Northwest Regional Water Reclamation Facility (NWRWRF)

200 Industrial Avenue
Fox Lake, Illinois 60020

Northwest Lake County
FPA 2022 Regional Systems Review

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Prepared by:

Donohue & Associates, Inc.
230 West Monroe Street | Chicago, IL 60606
donohue-associates.com

Donohue Project No.: 14125

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ABBREVIATIONS

ADF	average daily flow
ADWF	average dry weather flow
CMAP	Chicago Metropolitan Agency for Planning
DAF	design average flow
DMF	design maximum flow
DWF	dry weather flow
EBPR	Enhanced Biological Phosphorus Removal
EQ	Equalization
FPA	Facilities Planning Area
GBT	Gravity Belt Thickener
gpd	gallon per day
gpcd	gallons per capita per day
HGL	hydraulic grade line
I/I	Inflow and infiltration
IRSSW	Illinois Recommended Standards for Sewage Works
LCPW	Lake County Public Works Department
MG	million gallons
MGD	million gallons per day
MLE	Modified Lutz-Eddinger
MLSS	Mixed Liquor Suspended Solids
NPDES	National Pollution Discharge Elimination System
NWRWRF	Northwest Region Water Reclamation Facility
NWSS	Northwest Sewerage System
OPCC	Opinion of Probable Construction Costs
PE	Population Equivalent
RAS	Return Activated Sludge
RLEFF	Round Lake excess flow facility
SCADA	Supervisory Control and Data Acquisition S
SOR	Surface Overflow Rate
SSO	sanitary sewer overflow
TN	Total Nitrogen
TSS	Total Suspended Solids
TP	Total Phosphorus
WAS	Waste Activated Sludge

1. OVERVIEW

1.1 PURPOSE

The purpose of this study is to provide a review of the infrastructure and operations of the major elements of the Northwest Regional Water Reclamation Facility (NWRWRF) and the Northwest Sewerage System (NWSS) to ensure the efficient and effective operation of the Regional System serving the Northwest Lake County Facilities Planning Area (FPA). The goal of this review is to establish the existing baseline conditions and operations of the FPA to determine if the systems and equipment are being maintained in a way that best suits the needs of the community now and in the future. This report provides a review of the regional framework, existing systems, planned improvements, and recommended improvements.

1.2 PROJECT BACKGROUND

The Northwest Lake County FPA consists of the Northwest Regional Water Reclamation Facility and the Northwest Sewerage System. Lake County owns and operates the NWSS, which includes approximately 10 miles of interceptor sewers, force mains, and three pump stations. The vast majority of wastewater is delivered to the NWRWRF through the NWSS. Lake County also owns the Round Lake Excess Flow Facility (RLEFF). The RLEFF contains a wet-weather flow lift station, solids separation equipment, and three storage lagoons. Excess flow is temporarily stored to reduce the peak flow rate that the downstream interceptor transports to the NWRWRF. The Village of Fox Lake owns and operates the 12 million gallon per day (MGD) NWRWRF which receives most of its flow from the NWSS. The NWSS serves the Village of Fox Lake as well as eight other entities which are listed below.

1. Harbor Ridge Utilities Inc.
2. Village of Hainseville
3. Lake County Public Works
4. Village of Round Lake
5. Village of Round Lake Beach
6. Village of Round Lake Heights
7. Village of Round Lake Park
8. Village of Lake Villa

1.3 EXISTING FLOWS AND LOADINGS

The current design average flow (DAF) capacity of the NWRWRF is 12 MGD with the ability to treat a peak flow of 30 MGD, which also is the design peak hourly flow. The operating data from 2019 through 2021 was reviewed to analyze flows, loadings, and treatment process performance. The influent data was compared against the facility design parameters as summarized in Table 1-1. Average influent flows and loadings are approximately 50-70% of the design values.

Table 1-1 2019-2021 Average Influent Flows and Loadings

Parameter	Unit	Current Condition (Avg)	Design Condition	% of Design Condition
Flow	MGD	8.29	12.0	69%
BOD_5	lbs/day	14,109	21,520	66%
TSS	lbs/day	15,362	28,520	54%
Ammonia	lbs/day	1,496	2,200	68%
Phosphorus	lbs/day	327	600	55%

The daily NWRWRF influent flows from 2019-2021 are shown in Figure 1-1. Based on the 2019-2021 data, the facility received an average daily flow of 8.29 MGD. Extreme wet weather conditions in the fall of 2019, September 13, 2019, resulted in a maximum daily flow of approximately 27.3 MGD.

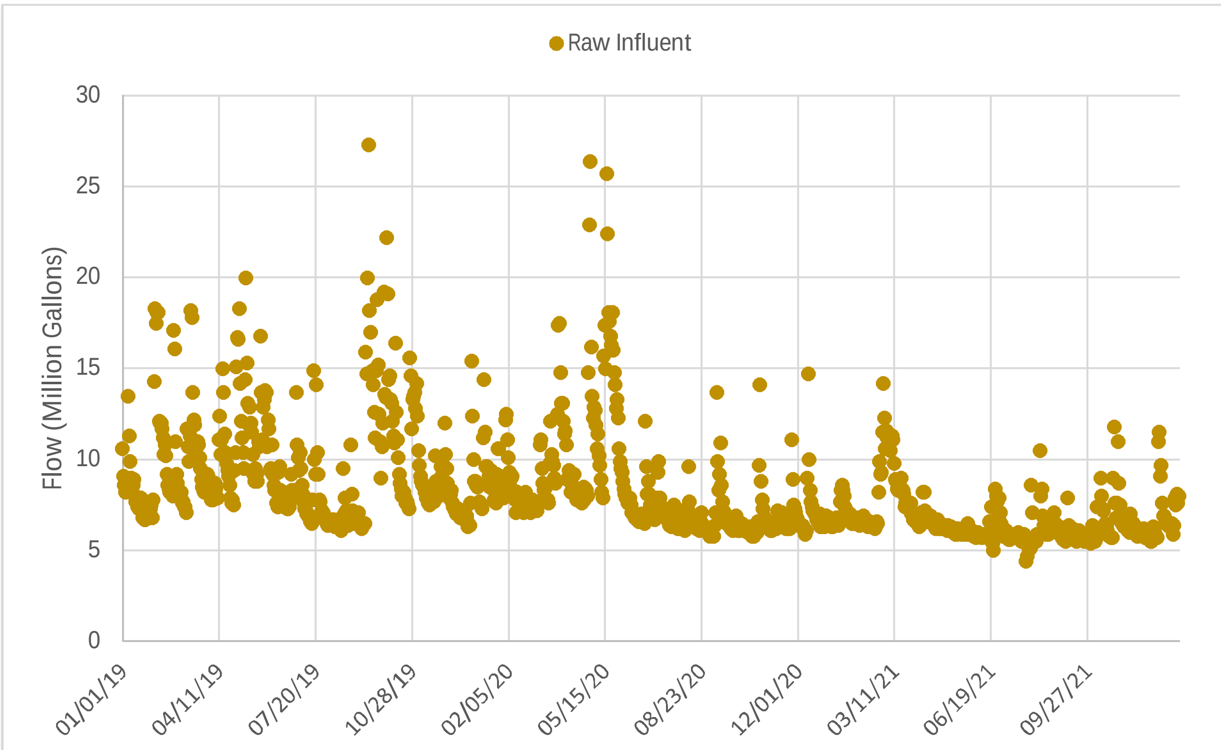

Figure 1-1 Raw Influent Daily Flow 2019-2021

Daily average influent BOD mass loadings from 2019-2021 were below the plant design loading of 21,520 lbs/day. The concentration of BOD in the influent flow averaged 223 mg/L, which is indicative of a predominantly domestic wastewater flow. Influent BOD loadings are shown in Figure 1-2.

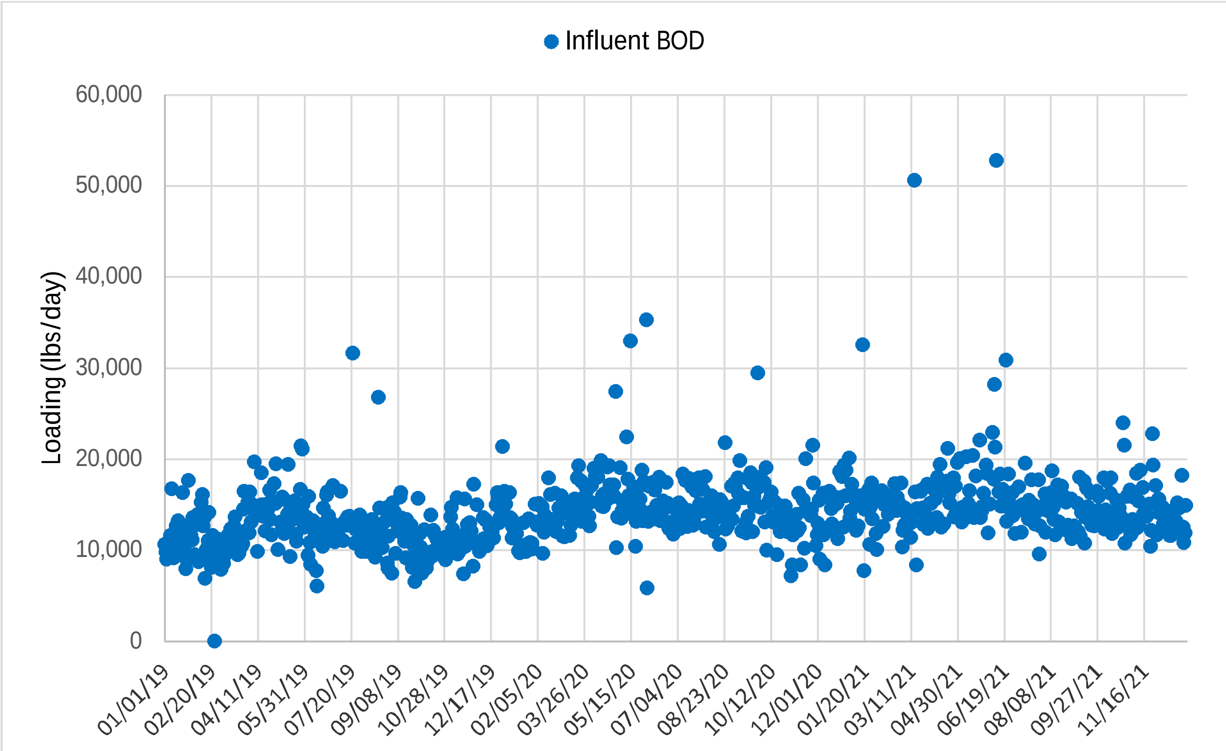

Figure 1-2 Influent BOD Loading 2019-2021

Daily average mass loadings of total suspended solids in the influent flow were comfortably below the plant's design loading of 28,520 lbs/day. The concentration of TSS in the influent flow averaged 238 mg/L from 2019-2021. Influent TSS loadings are shown in Figure 1-3.

