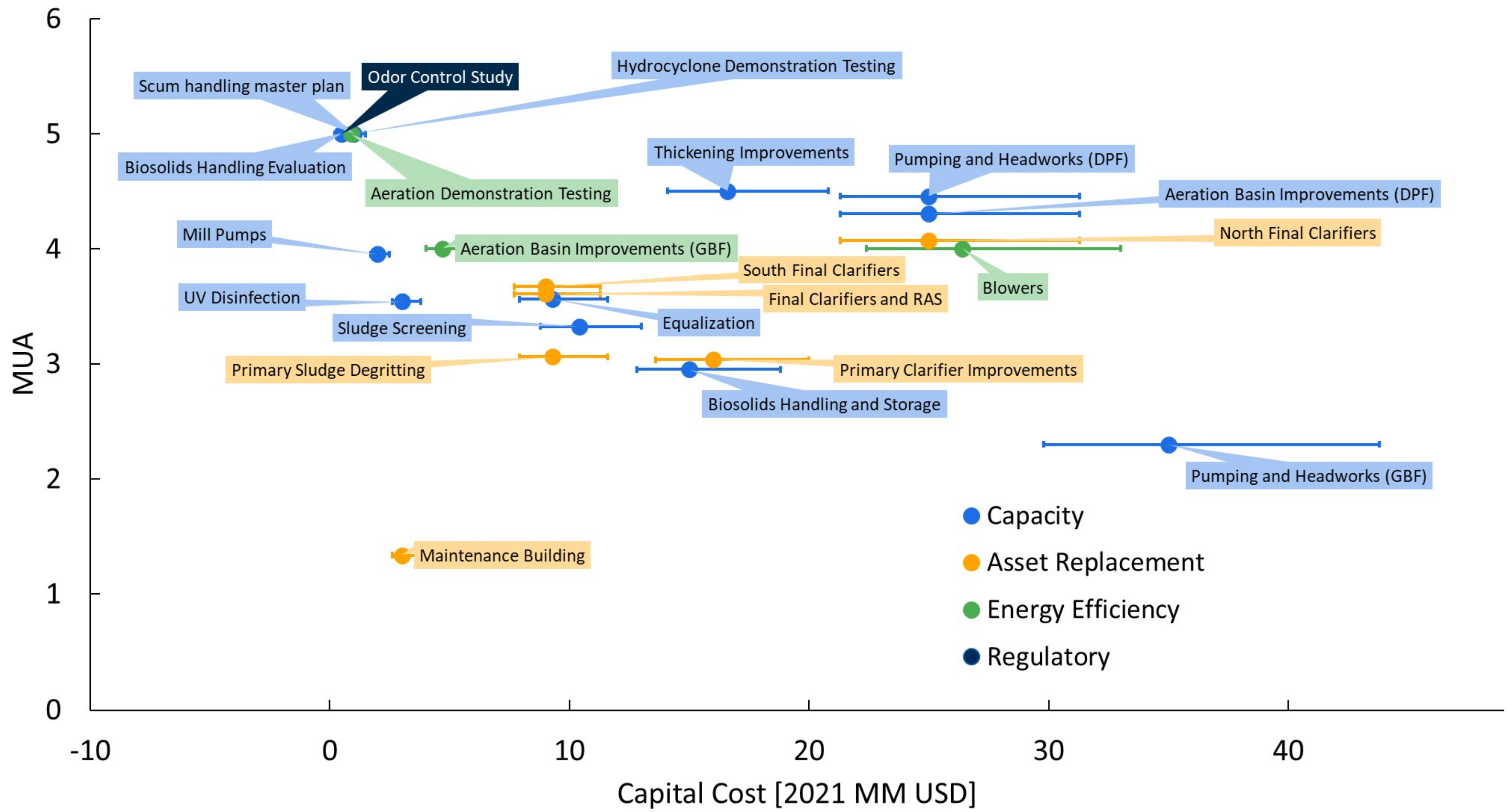


**Figure 8-2 Comparison of MUA Scores to Costs and Project Drivers**

The third step in developing the CIP financial model was to estimate the affordability of each planned project according to the availability of capital to finance new projects through new debt. NEW Water funds its large capital projects primarily through debt, so the affordability of a project is based on the ability to “take on” additional debt service for that project. It is important to note that NEW Water’s interceptor-related capital is included in the CIP financial model as it is an important aspect of NEW Water’s financial drivers that are outside of this Facility Plan. In general, the amount of money available for new debt service is based on the following formula:

