Project Plan

Wastewater Project Plan

Prepared for

North Kent Sewer Authority

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2220316

Prein&Newhof

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1 PROJECT BACKGROUND

This Project Plan is prepared on behalf of the North Kent Sewer Authority (hereinafter referred to as the Authority), in Kent County, Michigan, for the purpose of obtaining a Clean Water State Revolving Fund (SRF) loan from the State of Michigan for the construction of improvements to the PARCC Side Clean Water Plant (CWP). SRF is a low interest loan financing program that assists qualified local municipalities with the construction of needed water pollution control facilities.

The Authority's service area includes areas within the City of Rockford, Plainfield Charter Township, and the Townships of Alpine, Cannon, and Courtland. The service area is shown in Figure 1. The communities within the service area are in northern Kent County.

The Authority's CWP generally consists of screening, grit removal, bioreactor treatment, membrane filtration, ultraviolet disinfection, solids holding, and biosolids thickening. The jointly owned system includes approximately 36,000 lineal feet of gravity trunk sewer pipes, 3,200 lineal feet of force main, 1 lift station, and 100 manholes.

In 2020, the Authority revised its Wastewater System Evaluation which summarized the condition and needs of its wastewater treatment plant and collection system developed through the Stormwater, Asset management, and Wastewater (SAW) program. The updated 2020 Capital Improvement Plan (CIP), prepared by Prein & Newhof, identified and prioritized the Authority's capital improvement needs.

The recommended improvements will help make infrastructure more efficient, reduce the chance of failing wastewater assets, and protect water quality in the area. The proposed projects are aimed to address critical points in the treatment system that have high maintenance and operational cost or potential for failure.

The purpose of this report is to present a comprehensive plan and evaluation of alternatives for improving the existing CWP. The evaluation includes an analysis of cost, technical feasibility, and environmental impacts for the proposed projects over the next 20 years. None of the projects or projected 20-year needs include projects to extend infrastructure to new areas in or outside of the service area.

1.1 Study Area Characteristics

1.1.1 Delineation of Study Area

The study area comprises the Authority's service area shown in Figure 1. The service area includes areas within the City of Rockford, Plainfield Charter Township, and the Townships of Alpine, Cannon, and Courtland. The CWP is located at 4775 Coit Avenue NE, Grand Rapids, MI 49525.

The proposed projects will be conducted on the CWP site and include infrastructure owned and operated by the Authority. The proposed construction will occur in areas with existing infrastructure and on land previously developed in 2006. Therefore, no disruptions to the natural environment or cultural resources are expected. The proposed projects will not result in significant changes to the service area within the next 20 years.

1.1.2 Environmental Setting

1.1.2.1 Cultural Resources

The areas that are served by The Authority's wastewater collection and treatment system are located in northern Kent County. Since the recommended projects are not listed for equivalency status at this time, the State Historic Preservation Office (SHPO) and the Tribal Historic Preservation Office (THPO) were not contacted until further notice.

According to the National Register of Historic Places, there are no structures that are deemed worthy of historic preservation within the service area of the Authority. Further detail on the cultural resources in relation to the proposed projects is in the Environmental Evaluation Section of this report.

1.1.2.2 Natural Environment

The CWP site is located north of Grand Rapids in the western Michigan ecosystem. The CWP effluent is discharged to the Grand River, which ultimately flows into Lake Michigan in the City of Grand Haven, Michigan.

Adverse impacts to the natural environment will be avoided when possible and mitigated if necessary. Further detail on the natural environment in relation to the proposed projects is discussed in the Environmental Evaluation Section of this report.

1.1.3 Land Use

The Authority primarily serves residential areas with some commercial, institutional, public recreation, and industrial areas. Land use in each township of the service area is shown in the Zoning Maps in Appendix A. There are no major projected changes in the land use of the study area that would significantly impact wastewater flows beyond the flow allocations provided in Table 1.

1.1.4 Population Data

Population data for Kent County and the five major communities contributing to the Authority's wastewater system through 2045 have been developed by Grand Valley Metropolitan Council (GVMC) and are shown in Table 2.

From 2015 to 2045, the population in each community is expected to increase as follows:

- Plainfield Township: 23.6%.
- Alpine Township: 18.9%.
- City of Rockford: 18.9%.
- Courtland Township: 12.9%.
- Cannon Township: 14.2%.