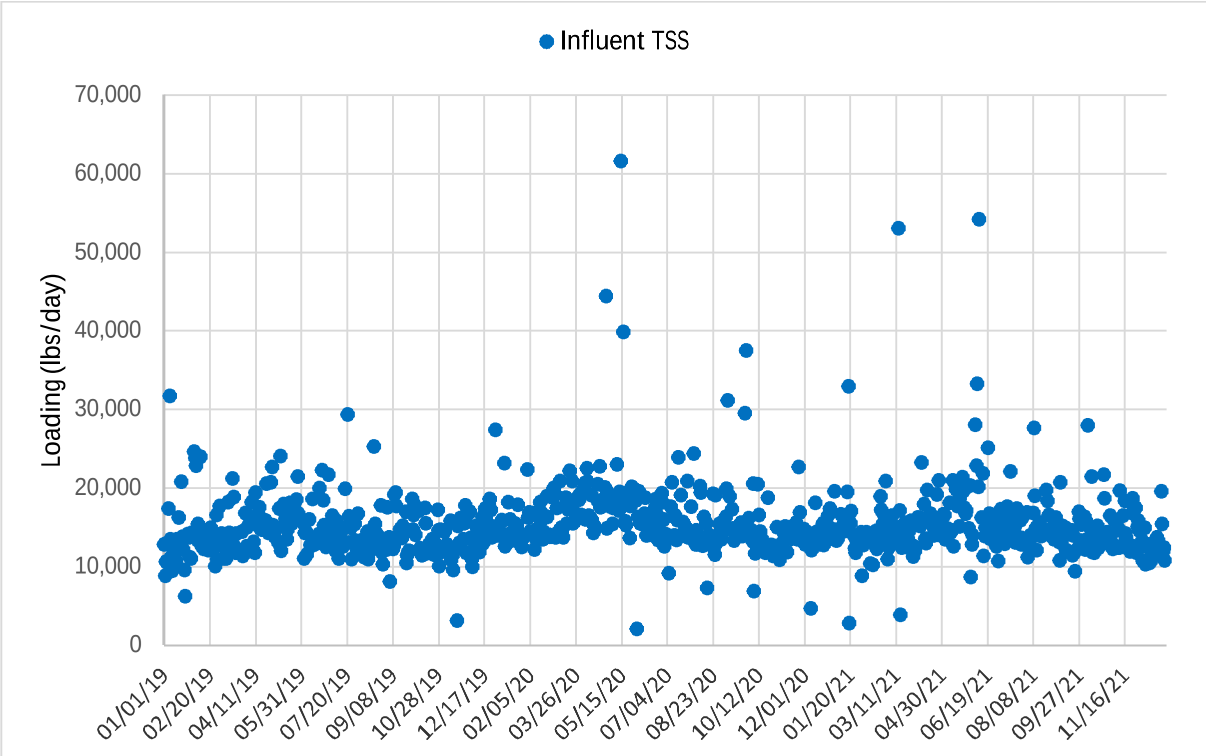

Figure 1-3 Influent TSS Loading 2019-2021

The daily ammonia mass loadings were below the plant design loading of 2,200 lbs/day. The concentration of ammonia in the influent flow to the plant averaged 24 mg/L from 2019-2021, indicative of a typical and normal domestic wastewater flow. Influent ammonia loadings are shown in Figure 1-4.

The ammonia loading reaching the biological Modified Lutzack-Ettinger (MLE) Process is greatly increased by the high concentration of ammonia that exists in the sidestream flow that is returned from the sludge dewatering process (centrate). The existing ammonia concentration of the centrate is 101 mg/L, the centrate average flow is 0.74 MGD and peak flow 1.49 MGD. When the MLE tanks were designed they were not sized to accommodate the ammonia load in the return flow from the digesters. Due to the increased ammonia loading, the biological process becomes stressed to the point that operations staff must place additional aeration tank volume on-line to achieve sufficient nitrification. This deficiency in capacity will become problematic as the plant approaches the design flow (12 MGD). Alternative solutions for ammonia removal for the sidestream are presented later in the report.

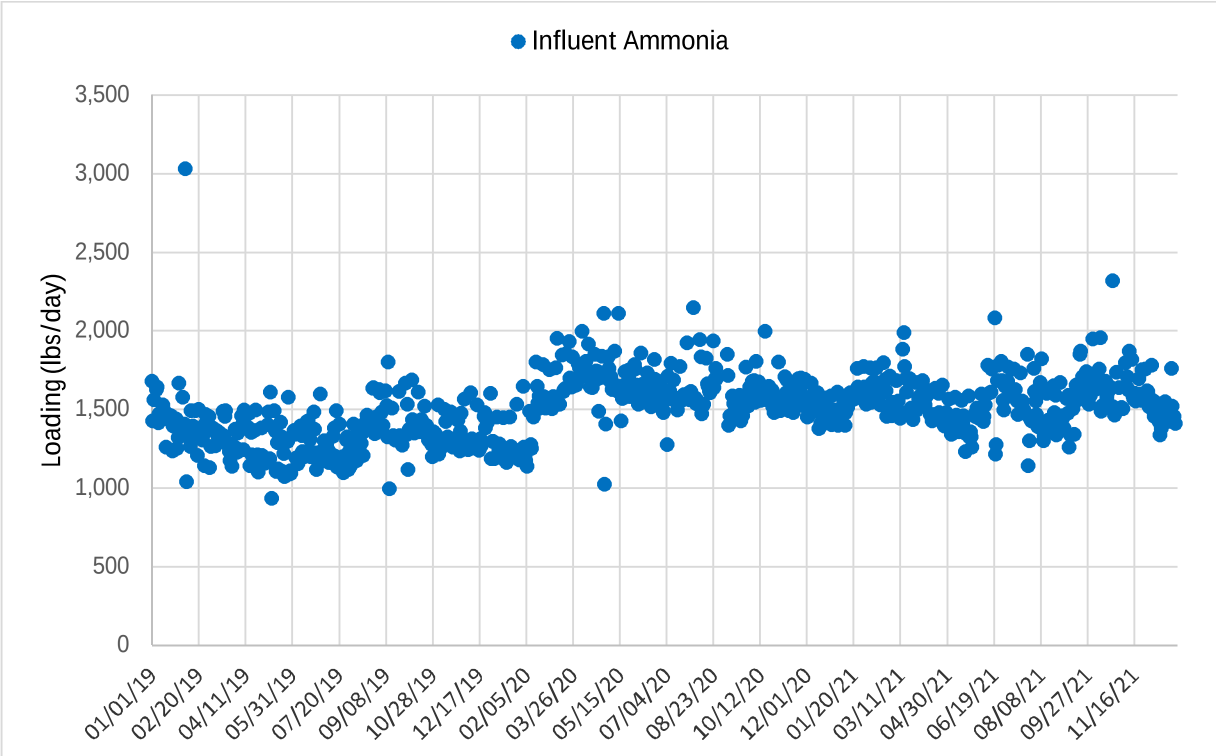

Figure 1-4 Influent Ammonia Loading 2019-2021

The average daily mass loading of total phosphorus (TP) was 327 lbs/day in comparison to the plant design loading of 600 lbs/day. The concentration of TP in the influent flow averaged 5.1 mg/L from 2019-2021. Influent TP loadings are shown in Figure 1-5.

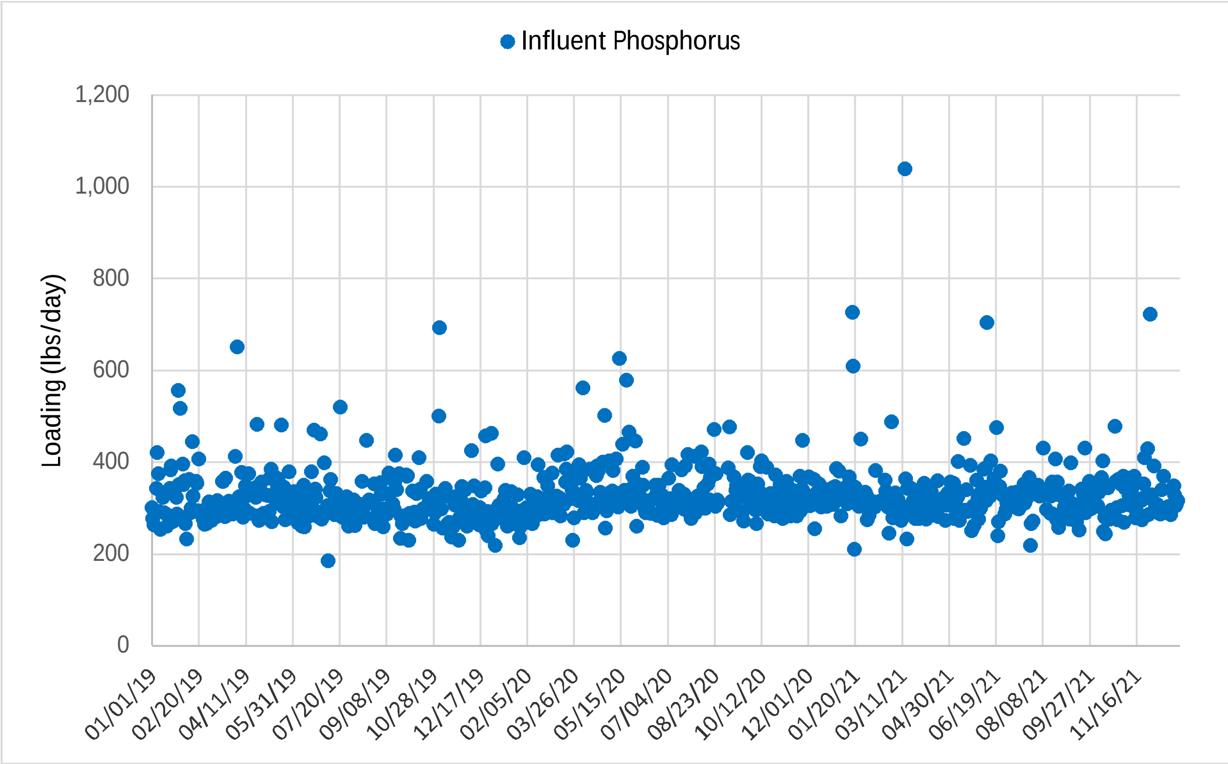

Figure 1-5 Influent Phosphorus Loading 2019-2021

1.4 FUTURE FLOWS AND LOADINGS

As stated, the current permitted design average flow (DAF) capacity of the NWRWRF is 12 MGD, with a design maximum flow (DMF) of 30 MGD. From 2019-2021, the facility received an average daily flow (ADF) of 8.29 MGD, and the maximum daily flow seen at the plant was 27.3 MGD.