Annual Total Revenue Collected by NEW Water

- Less the Annual Costs for O&M
- Less the Annual Costs for **Minor** Capital Projects (cost to fund minor repair and improvement projects where borrowing is not required)
- Less the Annual Costs for Existing Debt Service

= Annual Money Available for New Debt Service

The formula is illustrated on Figure 8-3. The gold line shows a projected amount of total revenue collected by NEW Water for each year over the next 10 years assuming a 3.5 percent annual increase. The light blue bars show costs associated with existing debt service. NEW Water will have a significant reduction in debt service after 2033 when the debt is retired for the largest loan associated with the R2E2 project. The green bars show annual minor capital costs. The remaining money, illustrated by the dark blue bars, shows the new debt service for the target completion year. As shown, the capital needs exceed the revenue generated with an assumed 3.5 percent annual increase**.** The 3.5 percent increase is used only for illustrative purposes and not as a presumed annual revenue increase.

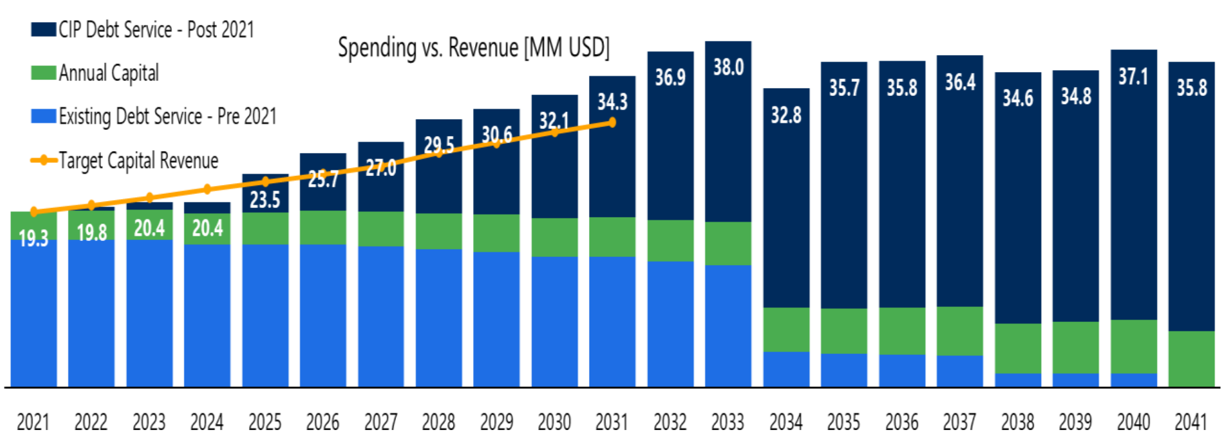


**Figure 8-3 New Water Capabilities for Additional Debt Service Assuming a 3.5 percent Annual Revenue Increase (Gold Line) Versus Needs for Target Completion Year**

The fourth step in developing the financial model was to determine when projects would be affordable. The CIP financial model is designed to automatically perform the following steps:

1. Calculate the amount of money available for each year using the formula described above. The amount of money available will depend on the assumed annual increases for new revenue, existing debt service costs, O&M costs, and minor capital project costs.

2. Attempt to meet a project's target completion year shown on Table 8-1.
3. If there are several projects targeted to start in the same year, prioritize the project with the highest MUA for that year as shown on Figure 8-1 and Table 8-2.
4. If the new project cannot be afforded because the additional debt service cannot be paid within the constraints of Step 1, push back the project 1 year.
5. Repeat Steps 1 to 4 by continually pushing projects back in time until the debt service for that project can be afforded. In general, if the total revenue is assumed to increase annually by a greater amount, NEW Water will be able to afford projects earlier.