Current Residential Equivalent Units (REUs) for each community are listed in Table 3 along with forecasted REUs, which were calculated based on the population growth shown in Table 2.

Since some residential users in Cannon and Courtland Townships are located around a lake, seasonal population increases are expected each year during the summer months. The overall seasonal effect on flow is minor.

1.1.5 Economic Characteristics

Historically, this area was composed mainly of lumber operations and sawmills. It was known for agricultural production of fruit, wheat, wool, corn, oats, and potatoes, according to Images of Michigan, a site that compiles historic primary sources. Today the Authority services an area with a well-diversified economy. Some major employers in the service area include Wolverine Worldwide, Inc., Byrne Electrical Specialists, Inc., and NBHX Trim Corporation based on the list of the Largest Employers in West Michigan published by The Right Place. In 2020, the median income in each community according to the U.S. Census Bureau was as listed:

- Plainfield Township: $73,961.
- Alpine Township: $56,881.
- City of Rockford: $86,694.
- Courtland Township: $99,291.
- Cannon Township: $103,908.

Unemployment and poverty are not major challenges for these communities. At this time, new industry will not have a significant effect on the REU count. The CWP has more than sufficient available capacity, see Existing Facilities Section.

1.2 Existing Facilities

As part of the SAW Grant, Prein&Newhof inventoried and assessed the condition of the CWP, lift stations, force mains, sewers and manholes within the Authority's wastewater collection system. A summary of the inventory and condition assessments for the proposed projects is briefly reviewed below. Additional condition assessments for the wastewater collection and treatment system are in the 2020 Wastewater System Evaluation. Generally, the system appears to be in good condition with acceptable climate resiliency.

The existing CWP was constructed in 2006. The environmental assessments were completed satisfactorily, and the site was filled and raised. Space was planned within the developed site for future CWP expansions.

1.2.1 Wastewater Treatment

The North Kent Sewer Authority PARCC Side Clean Water Plant generally consists of screening and grit removal, bioreactor treatment, membrane filtration, and UV disinfection prior to discharging final effluent to the Grand River. Biosolids are stored onsite in aerated biosolids holding tanks before being dewatered with inclined screw presses and sent to a landfill. A conceptual layout of the CWP is provided in Figure 2.

The most recent National Pollutant Discharge Elimination System (NPDES) Permit for the CWP was issued in September 2015 and is included in Appendix B. The CWP was last inspected March 10, 2022.

The CWP receives wastewater via a 48-inch gravity sewer. The treated effluent from the CWP is discharged by gravity to the Grand River via a 48-inch pipe.

According to the 2006 Basis of Design, the design average daily flow of the CWP is 8.0 million gallons per day (MGD) and the design maximum daily flow is 12.0 MGD. The membrane trains have been populated to treat 6.0 MGD. The average influent flow observed between 2008 and 2021, 3.70 MGD, is approximately 62% of the design average day flow. Instantaneous flow data is displayed on the CWP SCADA system screens but is not stored on the historian server. Only daily flow data is available for the study period. As a result, the maximum peak hourly flow and the peak hour to average day ratio were estimated based on available data from 4 Mile Lift Station and Forest Ridge Lift Station. By lift station proxy, the peak hourly flow is approximately 9.35 MGD and the peak hour to average day ratio is 2.5. Recent flow data was analyzed in the 2020 revision of the PARCC Side Clean Water Plant Capacity Analysis and is included in Appendix C.

1.2.1.1 Inventory

An inventory of the functionally and financially significant assets within the CWP has been prepared. The asset inventory was compiled from site visits and available documentation including basis of designs, record plans, maintenance records, and operations and maintenance manuals.

The inventoried items are grouped by treatment process, which includes the following: Comminutors, Influent Screw Pumps, Grit Removal, Screening, Bioreactors, Membranes, UV Disinfection, Odor Control, Biosolids Holding Tanks, Inclined Screw Press System, Chemical Feed, and Generator.

1.2.1.2 Condition Assessment

In order to evaluate the risk of failure (RoF) for each asset, condition assessments were performed where possible. The assessments are not meant to determine necessary maintenance, but rather to assess the current physical condition of the asset and its ability to perform as intended. The equipment listed below is located in the CWP.

Visual observation was used to determine if the assets showed signs of wear or failure. The CWP was visited and the majority of the assets were photo documented and compiled in a geographic information system (GIS) database. Operations and maintenance issues were discussed with the operators in an effort to reveal recurring problems that were not observable at the time of the visit.