The NWSS and NWRWRF serve the Village of Fox Lake, Harbor Ridge Utilities Inc., Village of Hainesville, Lake County Public Works, Village of Round Lake, Village of Round Lake Beach, Village of Round Lake Heights, Village of Round Lake Park, and the Village of Lake Villa. The 2050 CMAP population projections for the community served is presented in Section 2 of this report.

2. NORTHWEST REGIONAL INTERCEPTOR SEWER SYSTEM

2.1 SYSTEM BACKGROUND

The NWSS as discussed, is owned operated and maintained by Lake County and comprised of interceptor sewers, three major pump stations and an in-system excess flow storage facility. A Northwest Interceptor Capacity Analysis Report was completed by Donohue in 2022 to identify recommended improvements and flow storage capabilities. The "Sanitary Sewer Modeling & Capacity Analysis Northwest Interceptor Sewer Service Area" is included as Appendix A to this report. Future flows estimation was conducted as part of this analysis.

2.2 FUTURE FLOW ESTIMATION

2.2.1 PER CAPITA FLOWS

Future flows were based on 2050 Chicago Metropolitan Agency for Planning (CMAP) population projections. Existing daily average flows to the NWRWRF is about 7.4 MGD based on population served of 90,000, or 82 gallons per capita per day (gpcd). Note, this method for flow analysis differs from plant data. Residential and business water consumption is approximately 49 gpcd and 5 gpcd, respectively. The remaining 28 gpcd can be ascribed to baseflow (Figure 2-1). Future per population equivalent (PE) flow rates were conservatively assigned 50 gpcd of residential sanitary sewage flow and 15 gpcd of business flow with a diurnal pattern applied to account for the peaking factor. New sewers tend to utilize improved construction methods and experience less inflow and infiltration (I/I) than existing sewers, therefore future population growth was ascribed 15 gpcd of constant baseflow, for a total of 80 gallon per day (gpd) per PE.

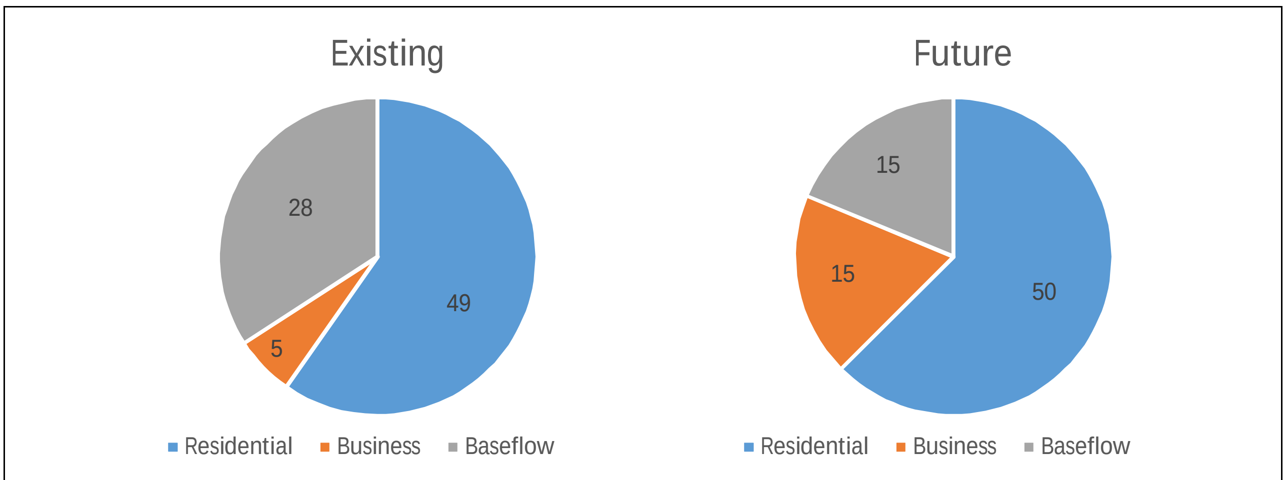

Figure 2-1 – Existing and Future Per Capita Flows

2.2.2 FUTURE SERVICE AREA

The service area of the NWRWRF is expected to expand. Some of this expanded flow will reach NWRWRF through interceptors not owned by Lake County Public Works (LCPW). However, since all flow must be treated at the plant, any additional flow to the NWRWRF may increase the amount of flow diverted to the RLEFF during storm events.

2.2.3 SUMMARY OF INCREASED SANITARY FLOWS

Increases in sanitary flow to the system were analyzed in the "Sanitary Sewer Modeling & Capacity Analysis Northwest Interceptor Sewer Service Area" and are summarized below. The full analysis and report can be found in Appendix A. The anticipated increase in sanitary flow is due to a combination of increased service area and 2050 CMAP population projections.

The resultant population projections and increased average dry weather flow (ADWF) are as follows:

Residential Flow:	65 gpcd
Business Flow:	15 gpcd
Infiltration:	+ 15 gpcd
Total:	80 gpcd
CMAP Population Growth:	X 26,458 PEs
2050 CMAP Additional Flow:	2.12 MGD
Petite Lake:	+ 0.68 MGD
Tall Oaks:	+ 0.13 MGD
Total Future Flow:	2.93 MGD
Existing ADWF:	+ 6.52 MGD
Total 2050 ADWF:	9.45 MGD (45% increase)
Existing Wet Weather Flow:	+ 0.88 MGD
Total 2050 Daily Average Flow:	10.33 MGD

The NWRWRF is permitted for an average daily flow of 12 MGD and is capable of treating the 2050 sanitary flow projections of 10.33 MGD. Along with sanitary dry weather flow, the NWRWRF must be prepared to treat wet weather flow.

2.3 HYDRAULIC EVALUATION

A hydraulic evaluation was completed as part of the interceptor report to determine wet weather flow predictions to the NWRWRF.

2.3.1 10-YEAR DESIGN STORMS

The 10-year recurrence level interval was selected as the desired level-of-service. Because of the wide range of times of concentrations throughout the system, a range of 10-year design storms were used, from 1 hour to 24 hours. Due its critical nature in the prevention of Sanitary Sewer Overflows (SSO), the RLEFF was evaluated to contain the 100-year-24-hour design storm. The analysis completed assumed all flow beyond the 30 MGD wet weather capacity at the NWRWRF be sent to the RLEFF. Based on conversations with plant staff, communications with the County have been poor in the past during large rain events causing issues at the plant. The possibility of an onsite flow equalization (EQ) basin at the NWRWRF will be considered.

2.3.2 FUTURE FLOW IMPACTS

Future flows were input into the model and the 10-year design storms re-run to ascertain the impact on the collection system. The primary impact is that with the additional flow to the NWRWRF, additional flow must be diverted to the RLEFF, or an onsite flow EQ basin at the NWRWRF.

2.3.3 ROUND LAKE SANITARY DISTRICT FLOW EQUALIZATION FACILITY

According to record drawings, the RLEFF has a total storage volume, when empty, of approximately 27 Million Gallons (MG). A normal water surface elevation of 750.00 (NAVD 88) should be maintained to keep the diffusers submerged, utilizing about 7.3 MG of basin storage, leaving 19.6 MG available for wet weather storage.

Due to its essential nature in preventing SSOs, the 100-year-24-hour storm was run through the model to determine whether there is sufficient storage capacity for a storm of this magnitude. Table 2-1 shows the results of the 100-year-24-hour storm capacity requirements for existing conditions and future (2050) flow conditions. The RLEFF provides sufficient storage for existing conditions under this storm event, but will require an additional 1.1. MG of storage capacity to accommodate future flow conditions under this storm event. Regardless, this is a higher level-of-service than the 10-year goal for sewers as outlined in the interceptor report.

Table 2-1: Round Lake Excess Flow Facility Storage Volumes

	Existing	Future (Year 2050)
Available Storage	19.6 MG	19.6 MG
Max Volume Required	16.5 MG	20.7 MG
Storage Remaining	3.1 MG	(1.1) MG
% Full	84%	106%

**Negative values indicated using parentheses.*

2.4 RECOMMENDED IMPROVEMENTS

The recommended improvements to the County system are outlined in the Interceptor Report in Appendix A. Based on the report, the RLEFF should be utilized under wet weather conditions. Communications between the County and the NWRWRF have caused issues in the past in mitigating wet weather. To eliminate necessary coordination between the two entities, an alternative to create storage onsite at the NWRWRF rather than the RLEFF will be discussed in this report.

3. NORTHWEST REGIONAL WATER RECLAMATION FACILITY

3.1 PLANT OVERVIEW

The NWRWRF was constructed in 1979 with a capacity to treat a DAF of 6 MGD. In the early 1990s, the plant was expanded to treat a DAF of 9 MGD with capacity to treat a DMF of 22.5 MGD. The treatment facility was most recently expanded in 2012 to increase the average flow treatment capacity of 12 MGD with the ability to treat a peak flow of 30 MGD. The 2012 expansion included conversion of the secondary treatment process from single-stage nitrification to a Modified Lutz-Eddinger (MLE) process. Figure 3-1 shows the overall schematic of the NWRWRF.