Figure 8-4 shows an example of how capital spending and debt service are pushed back time to fit within the constraints of 3.5 percent annual revenue increase.

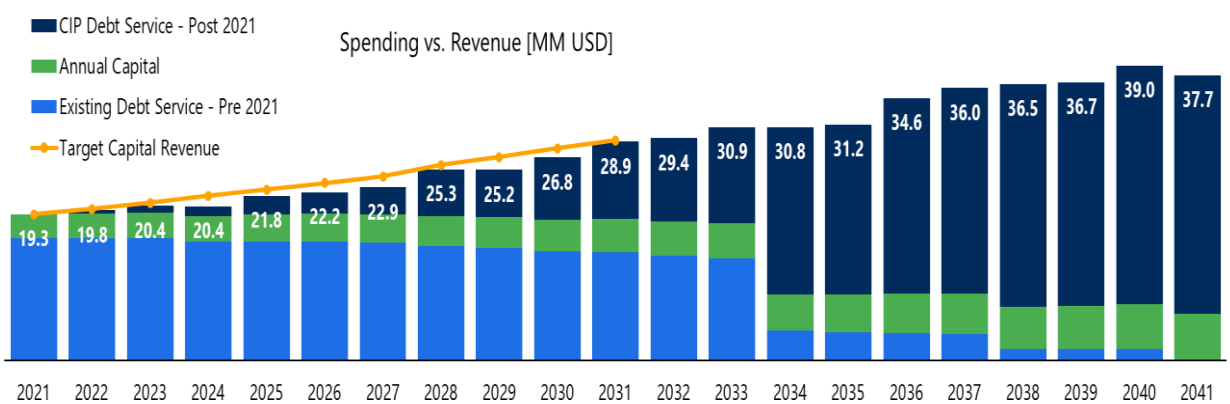


**Figure 8-4 New Water Capabilities for Additional Debt Service Based on a 3.5 Percent Annual Revenue Increase (Gold Line) versus Needs Based on Delayed Project Start Times**

The output of the CIP tool shows the target completion year for each project and the year it can be completed under the assumed revenue and cost projections. The output color codes the projects by how many years the project is deferred beyond the target completion year. (Green shows the target completion year is missed by 2 or less years. Yellow shows the target completion year is missed by 5 or less years. Red shows the target completion year is missed by more than 5 years.)

## 8.2 CIP Financial Model Results

The first CIP financial model analysis assumed moderate (3.5 percent) annual increase in O&M costs and minor capital project costs as well as 2 percent interest rate and no grant funding. This was considered the most likely future condition. The only variable that was adjusted was the growth of total revenue for NEW Water. If total revenue grows at the same 3.5 percent rate as growth in O&M costs and minor capital costs, there is little room to take on new debt service – resulting in significant delays to completion of projects. As total revenue increases at a rate greater than O&M and minor capital costs, there is additional capacity to fund new debt. The results of scenarios for annual target revenue increases varying from 4 percent per year to 7 percent per year are shown in Table 8-3. With a 4.0 percent annual total revenue increase, only two of the near-term projects shown on Table 8-1 can meet their target completion year. At a 5.5 to 6 percent annual total revenue increase, most near term projects meet their target completion year. As annual total revenue increases to 7 percent, all projects meet their target completion year.

However, as previously discussed, other factors can affect the affordability of new capital projects such as varying the assumed interest rate paid for new debt, varying the amount of assumed grant funding, and varying the assumed annual rate of increase for O&M costs or minor capital costs. Table 8-4 presents a sensitivity analysis of these parameters. The intent of the sensitivity analysis is to assess the impact on project completion by changing other assumptions (either higher or lower).