1.2.1.2.1 Influent

Flow passes through the influent flume chamber and is split between two channels.

1.2.1.2.2 Comminutors

Large solids still present in the wastewater are reduced in size by two comminutors that grind and shred wastewater debris prior to grit removal and fine screening.

1.2.1.2.3 Influent Screw Pumps

Following the comminutors, the wastewater is pumped up to the Headworks Building by three 60-inch screw pumps.

1.2.1.2.4 Grit Removal

A rotating paddle moves grit chamber contents in a circular motion, which forces the high-density grit to a central grit well while preventing the organics from settling. An air lift grit pump installed in a sump at the bottom of the tank sends grit-laden wastewater to a grit classifier.

1.2.1.2.5 Screening

After passing through the grit removal tank, the wastewater enters the screen inlet channel. Three rotating drum screens remove particles larger than 1.5 mm. The screenings are removed by a conveyor, compacted, and disposed of in a roll-off dumpster.

1.2.1.2.6 Bioreactors

Three bioreactors are present at the CWP, each sized to achieve the necessary retention time for biological growth prior to membrane filtration. Each bioreactor contains an anoxic zone, a swing (anoxic or aerobic) zone, and two aerobic zones in series.

1.2.1.2.7 Membranes

The Machine Building currently accommodates seven membrane tanks, five of which are populated with membrane trains. The mixed liquor from the bioreactors is filtered by membranes arranged in five trains in the membrane tanks. Particles larger than 0.04 µm are filtered out by the membranes.

1.2.1.2.8 UV Disinfection

Membrane permeate is disinfected by ultraviolet (UV) light. At a wavelength of 254 nm, UV light penetrates and modifies the genetic material of the microorganisms that remain in the wastewater. This process renders microorganisms incapable of reproducing.

1.2.1.2.9 Odor Control

The biofilter odor control system biologically treats air removed from areas with high levels of nuisance odors, such as gaseous hydrogen sulfide and other compounds naturally found in wastewater. Air is moistened, filtered through biofilter media, and discharged through the exhaust stacks.

1.2.1.2.10 Biosolids Holding Tanks

The biosolids holding tanks provide temporary storage, thickening, and decanting prior to disposal of the biosolids.

1.2.1.2.11 Inclined Screw Press System

After thickening in the biosolids holding tanks, the biosolids are sent to three submersible inclined screw press pumps. Biosolids are dewatered, polymer is added, and solids are conveyed to a dumpster for landfilling.

1.2.1.2.12 Chemical Feed

Sodium Aluminate, Citric Acid, and Sodium Hypochlorite feed systems are used to support plant operation.

1.2.1.2.13 Generator

The CWP is equipped with a 2.5 MW diesel generator and automatic transfer switch (ATS) to provide a secondary source of power in the event of power failure.

1.2.1.2.14 Buildings

There are five buildings at the CWP that are each their own respective process. The building asset groups include structural, mechanical, electrical, instrumentation and controls, and other assets.

1.2.2 Residuals

The Authority has an NPDES Permit, included in Appendix B, to comply with regulations for discharge of the sanitary effluent to the Grand River. This permit sets maximum quality and quantity effluent limits for various contaminants. Biosolids are dewatered and sent to a landfill.

Each Township has an Industrial Pretreatment Program (IPP) for industry to enforce local limits throughout the service area.

1.2.3 Lift Stations

The Authority owns one lift station named the Four Mile Lift Station. The Four Mile Lift Station has a dry well, wet well, control building, and odor control building. The station was constructed in 2002 and is generally in good condition. Design firm capacity is 8,250 gpm at 67-73 ft TDH.

1.2.4 Sewers and Force Mains

The Authority owns some gravity sewers and force mains within the service area. The Authority's trunks include approximately 36,000 lineal feet of gravity sewer pipes ranging from 24 to 48 inches in diameter, 3,200 lineal feet of force main pipes ranging from 12 to 30 inches in diameter, and 100 manholes. The gravity sewer pipe materials are primarily PVC pipe installed in the 2000's, some ductile iron, and lined cast iron under the Grand River.

1.2.4.1 Condition Assessment

An assessment of the physical condition of manholes and gravity sewer pipes was made to evaluate the risk of failure. 97% of the gravity sewer pipes were inspected with the CCTV method during the SAW grant period. An Industrial Waste Pretreatment Program is in place to protect wastewater collection infrastructure.