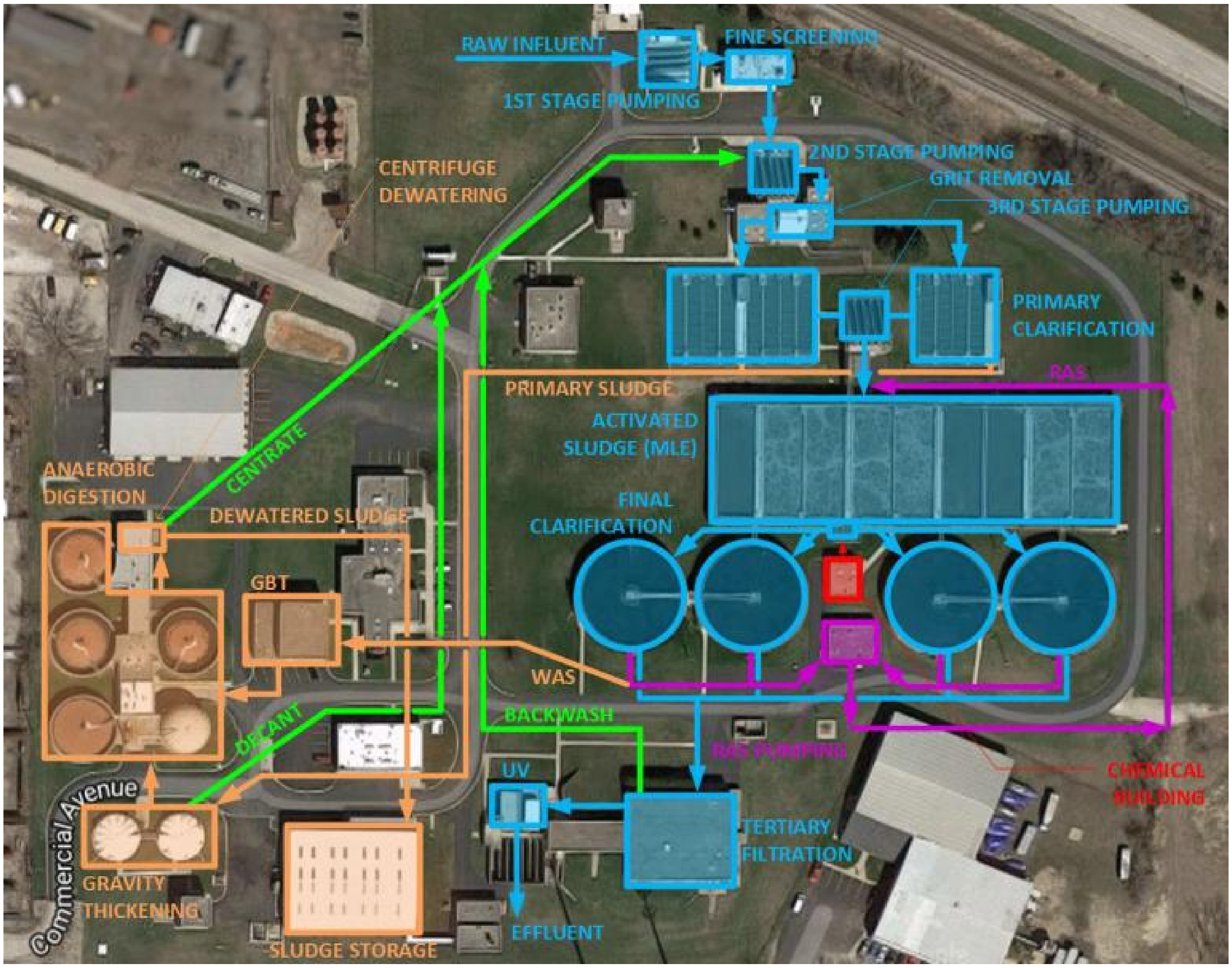

Figure 3-1: Overall NWRWRF Schematic

The NWRWRF currently employs first stage (raw sewage) pumping, fine screening, second stage (screened sewage) pumping, grit removal, primary clarification, primary effluent pumping, secondary treatment (MLE activated sludge process), secondary clarification, tertiary filtration, UV disinfection, primary sludge gravity thickening, waste activated sludge (WAS) gravity belt thickening, anaerobic digestion, centrifuge dewatering, and dewatered cake storage. The DAF existing capacity of the NWRWRF is 12 MGD, and the DMF as well as the DPHF are 30 MGD.

Raw wastewater is pumped through the first stage pumping station to screening. The pump station consists of five screw pumps each rated for 7.5 MGD. The firm capacity of the station is 30 MGD with one pump out of service. Hydraulic limitations upstream in the NWRWRF limit the flow at the pump station to 30 MGD even though the station has the ability to run at 37.5 MGD with all five pumps running.

The two fine screens are mechanical with perforated-plate screens with 6 mm openings. The screens can be bypassed using a manually cleaned bar rack. Regular maintenance is performed on the screens, but no major deficiencies were noted.

After screening, the sewage is pumped to grit removal by the second stage pumping station. The second stage pumping station is practically identical to the first stage pumping station utilizing a total of five screw pumps. The firm capacity of the pump station is 30 MGD with each screw pump rated at 7.5 MGD.

Three Eutek Headcell grit tanks are used for grit removal. The underflow from the grit tanks is pumped to a Eutek Slurrycup Snail grit washing and dewatering system.

The wastewater flows by gravity from girt removal to six primary clarifiers. The primary clarifier influent channel poses one of the main hydraulic bottlenecks in the facility because its peak flow capacity is 30 MGD. To avoid overflow of the channel, the plant is restricted to a capacity of 30 MGD. No major deficiencies were noted for primary clarification.

Primary sludge and scum from the primary clarifiers are pumped to gravity thickening for anaerobic digestion. Primary effluent is pumped from the third stage pumping station to the activated sludge basins. The pumping station is identical to the first and second stage pumping stations. The station has five screw pumps total, with four providing a firm capacity of 30 MGD.

The activated sludge basins consist of three parallel trains with three tank passes each, arranged in a MLE process for nutrient removal. Within each of the three trains the first pass serves as a denitrification reactor. Return activated sludge (RAS) and recycled flow from downstream are brought back to the first pass, accounting for approximately 200% of the forward flow through biological treatment. The NWRWRF must run all three MLE trains to maintain ammonia compliance. Although ammonia limits and nitrification are currently maintained, the three train MLE process is not capable of complete nitrification at the full design capacity of 30 MGD. It is recommended to treat side stream flow to remove the ammonia load being recycled from the solids processing. Several alternatives shall be discussed later in the report.

The mixed liquor from the activated sludge process is dosed with ferric chloride for chemical phosphorus removal before flowing to four secondary clarifiers. Three of the clarifiers are typically in operation with the fourth clarifier brought online during wet-weather events. Secondary clarifier 1 was rebuilt in 2021 and the NWRWRF plans to rebuild secondary clarifiers 2-4 in the coming years.

RAS from the secondary clarifiers is pumped back to the inlet of the activated sludge basins. The clarified secondary effluent flows by gravity to seven disc filters for tertiary filtration. The filter building has room for one extra disc filter to be installed in the future. No deficiencies were noted.

The filtered effluent flows by gravity to UV disinfection. The UV disinfection equipment is installed in a portion of the old chlorine contact tanks. The UV disinfection system control panel was replaced in 2017 due to its inability to successfully interface with the plant Supervisory Control and Data Acquisition (SCADA) system. The main deficiency noted was the condition of the concrete structure. The concrete in many places is deteriorating and needs to be patched and replaced. If major repairs are made to the UV structure, raising the system should also be considered. The water level in the UV channel could be raised approximately 5 feet without causing hydraulic issues with the disc filters. This would provide 5 feet of additional head which would help push more flow through the outfall sewer.

The UV system discharges to a series of pipes that carry the final effluent to the main discharge point (Outfall 001) in the Fox River. Outfall 001 is a 48 inch fiberglass pipe that runs under Pistakee Lake and discharges at the point where the Pistakee Lake empties into the Fox River. Outfall 002 is an overflow flume that discharges into Pistakee Lake when the final effluent flows are “greater than 22.5 MGD and high lake levels” according to the 2021 National Pollution Discharge Elimination System (NPDES) permit.

Outfall 001 is the primary outfall and Outfall 002 is the secondary outfall that discharges when the plant experienced high flows, or the Fox River is at high water levels. At high flows and high lake levels, Outfall 001 cannot handle the effluent flow and Outfall 002 is utilized to discharge to the lake. The issue with defining high water levels is that the use of Outfall 002 is affected by both flow rate and the elevation of the Fox River. Flow through Outfall 002 is not controlled; at a hydraulic grade of 745.59 above sea level or higher the effluent flow overtops the Outfall 002 weir and begins to discharge to the lake. Hydraulic grade is impacted by both the downstream water level and flow rate through the system making it very difficult to provide a definitive flow rate at which Outfall 002 begins to discharge.

The replacement of the Outfall 001 would result in the ability to handle higher peak flows practically eliminating the need to discharge through Outfall 002. The *2015 Five-Year Facility Assessment* report states the approximate replacement of the sewer would cost $22.5 million. Alternatively, the construction of an onsite EQ tank could provide an additional buffer to insulate the facility from future and present peak flows. This alternative will be investigated later in the report.

Primary sludge from the primary clarifiers is pumped to two gravity thickener tanks where it mixes with plant effluent and undergoes thickening from 2% to 5% solids concentration. The gravity thickened sludge is pumped to anaerobic digestion and supernatant is pumped back to the second stage pumping station.

WAS is thickened using two gravity belt thickeners (GBT). Five anaerobic digesters are used to stabilize the primary and secondary solids. The digested sludge is then pumped to two centrifuge units for dewatering. Only one centrifuge unit is operated at a time because of inadequate electric power to the building. The dewatered cake reaches approximately 25% solids content and is transferred via truck to the cake storage building. The cake in the building is hauled and land applied by private haulers. No deficiencies were noted, only the need to eventually expand storage capacity as the sludge quantity requires it.

Digester gas is utilized by boilers to heat the digesters. The excess biogas is flared or utilized by the cogeneration system installed in 2012.

3.2 EXISTING HYDRAULIC CAPACITY

The current permitted average flow capacity of the NWRWRF is 12 MGD with a design maximum flow of 30 MGD. The plant flow is pumped by three screw pump stations, each having four duty screw pumps with one pump on standby. Approximately 1 MGD of return flow from side stream processes joins with flow just upstream of the second stage pump station. Consequently, the actual firm DPHF capacity of the NWRWRF is approximately 29 MGD of influent wastewater due to the 1 MGD of recycled flow. Once influent flows pass 22.5 MGD Outfall 002 may be required. To eliminate effluent discharge to Outfall 002 the influent flow to the plant must remain under the existing target peak influent flow of approximately 22.5 MGD.

Using the fifth screw pump at each of the three pump stations increases the pumped flow to approximately 37.5 MGD. However, this flow rate is currently not hydraulically sustainable by the facility beyond several minutes due to strain on the second stage pump station belt drives and the overflow of the primary clarifier influent channel.

Since the RLEFF was built, the RLEFF has reduced peak flows to the plant as it was designed, especially in wet weather situations. Over the past three years the influent flow has seen a peak capacity of 27.3 MGD, which occurred on September 13, 2019.

For future peak flows, the hydraulic capacity of the NWRWRF will likely be exceeded due to increased frequency of large storm events. However, with current population projections, peak flows of higher than 30 MGD do not seem likely for the next 15-20 years. Onsite storage of excess flow at the NWRWRF would provide an additional buffer for the facility when peak flows rise above 22.5 MGD, and would provide further protection beyond the use of the RLEFF. Additionally, onsite EQ basins would provide flexibility in operations at the NWRWRF.

3.3 EXISTING TREATMENT EFFECTIVENESS

The NPDES permit under which the NWRWRF is operating was most recently renewed in 2021 and is set to expire in 2026. The key effluent limitations are summarized in Table 3-1 below:

Table 3-1: NPDES Permit Limitations

Parameter	Monthly Average Concentration (mg/L)	Daily Maximum Concentration (mg/L)	Monthly Average Load (lbs/day)	Daily Maximum Load (lbs/day)
$CBOD_5$	10	20	1,001	2,002
TSS	12	24	1,201	2,402
Ammonia Nitrogen				
April-May & Sept-Oct	1.0	2.2	75	165
June-August	1.0	2.5	75	188
November-February	-	2.7	-	270
March	1.5	2.2	113	220
Total Phosphorus	1.0	-	100	-
Chloride	500	-	50,040	-

Figure 3-2 and 14Figure 3-3 show the plant performance in from 2019 through 2021 in terms of final effluent carbonaceous BOD_5 ($CBOD_5$) concentrations and loading and total suspended solids (TSS) loadings, both based on the individual 24-hour composite samples. The NWRWRF operated within the effluent limitations for both of these parameters.