- ✓ **Impact on project affordability based on grant funding**. Table 8-4 shows a comparison of the 6 percent annual revenue increase base case (without grant funding) with a 5.5 percent revenue increase with grant funding. If NEW Water can achieve grant funding levels of about $15 million, it could lower its future revenue needs by about 0.5% but there would be delay of two additional projects. Thus the anticipated grant funding would only marginally decrease the required annual revenue increase. Grant funding above $15 million may become more consequential in reducing future required revenue. While it is clear that the State of Wisconsin will receive additional federal funding in the near-term, it is unclear at this time if NEW Water's infrastructure needs will be eligible for grant funding.
- ✓ **Impact on project affordability based on assumed higher interest rates**. Table 8-4 shows whether assuming a long-term interest rate of 3 percent versus 2 percent would cause project delays. Increasing the assumed interest rate from 2 percent to 3 percent would cause the delay of two additional projects if the annual increase in total revenue was held constant at 6%.
- ✓ **Impact on project affordability based on varied future O&M costs and minor capital costs**. Table 8-4 shows the impact of reducing the annual rate of O&M cost and minor capital cost increases from 3.5 percent to 2.5 percent. Reducing the assumed annual growth rate of O&M and minor capital costs allows for an annual revenue increase to be lowered from 6 percent to 5.5 percent with no additional project delays. Additionally, Table 8-4 presents the impact of O&M and minor capital cost increases from 3.5 percent to 4.5 percent. If the annual O&M and annual minor capital costs increase to 4.5%, the total annual revenue increase will need to increase to 6.5% to provide adequate funding.
- ✓ **Impact on project affordability based on varied annual project escalation**. Table 8-4 then shows the impact of assuming a lower annual escalation cost in projects – from 3 percent to 2 percent. Even with a reduction in the assumed project cost escalation, reducing the annual revenue increase from 6 percent to 5.5 percent would still result in the delay of two projects. Table 8-4 also presents the impact of an increasing project escalation – from 3 percent to 4 percent. If the annual project escalation costs increase to 4% the total revenue would need to increase to 6.5% to complete the projects in a similar time.

Finally, Table 8-1 shows a group of projects currently not scheduled during the 20-year planning period. The need for these projects will depend on future regulations or future capacity requirements. It is possible that one or more of these projects will need to be completed in the next 20 years. In general, NEW Water will have a large capacity to take on new debt to complete these added projects after 2034. If one of these projects should be required before 2034, it would cause appreciable delay to the other projects scheduled between 2025 and 2034 without a significant increase in the annual revenue increases..