1.2.4.1.1 Summary of Gravity Sewer Pipe Conditions

There are a few structural concerns and areas with inflow and infiltration (I/I). The impact of infiltration is discussed in a separate 2019 Sewer Flow Study as a part of the SAW program.

1.2.4.1.2 Force Mains

Inspections to assess the condition of force mains were not conducted because current inspection technology is generally regarded to be not cost effective for most force mains.

1.3 Summary of Project Need

As described in the previous sections, a detailed inventory and condition assessment of the CWP and wastewater collection system was recently performed and documented in the 2020 Wastewater System Evaluation. Results from the 2020 PARCC Side Clean Water Plant Capacity Analysis (Appendix C) and the 2019 Sewer Flow Study were used in combination with the condition assessment results to develop the 2020 CIP. The projects described in this section were determined through the asset management process and represent the highest priority wastewater collection system needs.

1.3.1 Standards Compliance and Reliability

The Authority's system is currently in overall good condition, but aging. The CWP was built between 2006 and 2008.

The CWP met the NPDES permit discharge requirements within the past few years, with the exception of a few rare violations. Most violations have been due to minor equipment malfunction, such as in September, October, and July 2021. In 2020 and 2019, the violations were reporting issues. The Authority has an outstanding track record of meeting or exceeding permit expectations.

1.3.2 Orders of Enforcement Action

There are currently no orders of enforcement in place for the Authority's wastewater system.

1.3.3 Water Quality Problems

The wastewater treatment system has measurable concentrations of Per- and Polyfluoroalkyl Substances (PFAS) in the waste stream. PFAS are a family of chemicals that are regulated by the Michigan Department of Environment, Great Lakes, and Energy (EGLE). Addressing PFAS is a major aim of the proposed Projects No. 1 and 2 in this Project Plan.

Project No. 4 adds equalization capacity for the process to prevent back-ups and overflows during peak flows.

There are current flow limitations within the treatment system, especially at the membranes, that add additional risk of overflows and contamination to waters of the state. Projects No. 3 and 5 are addressing assets with a high risk of failure that are critical to the treatment process. Water quality problems associated with the operation of the existing wastewater collection system have been minimized by proactive monitoring of treatment system assets and needs.

1.3.4 Projected Needs for the Next 20 Years

The CWP and wastewater collection system have various projected needs over the 20-year design period. This project plan relied on the Wastewater System Evaluation conducted under the SAW Grant in 2020 for the most recent condition assessment.

1.3.4.1 Wastewater Treatment Plant Needs

1.3.4.1.1 Comminutors

The CWP currently operates two comminutors that grind and shred wastewater debris prior to grit removal and fine screening. The motor for Comminutor No. 1 is showing signs of wear and corrosion. Both motors and cutter stacks will eventually need to be replaced.

Furthermore, the grinding action of the comminutors is believed to result in release of PFAS from debris into the water. The PFAS can subsequently pass through the downstream treatment processes and into the environment. A project is needed to address the deteriorating comminutors while simultaneously preventing PFAS-laden materials from passing through the downstream treatment processes.

1.3.4.1.2 Influent Screw Pumps

No significant defects were detected. Screw Pump No. 3 has a history of electrical problems, which may accelerate the need for electrical maintenance and replacement in the future.

1.3.4.1.3 Grit Removal

No significant defects were observed in the grit removal assets. Within the next 20 years, the grit equipment may require reassessment to see whether the condition has deteriorated.

1.3.4.1.4 Screening

The screening assets have shown persistent operational challenges. As of 2019, the tops of the screens were beginning to corrode. The screenings conveyors were known to plug, causing troughs to overflow inside the Headworks Building. Furthermore, the conveyor system used to transport the captured screenings does not have built-in redundancy and is the weak point in the screening process. The shaftless auger in the conveyor is expensive to replace and has a very long lead time. Additionally, the gathering conveyor motor showed signs of wear and corrosion.

A project is needed to replace the fine screen in order to improve reliability of a critical piece of the wastewater treatment process and add adequate redundancy. Replacement is also needed to remove PFAS-laden materials and reduce the risk of contamination of waters of the State.

1.3.4.1.5 Bioreactors

The bioreactor assets are generally in good condition. There is minor cracking in the Tank No. 1 concrete wall near the waste activated sludge (WAS)/foam wet well. The WAS gate is not working as intended and needs to be manually operated. Over the 20-year service life, these issues may need to be addressed.