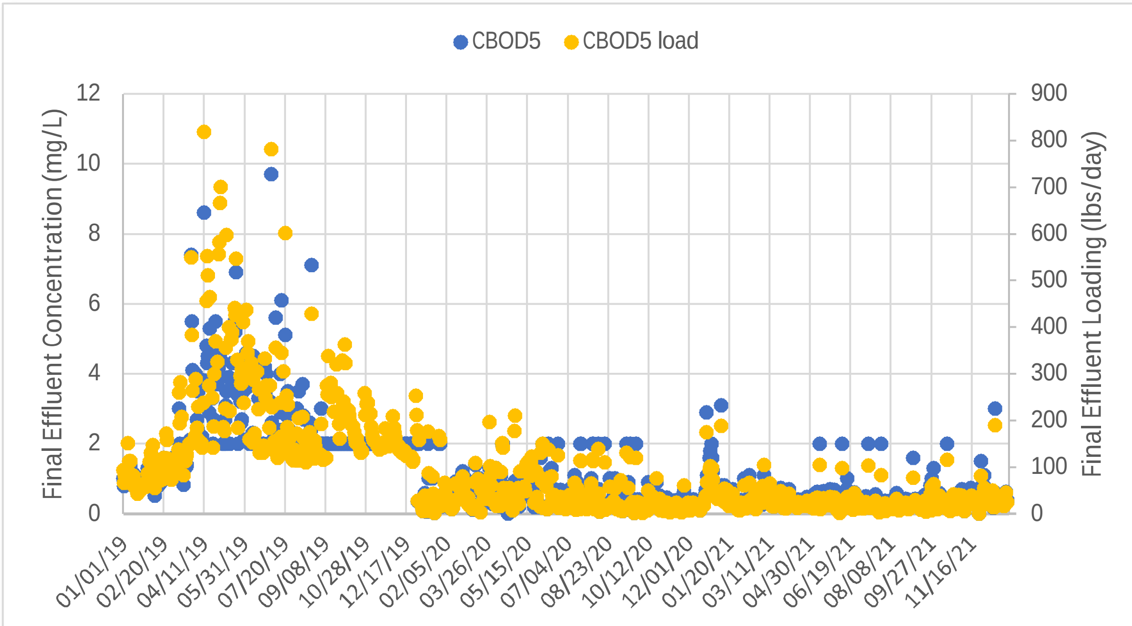

Figure 3-2: Effluent CBOD5 Concentrations and Loadings

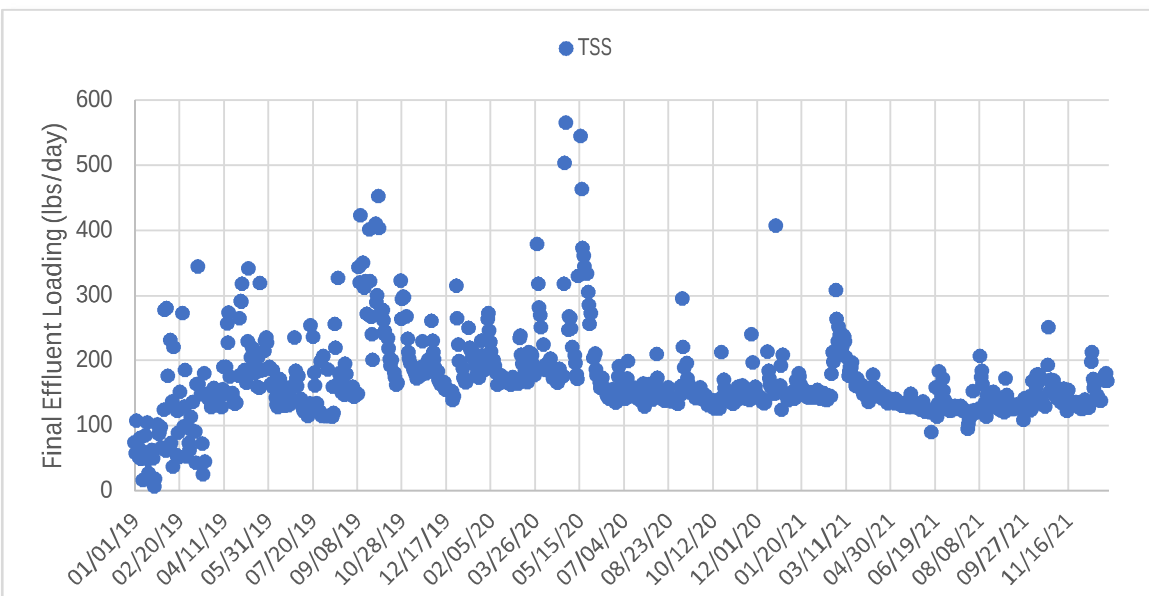

Figure 3-3: Effluent TSS Loadings

The effluent ammonia performance shown in

Figure 3-4 displays adequate performance of nitrification. From 2019 through 2021 the facility operated within the existing NPDES limitations of NH_3 final effluent.

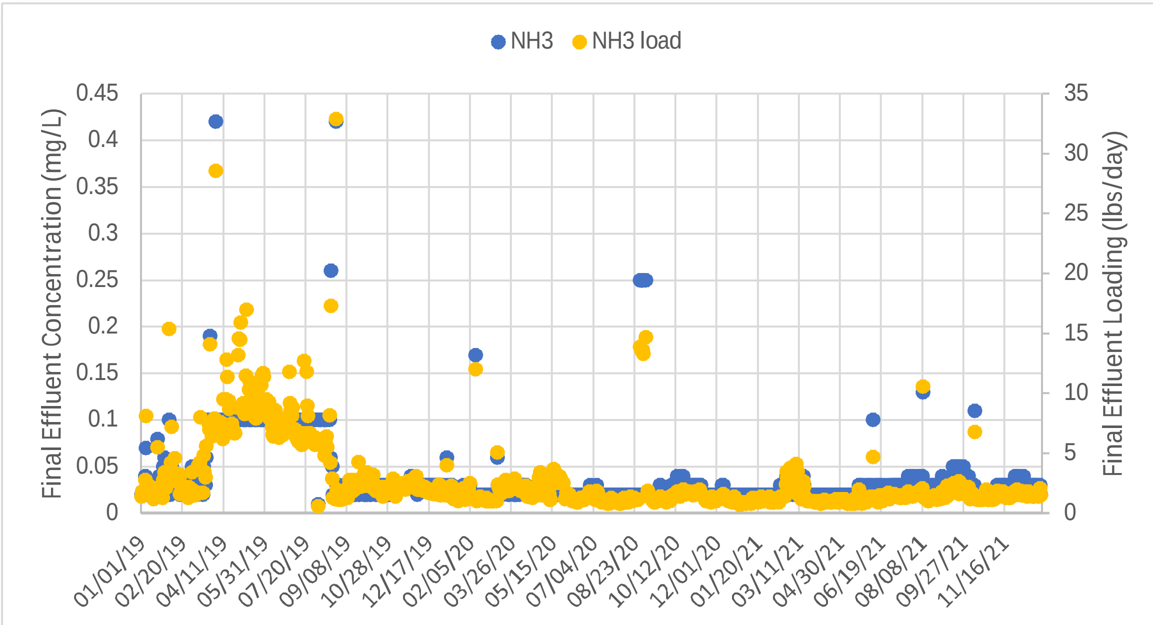

Figure 3-4: Effluent Ammonia Nitrogen Concentrations and Loadings

The ammonia loading on the biological MLE process is greatly increased by the high concentration of ammonia in the sidestream flow that is returned from the sludge dewatering centrifuge centrate. Due to the increased sidestream ammonia loading, the biological process becomes stressed to the point that the plant must place the third MLE train on-line to achieve sufficient nitrification. This deficiency in capacity will become problematic as the influent flow to the plant approaches design (12 MGD). Additional ammonia removal alternatives will be discussed in this report.

Effluent TP performance is shown in

Figure 3-5. The NPDES TP requirements of the plant effluent are successfully maintained by managed chemical dosage. Similar to other municipal facilities in Illinois, the NWRWRF only requires a monthly average TP limit. The NWRWRF typically maintains monthly TP averages of around 0.55 mg/L.

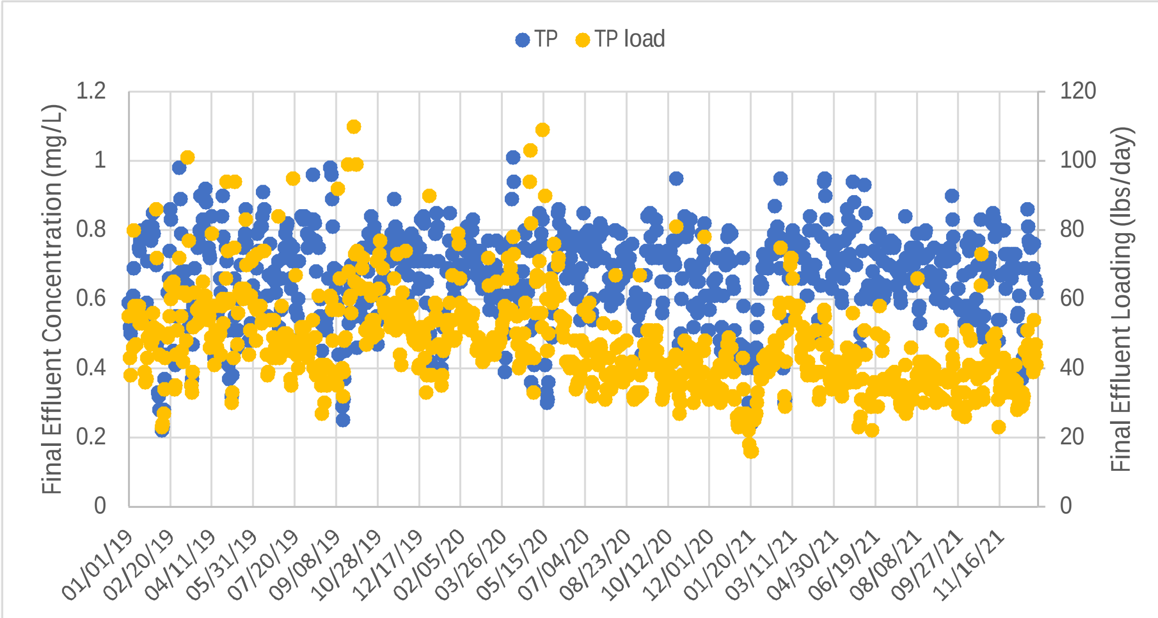

Figure 3-5: Effluent Total Phosphorus Concentrations and Loadings

In 2016 a “Phosphorus Removal Feasibility Study” was submitted to the IEPA which assessed the method, time frame, and cost of reducing phosphorus levels from the current effluent limit of 1 mg/L to effluent limits of 0.5 mg/L and 0.1 mg/L. These proposed future effluent limits are significant in that the existing system is not be capable of achieving the most stringent of the future limits (0.1 mg/L). The “Phosphorus Removal Feasibility Study” is included as Appendix B.