## Table 8-3 Impact of Increasing Annual Revenue on Project Completion

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Target Total Revenue Annual Increase | | 4.00% | 4.50% | 5.00% | 5.50% | 6.00% | 7.00% |
| Target O&M Revenue Annual Increase | | 3.50% | 3.50% | 3.50% | 3.50% | 3.50% | 3.50% |
| Annual Capital Annual Increase | | 3.50% | 3.50% | 3.50% | 3.50% | 3.50% | 3.50% |
| Assumed Interest Rate | | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% |
| Include Grant Funding? | | No | No | No | No | No | No |
| Escalation Percentage | | 3.00% | 3.00% | 3.00% | 3.00% | 3.00% | 3.00% |
| Escalation Start Year | | 2021 | 2021 | 2021 | 2021 | 2021 | 2021 |
| MUA Scaling Factor | | 1 | 1 | 1 | 1 | 1 | 1 |
| **Project** | **Desired Year** | **Modeled Year** | **Modeled Year** | **Modeled Year** | **Modled Year** | **Modeled Year** | **Modeled Year** |
| **Near-Term Projects** | | | | | | | |
| DPF Pumping and Headworks (DPF) | 2024 | 2025 | 2024 | 2024 | 2024 | 2024 | 2024 |
| GBF North Final Clarifiers | 2024 | 2029 | 2026 | 2025 | 2025 | 2024 | 2024 |
| GBF Primary Clarifier Improvements | 2024 | 2030 | 2029 | 2026 | 2025 | 2025 | 2024 |
| GBF Pumping and Headworks (GBF) | 2025 | 2034 | 2032 | 2031 | 2030 | 2029 | 2027 |
| GBF Thickening Improvements | 2022 | 2024 | 2023 | 2023 | 2022 | 2022 | 2022 |
| GBF Biosolids Handling and Storage | 2025 | 2031 | 2029 | 2027 | 2026 | 2025 | 2025 |
| GBF Mill Pumps | 2026 | 2033 | 2031 | 2030 | 2029 | 2027 | 2026 |
| GBF Primary Sludge Degritting | 2023 | 2030 | 2026 | 2023 | 2023 | 2023 | 2023 |
| GBF Blowers | 2029 | 2034 | 2034 | 2034 | 2032 | 2031 | 2029 |
| DPF Final Clarifiers and RAS | 2025 | 2032 | 2030 | 2029 | 2027 | 2026 | 2025 |
| DPF UV Disinfection | 2027 | 2034 | 2034 | 2033 | 2031 | 2030 | 2027 |
| GBF Maintenance Building | 2027 | 2035 | 2034 | 2034 | 2032 | 2031 | 2027 |
| GBF South Final Clarifiers | 2029 | 2035 | 2034 | 2034 | 2032 | 2031 | 2029 |
| DPF Aeration Basin Improvements (DPF) | 2026 | 2033 | 2031 | 2030 | 2029 | 2027 | 2026 |
| DPF Equalization | 2027 | 2034 | 2034 | 2032 | 2031 | 2030 | 2027 |
| GBF Aeration Basin Improvements (GBF) | 2029 | 2035 | 2034 | 2033 | 2031 | 2031 | 2029 |
| GBF Sludge Screening | 2030 | 2036 | 2034 | 2034 | 2033 | 2031 | 2030 |
| **Future Equipment Replacement Projects** | | | | | | | |
| GBF Air pollution control equipment renewal (WESP, scrubber, | 2035 | 2037 | 2035 | 2035 | 2035 | 2035 | 2035 |
| GBF Dewatering/drying equipment renewal | 2035 | 2037 | 2035 | 2035 | 2035 | 2035 | 2035 |
| GBF Biogas generator replacement | 2040 | 2040 | 2040 | 2040 | 2040 | 2040 | 2040 |
| GBF Biogas collection and conditioning equipment renewal | 2040 | 2040 | 2040 | 2040 | 2040 | 2040 | 2040 |
| GBF Heat exchanger/thermal oil system renewal | 2040 | 2040 | 2040 | 2040 | 2040 | 2040 | 2040 |
| GBF Ash handling system renewal | 2035 | 2037 | 2035 | 2035 | 2035 | 2035 | 2035 |
| GBF Incinerator sludge feed equipment renewal | 2035 | 2037 | 2035 | 2035 | 2035 | 2035 | 2035 |
| GBF RAS/WAS, SEP pumping systems | 2035 | 2037 | 2035 | 2035 | 2035 | 2035 | 2035 |
| GBF Phosphorus control - chemical feed system | 2035 | 2037 | 2035 | 2035 | 2035 | 2035 | 2035 |
| GBF Odor control equipment renewal | 2040 | 2040 | 2040 | 2040 | 2040 | 2040 | 2040 |
| GBF Septage receiving equipment renewal | 2035 | 2037 | 2035 | 2035 | 2035 | 2035 | 2035 |
| GBF Digester mixing, heating, gas recovery renewal | 2040 | 2040 | 2040 | 2040 | 2040 | 2040 | 2040 |
| GBF Electrical distribution system renewal | 2050 | 2050 | 2050 | 2050 | 2050 | 2050 | 2050 |
| GBF Basin mixer replacement (30) | 2040 | 2040 | 2040 | 2040 | 2040 | 2040 | 2040 |
| DPF Compressor upgrades | 2025 | 2030 | 2027 | 2025 | 2025 | 2025 | 2025 |
| DPF Sludge storage tank/chemical building demolition | 2050 | 2050 | 2050 | 2050 | 2050 | 2050 | 2050 |
| DPF Electrical distribution system renewal | 2050 | 2050 | 2050 | 2050 | 2050 | 2050 | 2050 |
| DPF Basin mixer replacement (8) | 2040 | 2040 | 2040 | 2040 | 2040 | 2040 | 2040 |

**Table 8-4 Sensitivity Analysis of Various Financial Assumptions on Project Completion**

| | | Financial Impact of Obtaining Grant Funding | | Financial Impact of Higher Interest Rates | | Financial Impact of Varied Annual O&M and Annual Minor Capital Cost Increaeess | | | Financial Impact of Varied Annual Escalation Rates | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Target Total Revenue Annual Increase | | 5.50% | 6.00% | 6.00% | 6.00% | 6.50% | 5.50% | 6.00% | 6.50% | 5.50% | 6.00% |
| Target O&M Revenue Annual Increase | | 3.50% | 3.50% | 3.50% | 3.50% | 4.50% | 2.50% | 3.50% | 3.00% | 3.50% | 3.50% |
| Annual Minor Capital Annual Increase | | 3.50% | 3.50% | 3.50% | 3.50% | 4.50% | 2.50% | 3.50% | 3.00% | 3.50% | 3.50% |
| Assumed Interest Rate | | 2.00% | 2.00% | 3.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% |
| Include Grant Funding? | | Yes | No | No | No | No | No | No | No | No | No |
| Escalation Percentage | | 3.00% | 3.00% | 3.00% | 3.00% | 3.00% | 3.00% | 3.00% | 4.00% | 2.00% | 3.00% |
| Escalation Start Year | | 2021 | 2021 | 2021 | 2021 | 2021 | 2021 | 2021 | 2021 | 2021 | 2021 |
| MUA Scaling Factor | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Project** | **Desired Year** | **Optimized Year** | **Optimized Year** | **Optimized Year** | **Optimized Year** | **Optimized Year** | **Optimized Year** | **Optimized Year** | **Optimized Year** | **Optimized Year** | **Optimized Year** |
| **Near-Term Projects** | | | | | | | | | | | |
| DPF Pumping and Headworks (DPF) | 2024 | 2024 | 2024 | 2024 | 2024 | 2024 | 2024 | 2024 | 2024 | 2024 | 2024 |
| GBF North Final Clarifiers | 2024 | 2024 | 2024 | 2025 | 2024 | 2024 | 2024 | 2024 | 2024 | 2025 | 2024 |
| GBF Primary Clarifier Improvements | 2024 | 2025 | 2025 | 2025 | 2025 | 2025 | 2025 | 2025 | 2024 | 2025 | 2025 |
| GBF Pumping and Headworks (GBF) | 2025 | 2029 | 2029 | 2029 | 2029 | 2029 | 2029 | 2029 | 2027 | 2029 | 2029 |
| GBF Thickening Improvements | 2022 | 2022 | 2022 | 2022 | 2022 | 2022 | 2022 | 2022 | 2022 | 2022 | 2022 |
| GBF Biosolids Handling and Storage | 2025 | 2025 | 2025 | 2026 | 2025 | 2026 | 2025 | 2025 | 2025 | 2026 | 2025 |
| GBF Mill Pumps | 2026 | 2027 | 2027 | 2028 | 2027 | 2027 | 2027 | 2027 | 2026 | 2028 | 2027 |
| GBF Primary Sludge Degritting | 2023 | 2023 | 2023 | 2023 | 2023 | 2023 | 2023 | 2023 | 2023 | 2023 | 2023 |
| GBF Blowers | 2029 | 2032 | 2031 | 2032 | 2031 | 2031 | 2031 | 2031 | 2030 | 2032 | 2031 |
| DPF Final Clarifiers and RAS | 2025 | 2026 | 2026 | 2026 | 2026 | 2026 | 2026 | 2026 | 2025 | 2026 | 2026 |
| DPF UV Disinfection | 2027 | 2031 | 2030 | 2031 | 2030 | 2030 | 2030 | 2030 | 2029 | 2031 | 2030 |
| GBF Maintenance Building | 2027 | 2032 | 2031 | 2032 | 2031 | 2031 | 2031 | 2031 | 2030 | 2032 | 2031 |
| GBF South Final Clarifiers | 2029 | 2032 | 2031 | 2032 | 2031 | 2031 | 2031 | 2031 | 2030 | 2032 | 2031 |
| DPF Aeration Basin Improvements (DPF) | 2026 | 2027 | 2027 | 2027 | 2027 | 2027 | 2027 | 2027 | 2026 | 2028 | 2027 |
| DPF Equalization | 2027 | 2031 | 2030 | 2031 | 2030 | 2030 | 2030 | 2030 | 2027 | 2031 | 2030 |
| GBF Aeration Basin Improvements (GBF) | 2029 | 2031 | 2031 | 2031 | 2031 | 2031 | 2031 | 2031 | 2029 | 2031 | 2031 |
| GBF Sludge Screening | 2030 | 2032 | 2031 | 2032 | 2031 | 2031 | 2031 | 2031 | 2030 | 2032 | 2031 |