The NPDES permit does not specify total nitrogen (TN) limits but does require that facilities monitor effluent TN concentrations weekly. Nitrate/nitrite nitrogen monitoring is also required and is monitored at the plant on a weekly basis. The TN and NO3/NO2 effluent data from 2019 through 2021 is displayed in Figure 3-6. The average effluent TN for 2021 was approximately 16.5 mg/L with over 90 percent being comprised of nitrate/nitrite.

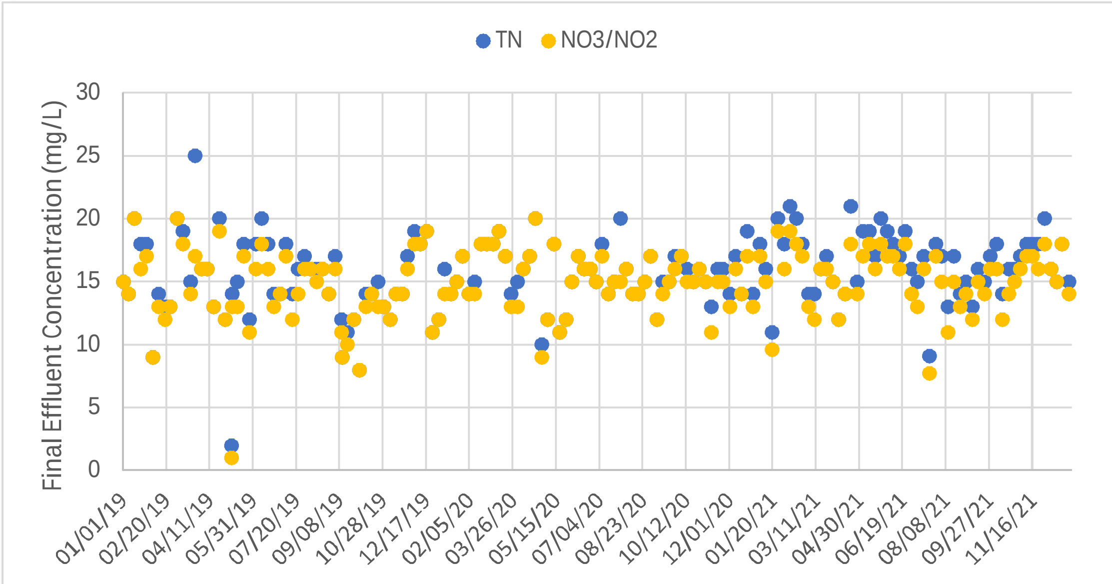

Figure 3-6: Effluent Total and Nitrate/Nitrite Nitrogen Concentrations

Final effluent chloride performance from 2019 through 2021 is shown in Figure 3-7. Numerical limits for effluent chloride monthly average concentration and loading were added to the NPDES permit in 2021. The facility remained within the specified limits.

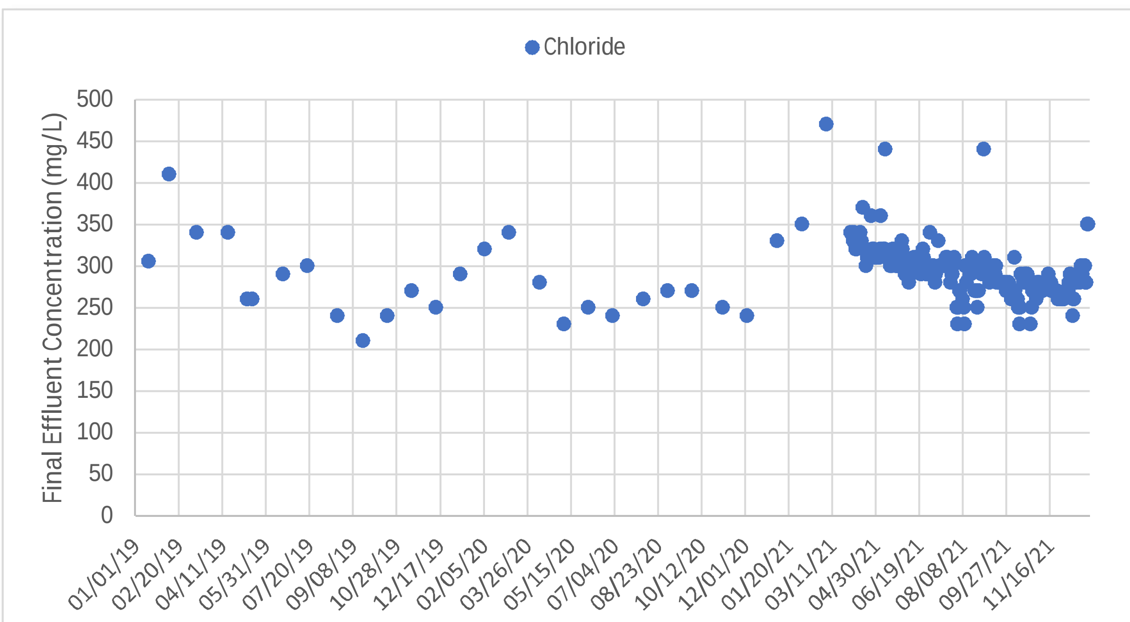

Figure 3-7: Effluent Chloride Concentrations

The NWRWRF is currently operating within the limitations set by the NPDES permit with operating margins. No current treatment level deficiencies were noted, and the current flows of the existing facility do not warrant any immediate improvements related to chloride.

3.4 PLANT IMPROVEMENTS 2017-2022

3.4.1 IN-HOUSE IMPROVEMENTS

The NWRWRF staff have made updates and improvements to the existing plant over the past 5 years since the last FPA was completed. Table 3-2 outlines the improvements completed.

Table 3-2: In-House Improvements

Date	Cost	Work Completed	Reason for Work Completed
04/02/17	$26,060.00	Replacement of UV disinfection system controller	Recommended in 2017 report to replace control panel to allow it to interface with plant SCADA
08/22/17	$231,000.00	First-stage screw pump emergency repairs (pumps 3 & 4)	Several large cracks in screw pump station
08/14/18	$33,572.00	Replace UV disinfection lamps and sleeves	End of useful life
2018 & 2019	$50,000.00	Installed Boerger grinders in buildings #35 & #36	Ragging issues / Allow for future install of rotary lobe pumps
01/02/19	$16,000.00	Retrofitted mixers in Aeration tanks	Poor propeller design from manufacturer
09/02/19	$23,000.00	Replaced upstairs Furnace in building #70	Past usable life
09/10/19	$193,494.00	Reroofing of building 10	Roof evaluation conducted in 2017, recommended roof replacement over next several years.
09/10/19	$629,999.99	Aeration header replacement	Recommended in 2017 report to replace leaky air piping to improve electrical energy use and aeration
11/26/19	$548,000.00	Installation of 18 flow meters for flow monitoring	Study was done in 2014 resulting in the need of permanent flow meters to accurately depict system conditions
06/23/20	$38,392.00	Replace UV disinfection lamps and sleeves	End of useful life
11/10/20	$85,000.00	Repair and maintenance of NWRWRF SCADA system (automation, instrumentation, IT, HMI system maintenance, troubleshooting, and repairs)	General servicing and repair of system
2020 & 2021	$25,000.00	Replaced Wemco chopflo pumps with Wemco screw flow	Choplfo pumps were not ideal for the application
01/12/21	$313,709.00	Reroofing buildings 20, 35, 75, and 77	Roof evaluation conducted in 2017, recommended roof replacement over next several years.
04/13/21	$714,000.00	Screw Pump Replacement (1 first-stage, 3 second-stage)	Reached the end of their useful service life.
07/27/21	$425,496.00	Rebuild of Secondary Clarifier #1	Clarifier mechanism outperformed useful life of 15-20 years, originally installed in 1991.
11/23/21	$117,955.01	Rebuild Tertiary Disc Filter #1	Put into service in 2006, the components being replaced outperformed their useful life of 5-10 years.
03/08/22	$281,397.00	Reroofing buildings 36, 45, and 50. Also repair of building 75 (Secondary Tank) masonry.	Roof evaluation conducted in 2017, recommended roof replacement over next several years.

07/12/22	$48,429.00	Centrifuge mechanical equipment repairs	Mechanical Failure / Emergency Repairs
09/01/22	$30,000.00	Installed Boerger rotary lobe pump in building #36	Eventually have less components for the pumping system. Current ODS pumps require large compressors, air dryer, and air cooler to operate.
01/27/23	$45,980.00	Alfa Laval centrifuge rebuild	Mechanical Failure / Emergency Repairs
02/01/23	$30,000.00	Replaced rotating assembly on RAS pump #5	Failure and past usable life
03/01/23	$40,000.00	Replaced VFD's for Andritz centrifuge	Outdated and failed VFD

3.5 FUTURE FLOWS AND LOADINGS

Future flows were based on the 2050 CMAP population projections, which are considered conservative. Existing daily flow to the NWRWRF, based on population, is approximately 7.4 MGD from a population of about 90,000, or 82 gallons per capita per day. The 2050 CMAP population growth is estimated to be 26,458, and Donohue estimated future gallons per capita per day as 80 gpcd as calculated in Section 2. This results in an ADWF of 9.45 MGD, a 14% increase of the current ADWF, based on plant data, of 8.29 MGD. Adding existing wet weather flow to the future ADWF results in a total 2050 daily average flow projection of 10.33 MGD. The NWRWRF is permitted for an average daily flow of 12 MGD, future projected average daily flows are within allowable limits.

3.6 FUTURE REGULATIONS (NPDES PERMIT)

The anticipated regulatory developments most likely to impact the NWRWRF in the future include stricter TP limits and potential numerical TN limits.

Stricter effluent TP limits may be imposed on the NWRWRF and other municipal plants in Illinois as a result of the statewide approach to nutrient management. The Illinois EPA requires the preparation of phosphorus removal feasibility reports in the NPDES permit special conditions. Over the past few years, numerical values of 0.5 and 0.1 mg/L continue to be specified along with a monthly averaging compliance period.