## 8.3 Other CIP Considerations Based on Project Criticality and Phasing

Tables 8-3 and 8-4 show the challenge NEW Water has meeting its target completion year for near term projects without a relatively large annual increase in revenue. NEW Water can also consider two additional strategies to manage the capital needs – project deferment of less critical projects and project phasing. First, it can potentially defer projects, realizing that there is a consequence in deferring projects. The consequence of deferring projects beyond their target completion years was assessed and Table 8-5 describes the consequence of project deferment and ranks that consequence by high and medium. There are no low consequence projects recommended in the Facility Plan.

**Table 8-5 Impacts of Project Deferment**

| Impacts of Deferment | Consequence Associated with Deferment | Ranking of Consequence |
|---|---|---|
| Cannot meet near-term capacity | Without improvement, NEW Water will not meet the existing or near-term demands of the facility. Risk of sanitary sewer overflows, permit violations, and limitations on growth. | High - Required by target year. |
| Cannot meet future capacity | Without improvement, NEW Water will not meet the long-term demands of the facility. Risk of limiting residential and/or industrial growth in the community. Potential to defer project. | Medium - Project schedule needs to align with timing of capacity need. |
| Cannot meet regulatory requirements | Without improvement, NEW Water faces risks of fines, consent orders, sewer moratoriums and potentially negative impact to public health and the environment. | High - Required by target year. |
| Increased temporary investments | Temporary investment can be made to defer the full rehabilitation, at an increased overall project cost. | Medium - Increased whole-life cost of asset but project can be deferred for up to 5 years or implemented in a phased approach. |
| Decreased reliability | Reliable operation to meet level of service and rated capacity will decrease. | Medium - Increased operational risk for permit but can be deferred for up to 5 years. |
| Increased facility operating costs | Increased cost from energy, chemical, and/or operation. | Medium - Can be deferred; potential areas for near-term, phased implementation and applied research. |
| Decreased level of performance | Limits the ability for NEW Water to continue to meet the level of service currently delivered to customers in the form of environmental or community impacts. | Medium - Deferment may be acceptable. |

As can be seen from Table 8-5, not all impacts of deferment are equal. Some impacts of deferment may require addressing operational challenges or using more energy. While these impacts result in more O&M challenges, and possibly O&M costs, they are manageable while not being preferred. Other impacts of deferment are more consequential as they will result in NEW Water not having required capacity and/or not meeting permit requirements. Meeting target completion years for projects driven by meeting capacity or meeting regulatory requirements is considered most critical. Table 8-6 applies this ranking to the near-term projects. There are five projects where the consequence of deferment is considered medium. With other compensating efforts such as more maintenance or more operational effort, these projects could be deferred to help manage long-term debt.

A second option NEW Water can consider is reducing its debt service by phasing a project. Phasing is an approach where the project would be started on time but would be intentionally performed over a longer period or even separated into separate capital projects. For example, clarifier upgrades or aeration basin upgrades are projects where the same work is repeated across several process units. While it tends to take more managerial time, phasing projects may also need to be considered. Table 8-6 summarizes projects where phasing could be considered. There are at least six projects that could be potentially phased over a longer period should there be a need to manage long-term debt.