The implementation of a 0.5 mg/L monthly average limit on the NWRWRF would likely be tolerable from a process perspective. Since the facility is already equipped with tertiary filtration, the main consequences of the 0.5 mg/L TP limit would likely be the need to add more chemical and the secondary effects of that need. This would involve an increased frequency of chemical deliveries, potentially more chemical storage, increased solids production, and the potential to manage clarifier solids loading rates due to the increase in solids in the mixed liquor by addition of chemical solids. The addition of an online effluent phosphate analyzer with feedback to chemical dosing would help reduce the overdosing of chemicals if 0.5 mg/L TP limits are implemented.

To reduce the reliance on chemicals, biological process modifications to encourage biological phosphorus removal could be considered. However, the NWRWRF lacks unused spare tankage for the needed anaerobic reactor space so additional tankage would have to be constructed. The plant also processes WAS through anaerobic digestion, which releases much of the biologically accumulated phosphorus back into the solution. These two elements increase the cost and complexity of biological phosphorus removal provisions, making it less desirable.

The imposition of a 0.1 mg/L monthly average TP limit would be much harder to comply with for the NWRWRF. Based on the two weeks of jar testing reported in the 2016 Phosphorus Study, the amount of chemical to reduce the effluent TP from 1.0 mg/L to 0.1 mg/L would nearly quadruple. This level of chemical addition would be unsustainable for the current facility, given the demands for the mixed liquor TSS associated with nitrification requirements and the clarifier solids loading rates.

The 0.1 mg/L TP limit would require a post tertiary process that provides reactive filtration. A single reactive filtration stage, such as a continuous backwash or moving bed sand filters, may need to be added to achieve the 0.1 mg/L requirement. Regardless of the number of stages, reactive filtration would require another pumping station to overcome the anticipated head loss between the filters and UV disinfection. The advantage of a reactive filtration system would be the potential ability to use it for tertiary denitrification, which could meet TN levels below 6-8 mg/L if ever required.

A 0.1 mg/L TP limit would also require sidestream phosphorus removal. Phosphorus removal would likely be required from centrate since the NWRWRF utilized anaerobic digestion. By removing phosphorus from the centrate, less phosphorus would be recycled to the liquid treatment train.

If the 0.1 mg/L TP limit were ever to be implemented, it would be very costly and complex for the NWRWRF to meet the requirement, regardless of how it is achieved. While the 0.1 mg/L limit appears very unlikely, the 0.5 mg/L could be imposed within the next 10 years.

Numerical TN limits could be imposed within the coming years. If this occurs, the probable numerical effluent limit for TN would be 10 mg/L. The NWRWRF current achieves an annual TN limit of 16.5 mg/L with monthly averages ranging from 11 to 21 mg/L. The main limitation of denitrification at the plant stems from the overall nitrate recycle (RAS plus sidestream) rate. The RAS and internal recycle pump capacities are each 12 MGD. If a 10 mg/L TN limit is imposed, the combination of RAS and internal recycle flow would need to increase to 400% to accommodate the forward flow through the plant. If the increase in flow comes from internal recycle, the hydraulics of the activated sludge tanks would need to be assessed for compatibility with the increased recycle flow rate.

If a TN limit below 6-8 mg/L were imposed, a post tertiary treatment process would likely be required as previously discussed. Using a continuous backwash or moving bed sand filters as media for attached growth denitrification could also provide additional phosphorus removal downstream of the disc filters.

Trotter & Associates is currently completing a Phosphorus Optimization Study, slated to be completed in Spring 2023 that will further discuss the future anticipated phosphorus limits and how to meet these limits.

3.7 IMPROVEMENTS DISCUSSION

3.7.1 TREATMENT IMPROVEMENTS

Currently, no plant improvements are required based on existing performance and compliance with the existing NPDES permit. Additionally, no plant expansion is needed per population growth predictions for 2050. Potential future treatment upgrades discussed with plant staff were related to process capacity bottlenecks for the activated sludge system. The treatment improvements investigated are below:

- Addition of selectors upstream of MLE Tanks (improve process performance and improve phosphorus removal)
- Additional MLE Tanks (increase ammonia treatment capacity)
- Sidestream treatment (reduce ammonia returned to the MLE process in the centrate)
    - Microvi Treatment System
    - DEMON Anammox System

3.7.2 ADDITION OF SELECTORS

To promote enhanced biological phosphorus removal (EBPR), selectors would be added upstream of the existing MLE tanks. RAS piping modifications would be required to discharge RAS into the new selector zones. The current RAS pumping system sizing requires further evaluation to determine exact sizing and configuration to meet EBPR requirements. It is recommended to develop a BioWin process model to further analyze this treatment improvement.

The addition of selectors upstream of the existing MLE tanks will be difficult with the current site restrictions. This option is not as costly as additional MLE tanks. Table 3-3 shows the opinion of probable construction costs and engineering to construct selectors upstream of the existing MLE tanks. The detailedOpinion of Probable Construction Cost (OPCC) can be found in Appendix E.

Table 3-3: OPCC & Engineering for Selector Addition Upstream of MLE Tanks

Description	Cost
Opinion of Probable Construction Cost	$5,627,000
Contractor Overhead & Profit (25%)	$1,406,750
Contingency (30%)	$2,111,000
Total Construction Costs	$9,145,000
Engineering (15%)	$1,372,000
Total Project Costs	$10,517,000

3.7.3 ADDITIONAL MLE TANKS

As discussed the current MLE tanks are not sized to accommodate the large ammonia loading in the centrate recycle flow. Additional MLE tankage could be added to accommodate the recycle flow to keep ammonia down as plant size increases as well as provide additional volume to install selector zones in the future for EBPR. However, the addition of new MLE tankage would be difficult with the current site restrictions around the existing MLE tanks, this option would be costly. Table 3-4 outlines opinion of probable construction cost and engineering costs to construct additional MLE tanks. The detailed OPCC can be found in Appendix E.

Table 3-4: OPCC & Engineering for Additional MLE Tanks

Description	Cost
Opinion of Probable Construction Cost	$9,056,000
Contractor Overhead & Profit (25%)	$2,264,000

Contingency (30%)	$3,396,000
Total Construction Costs	$14,716,000
Engineering (15%)	$2,208,000
Total Project Costs	$16,924,000

3.7.4 SIDE STREAM TREATMENT

To address ammonia concerns, the majority of the ammonia loading comes from the centrate. Two alternative technologies were investigated to treat the centrate sidestream separately, prior to the centrate discharge at the head of the plant. Those two technologies were Microvi and DEMON – Anammox. Donohue reached out to both manufacturers to provide background information and proposals for the NWRWRF. The characteristics of the sidestream are outlined in Table 3-5.

Table 3-5: Sidestream Characteristics

Parameter	Units	Value
Avg. Flow	MGD	0.74
Peak Flow	MGD	1.49
Ammonia	mg/L	101
COD	mg/L	875
BOD	mg/L	437
TSS	mg/L	647
pH	-	7.5
Alkalinity	mg/CaCO3/L	1500
TP	mg/L	16.34

3.7.4.1 Microvi – Sidestream Ammonia Removal System

Microvi utilizes an ammonia removal biocatalyst referred to as Aerovi. This is used as an effective and efficient process to achieve low ammonia standards with a sidestream process having variable load conditions. Microvi provided a proposal to install a sidestream ammonia removal system at NWRWRF, this proposal is attached as Appendix C.

The Microvi system is anticipated provide 90% ammonia removal against average, as Nitrogen. The process would include feeding dewatered digester liquors to the flow distribution chamber Microvi MNE reactor by variable speed pumps. Flow is to be evenly split between all three (3) MNE reactors. The reactors operate as completely mixed liquor reactors through fine bubble diffusion aeration system and mixers.

Recommended sizing of the Microvi system is shown in Table 3-6. Based on conversations with Microvi representative, they are interested in a possible pilot study at the NWRWRF.

Table 3-6: Microvi System Design

Parameter	Units	Value
Total Number of Bioreactor Systems	No.	3
Mixer Orientation	-	Vertical Turbine
Mixer Motor	HP	3 (TBC)
Bioreactor Dimensions	ft x ft	11 x 33.5
Top Water Level	ft	11

Table 3-7 shows the OPCC and engineering cost to construct the Microvi system. The detailed OPCC can be found in Appendix E.

Table 3-7: OPCC & Engineering for Microvi System

Description	Cost
Opinion of Probable Construction Cost	$3,999,000
Contractor Overhead & Profit (25%)	$999,750
Contingency (30%)	$1,500,000
Total Construction Costs	$6,499,000
Engineering (15%)	$975,000
Total Project Costs	$7,474,000

The Microvi System is more cost effective than the DEMON system due to the DEMON requirement of an upstream EQ basin.

3.7.4.2 DEMON Anammox Process

DEMON® Anammox treatment technology provides continuous deammonification using granular, anaerobic ammonium oxidizing bacteria anammox biomass that is retained by micro-screens. DEMON® uses both ammonia oxidizing bacteria (AOB) and anammox bacteria to remove ammonia and total inorganic nitrogen. World Water Works provided a preliminary DEMON® proposal to install a Sidestream ammonia removal system at NWRWRF, this proposal is attached as Appendix D. Based on the proposal, the implementation of the DEMON® Anammox process achieved greater than 90% ammonia removal at the Strass WWTP, which has been operational since 2004 using the Anammox technology. The system design for the NWRWRF is anticipated to achieve 85% ammonia removal and 75% total inorganic nitrogen. The DEMON® Anammox process uses 60% less aeration energy then conventional activated sludge systems and no external carbon for removal of nitrates while still achieving the removals mentioned above.

The DEMON® process will include feeding from one (1) new equalization reactor to two (2) parallel trains to create DEMON treatment systems. The new EQ tank upstream will allow the DEMON® process to run continuously regardless of dewatering schedule. New mixers and aeration system will be placed in the reactor to provide the mixing energy for re-suspension of the granules, proper mixing distribution of the influent feed flow and provide the necessary aeration for filtration. An internal settling zone will be used to settle out the MLSS / Anammox biomass and allow the treated water to be discharged. Recommended sizing of the DEMON system is shown in Table 3-8.

Table 3-8: DEMON System Design

Parameter	Units	Value
Total Number of Trains	No.	2
Blowers	No.	4
Design Air Flow	SCFM	250
Bioreactor Dimensions	ft x ft	20 x 40
Side Water Depth	ft	21

Maintenance and operations of the DEMON® System is fairly minimal, and consists mostly of controls maintenance using Dissolved Oxygen (DO) and pH probes. The anammox bacteria are slow growing but very resilient, once the seed sludge kick starts the system minimal maintenance is required. Based on conversations with the manufacturer a Characterization Study is recommended. The Characterization study would include 2 weeks minimum of analysis of the centrate to analyze various characteristics to determine the viability of the DEMON® System at the plant. The Characterization Study parameters are also included in Appendix D.