A final option for consideration to ease the financial impact of the CIP is alternative funding mechanisms such as utilization of capital reserve funds or 30-year loan terms.

Overall, it will be challenging for NEW Water to achieve its desired project completion without approximately 5.5 to 7 percent average annual revenue increases. The following options may allow for reduced annual revenue increases:

- ✓ Achieve a combination of favorable factors such as more grant funding and lower interest rates and lower increases in the annual O&M budget.
- ✓ Defer medium ranked projects or potentially phase projects to stretch out the long-term borrowing.
- ✓ Consider other means to reduce annual debt costs such as longer-term loan terms.

It is important to note that there are numerous factors that can result in increases to the needed annual revenue increases. For example:

- ✓ Rising interest rates, inflation, and/or higher than anticipated increases in the annual O&M budget.
- ✓ Unanticipated regulatory or capacity-driven infrastructure needs.

Managing the CIP will be an adaptive process where each year NEW Water will need to consider the changes in flows and loads, updates in equipment life, implementation of external regulations, inflationary pressures, and the financial market conditions to decide on what capital improvements it needs to make.

Finally, as discussed in Chapter 9, applied research on developing technologies may lead the identifying more affordable options to meet NEW Water objectives.

### Table 8-6 Project Critically and Potential Phasing

| Facility | Project | Target Completion Year | Total Project Cost (2021 MM USD) | Criticality | Potential Phasing |
|---|---|---|---|---|---|
| DPF | Pumping and Headworks | 2025 | $25 | High - Needed to meet capacity | |
| GBF | North Final Clarifiers | 2025 | $25 | High – Needed to meet regulations | Phase clarifier improvements |
| GBF | Primary Clarifier Improvements | 2025 | $16 | High – Could be mitigated with add O&M | Phase improvements of clarifiers |
| GBF | Pumping and Headworks | 2026 | $35 | High - Needed to meet capacity | Separate influent pumping from screening |
| GBF | Thickening Improvements | 2025 | $17 | High - Needed to meet capacity | |
| GBF | Biosolids Handling and Storage | 2025 | $15 | High - Needed to meet capacity | |
| GBF | Mill Pumps | 2023 | $2 | Low | |
| GBF | Primary Sludge Degritting | 2025 | $9 | Medium – Could be mitigated with added O&M | Phase replacement of gritting processes |
| GBF | Blowers | 2030 | $26 | Medium – would not realize potential savings | Phase blower implementation |
| DPF | Final Clarifiers and RAS | 2026 | $9 | High - Needed to meet capacity | |
| DPF | UV Disinfection | 2030 | $3 | High - Needed to meet capacity | |
| GBF | Maintenance Building | 2025 | $3 | Medium | |
| GBF | South Final Clarifiers | 2030 | $9 | High - Needed to meet capacity | |
| DPF | Aeration Basin Improvements | 2027 | $25 | High - Needed to meet capacity | |
| DPF | Equalization | 2028 | $9 | High - Needed to meet capacity | |
| GBF | Aeration Basin Improvements | 2030 | $5 | Medium – Would not realize potential savings | Phase improvements of each basin |
| GBF | Sludge Screening | 2035 | $10 | Medium – Could be mitigated with added O&M | |

# 9.0 Applied Research Plan – to be completed

# Appendix A. Flows and Loads

# Appendix B. Hydraulic Modeling

# Appendix C. Process Modeling

# Appendix D. Infrastructure Gap Analysis

# Appendix E. Visioning Workshop Materials

# Appendix F. Multi-Attribute Utility Analysis

# Appendix G. Long-Range Plan for De Pere

# Appendix H. Headworks and Screening

# Appendix I. Thickening

# Appendix J. Aeration and Nutrient Control

# Appendix K. Whole Plant Odor Control

# Appendix L. Energy/Nutrients