Table 3-9 shows the OPCC and engineering cost to construct the DEMON system. The broken out OPCC can be found in Appendix E.

Table 3-9: OPCC & Engineering for DEMON System

Description	Cost
Opinion of Probable Construction Cost	$5,372,000
Contractor Overhead & Profit (25%)	$1,343,000
Contingency (30%)	$2,015,000
Total Construction Costs	$8,730,000
Engineering (15%)	$1,310,000
Total Project Costs	$10,040,000

3.7.5 HYDRAULIC IMPROVEMENTS

The NWRWRF can handle the hydraulic peaks currently reaching the facility. The upstream storage at the RLEFF allows the peak NWRWRF influent flows to be managed to approximately 30 MGD. Below a net forward flow of 29 MGD DPHF, the plant can pass with four duty screw pumps operating at its second stage pumping station.

If a DPHF exceeds 30 MGD the influent flow would exceed the current capacity of the NWRWRF and the total existing pumping capacity of each of the three pumping stations with all four duty screw pumps running. To pass larger flows, improvements to the three pumping stations would be required, as would improvements at all the passive hydraulic bottlenecks in the plant. The passive bottlenecks include the primary clarifier influent channel and potentially the third stage pumping station discharge channel.

Other unit processes may begin to show signs of hydraulic overload at flows above 30 MGD. In particular, the secondary clarifiers are close to their maximum allowed surface overflow rate (SOR) per Illinois Recommended Standards for Sewage Works (IRSSW) and would exceed the allowable SOR at influent flows of 32 MGD. The firm capacity of the tertiary filters would also be exceeded at 32 MGD in terms of the recommended maximum loading of 5 gpm/sf submerged area. Additionally, the outfall pipe under Pistakee Lake would need to be brought up to the new peak flow rate above 30 MGD.

It is possible that the storms experienced in the coming years will exhaust the storage available at the RLEFF, but with the forecasted slowing population projections it seems unlikely. However, eventually higher peak flows will reach the NWRWRF, and hydraulic upgrades will need to be made.

Rather than making DPHF improvements to multiple components at the NWRWRF, adding additional storage at the NWRWRF is a better planning approach. Onsite storage would not only bridge the gap between managing future influent peak flows and the current net DPHF available at the plant, but also avoid exposing the outfall sewer to further peak flow increases.

3.7.5.1 Onsite Flow Equalization

The NWRWRF currently discharges to two (2) outfall locations. Outfall 001, a 48 inch fiberglass pipe that runs under Pistakee Lake, that discharges up to 22.5 MGD and Outfall 002, an overflow flume that discharges into Pistakee Lake, for flows over 22.5 MGD. The plant rarely discharges through Outfall 002. Based on conversations with plant staff, the NWRWRF has discharged through Outfall 002 twice in the past two years. Outfall 002 is not controlled and discharge through this Outfall should be limited.

In order to prevent discharging through the flume, Outfall 001 piping would need to be upsized or onsite equalization basins would be required to hold wet weather flows. The estimated cost to upsize the existing Outfall 001 piping was determined to be $22.5M (2015 cost) in the 2017 Northwest Lake County FPA Regional System Review. Based on the Engineering News-Record Index, that cost in 2023 dollars is $29.5M.

Equalization basin sizing was analyzed to compare the cost of EQ basins versus the large cost of upsizing the Outfall 001 piping. To determine the necessary onsite wet weather storage needed, multiple storm events were modeled with the plant operating at 22.5 MGD, to limit the need to operate Outfall 002. Each reoccurrence interval was modeled as a 24 hour event. Table 3-10 shows the required onsite EQ volume required to mitigate wet weather beyond 22.5 MGD.

Table 3-10: Onsite Equalization Volume

Reoccurrence Interval(1) (Years)	Required EQ Volume (MG)	
	Existing (2022)	Future (2050)
1	1.64	3.03
5	6.40	7.81
10	8.25	10.29
100	17.46	20.52

(1) All reoccurrence intervals modeled as 24 hour duration
(2) Plant modeled as a free outfall, operating at 22.5 MGD

The current (2023) costs for earthen EQ basins and concrete EQ Basins is $0.75/gallon and $3.32/gallon, respectively based on past project experience. This pricing includes construction only and no engineering or contingency. Table 3-11 shows anticipated construction costs for Earthen and Concrete EQ basins at the various existing volumes and reoccurrence intervals.

Table 3-11: Equalization Basin Construction Costs

Reoccurrence Interval (Years)	Required EQ Volume (2022)	Earthen EQ Basin	Concrete EQ Basin
1	1.64	$ 1,230,000.00	$ 5,444,800.00
5	6.4	$ 4,800,000.00	$ 21,248,000.00
10	8.25	$ 6,187,500.00	$ 27,390,000.00
100	17.46	$ 13,095,000.00	$ 57,967,200.00

The NWRWRF has already acquired land to install onsite flow equalization basins.

3.7.6 NWRWRF 5-YEAR IMPROVEMENTS SCHEDULE

The NWRWRF staff has compiled a list of budgeted projects for the next 5 years based on priority. The priority rankings are High, High/Medium, Medium, Medium/Low, and Low. Table 3-12 outlines the anticipated improvements. A majority of these improvements would be completed in-house.

Table 3-12: 5-Year Improvements

Priority	Project	Time Frame
High	Complete Cleaning Primary Digesters #2,#3, and #4	2023-2025
High	PLC Update for all process units	2023-TBD
High	Rebuild current UV system	2023-2024
High	Change out/Replace the MCC in #20	2023-2024
High	Rebuild another filter cell in building 60	2023-2024
High/Medium	JWC Inline Grinder for PD#1	2023-2024
High/Medium	Change out Inadequate Neuros Blowers to Aerzen Delta Hybrids	2024-2025
High/Medium	Install three more Boerger pumps in buildings 35 & 36	2023-2025
High/Medium	New Influent Screens with higher catch percentage	2023-2025
High/Medium	Replace Alfa-Laval Centrifuge	2023-2025
Medium	Sludge Thickener collectors will need new metal work or reconditioning.	2023-2026
Medium	Excess flow/ storm event diversion tanks	2023-2027
Medium	Side Stream Treatment for Excess ammonia	2023-2026
Medium/Low	Add another set of UV Banks for higher flows	2023-2027
Medium/low	Install real time Phosphorus controller	2023-2027
Medium/low	Continue with roof replacements	2023-2027
Medium/Low	Continue Tuck Pointing on buildings	2023-TBD
Medium/Low	Continue with Crack Repair around Facility	2023--TBD
Low	Asphalt Drive around facility	2023-TBD

3.8 STAFFING DISCUSSION

A review of staffing tasks for the NWRWRF was completed using the "Northeast Guide for Estimating Staffing and Publicly and Privately Owned Wastewater Treatment Plants, November 2008".

The analysis was completed to review job tasks for the following categories:

- Operators
- Maintenance
- Laboratory Personnel
- Management

Other staffing positions considered that are not included in the guide are below:

- Pretreatment Coordinator
- Quality Assurance

The Northeast Guide for Staffing Estimates requires plant staffing shift selection between the following:

- One Shift Plant: A facility that has one shift a day, five days a week.
- 24/7 Shift Plant: A facility that is staffed seven days a week twenty four hours per day.
- One Plus Shift Plant: Any facility whose staffing schedule does not fit into the previous two categories.

The NWRWRF is staffed in two shifts 7 AM – 3:30 PM and 3 PM – 11:30 PM, 5 days a week and is staffed for 4.5 hours on the weekends. The NWRWRF falls under the One Plus Shift Plant category based on the current staffing plan. In addition to staffing, the Northeast Guide requires plant capacity input and the NWRWRF falls under the 10 MGD – 20 MGD range. The staffing guide then requires input on all processes and facilities at the plant to determine how many personnel are required based on plant operations. Full time employment assumes 2080 hours annually. To account for sick days, holidays, and vacation time 1500 hours annually per employee was used for this analysis. Based on these inputs, the current and recommended staffing is shown in Table 3-13.

Table 3-13: Current and Recommended Staffing

Job Category	Current	Recommended
Operators	6	6
Maintenance	3	5
Laboratory Personnel	1	2
Management	2	2
Pretreatment	1	2
Quality Assurance	0	1

Based on this analysis, the NWRWRF could utilize five (5) additional staff to support the current job tasks to operate and maintain the plant.

4. IMPROVEMENT RECOMMENDATIONS

4.1 COLLECTIONS SYSTEM

Donohue conducted a Sanitary Sewer Modeling & Capacity Analysis that was completed in October 2022. All collections system improvement recommendations are outlined in that report, which can be found in Appendix A. A brief overview of improvements can also be found in this section.

4.1.1 FURTHER ANALYSIS RECOMMENDATIONS

Based on the Interceptor Capacity Analysis Report, Donohue recommends follow-up flow monitoring within the system and a sanitary sewer evaluation survey that involves various field testing and inspection methods to eliminate sources of I/I.

The structures in the floodplain (483 manholes, 17 pump stations) are recommended to be investigated further to compare manhole rim elevations to the 100-year floodplain level. Adjusting manhole rim elevations to above the floodplain will help prevent water, from large storm events, from entering the sanitary sewer system.

4.1.2 EAST MAIN LIFT STATION RECOMMENDATIONS

Currently, the only trigger to divert flow to the RLEFF is when the NWRWRF reaches capacity. There remains a risk that the East Main LS could reach capacity without the NWRWRF doing so, in which case the diversion to the RELFF would not trigger. In this case, the water level would rise in the interceptor until it is diverted to RELFF which risks basement backups. A memorandum from Christopher Burke Engineering outlines suggested programing improvements to lower the hydraulic grade line in the interceptor.

4.2 NWRWRF

The NWRWRF has outlined an improvements schedule, internally, that provides anticipated improvements for the next 5 years. That table can be found in Section 3.7.6. Based on the Table provided by staff and the findings of this report the below recommendations have been made.

4.2.1 PROCESS RECOMMENDATIONS

Donohue recommends that NWRWRF have further follow up with Microvi on the implementation of a pilot study at the plant. Microvi is the most cost effective option to treat the high centrate sidestream ammonia loadings. Because these technologies are relatively new, a small pilot study will ensure Microvi can effectively treat the centrate sidestream to the needs of the plant. Microvi is recommended over DEMON due to the DEMON requirement for a large EQ tank upstream.

4.2.2 HYDRAULIC RECOMMENDATIONS

Donohue recommends the NWRWRF implement on site flow equalization to provide flexibility in operations as well as future planning for climate change and the increase in large wet weather events. An earthen lagoon to accommodate the wet weather flow, beyond the 22.5 MGD Outfall 001 limitation, for a 10 year 24 hour storm is recommended. This volume equates to 8.25 MG of excess flow storage onsite.