1.3.4.1.6 Process Aeration

The Process Aeration assets are generally in good condition. The diffusers were recently replaced in 2015. The only minor defect is the beginning of corrosion on the air header isolation valves at the bioreactor tanks.

1.3.4.1.7 Membrane

No significant defects were observed for the Membrane assets. A scheduled membrane replacement program was started in 2017 and completed in 2019. During the service life, membrane performance should be monitored for whether it merits replacement.

However, the roof of the Machine Building that houses the membranes is starting to fail due to excess moisture. Humidity from the aerated membrane process is accumulating on the walls and ceiling of the Machine Building causing safety and aesthetic issues, while potentially contributing to a roofing failure. A project is needed to minimize the humidity by covering the tanks to prevent further safety, aesthetic, and roofing challenges.

1.3.4.1.8 UV Disinfection

The UV Disinfection assets are generally in good condition. The automatic controller is beginning to rust and should be monitored over the service life for degradation.

1.3.4.1.9 Administration Building

The Administration Building assets are in generally good condition. Interior ceiling panels have been damaged by leaks and may necessitate minor replacement of stained tiles during the service life.

1.3.4.1.10 SCADA System

During the service life, the Authority may need to upgrade the software and computer system from Windows XP.

1.3.4.1.11 Flow Equalization

The CWP currently does not have flow equalization capability to buffer peak flows during heavy wet weather events. High influent flows associated with flooding of homes near the Grand River have exceeded the firm capacity of the membrane filtration process in the past. This reality requires that all the membrane trains should meet higher influent flows during flood conditions. This would pose a significant challenge if one membrane train was undergoing maintenance during a rain event. When the membrane filtration process is unable to keep up with flood flows, the collection system must be used as equalization. It is desirable to build equalization at the CWP instead. Historical maximum day flow has been as high as approximately 10 MGD. Despite efforts to remove I/I from the collection system, the potential for more frequent high intensity wet weather events require action be taken at the CWP. A project is needed to either expand the capacity of the membrane filtration process or provide equalization capability at the CWP to reduce the risk of overflows during heavy wet weather events. See Appendix C for the 2020 SAW Capacity Analysis for further details on the current flows.

1.3.4.1.12 PFAS Treatment

Per- and Polyfluoroalkyl Substances (PFAS) are a family of chemicals that are regulated by EGLE. These chemical compounds include perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). The CWP does not currently have the capability to treat PFAS within the waste stream and plant effluent has consistently shown high PFAS concentrations. In February 2022, the CWP reported high PFAS levels to EGLE including 170 nano grams per liter (ng/L) PFOS, and 7.7 ng/L PFOA. The anticipated CWP permit limits are as follows: 12 ng/L PFOS and 584,000 ng/L PFOA. The collection system services communities in a large, undefined PFAS plume. Preventing PFAS from entering the collection system through cured-in-place pipe (CIPP) lining or sewer replacement is not practical due to the undefined and dynamic nature of the plume within the collection system. Therefore, a project is needed to treat PFAS and lower the PFAS levels in the effluent to meet anticipated NPDES permit limits.

1.3.4.2 Collection System Needs

The joint collection system is in overall good condition and likely will not require major capital improvements during the 20-year design period.

1.3.4.3 Lift Station Needs

The 2019 System Evaluation indicated that modeled future flow to Four Mile Lift Station indicates a 50% increase, which would exceed firm capacity. This Lift Station may require upgrades within the service life.

1.3.5 Future Environment without Proposed Projects

Without the construction of the proposed projects, the water quality of groundwater, local streams, creeks and rivers, and the buildings served by the wastewater collection system could be degraded or severely harmed. Additionally, the health and reproduction of native ecosystems would also be affected by the long-term release of PFAS.

2 ANALYSIS OF ALTERNATIVES

2.1 Identification of Potential Alternatives

2.1.1 Optimum Performance of Existing Facilities

Optimizing the performance of existing facilities will not address PFAS and capacity issues. An Industrial Pretreatment Program has already been implemented by the Authority. The existing controls and facilities are ably monitoring operations, and the facility is operating optimally. Therefore, this option was not considered further.

2.1.2 Regional Alternatives

The Authority is already a regional system; therefore, regional alternatives were not considered further.

2.1.3 Water and Energy Efficiency

Water and energy efficiency is important when considering alternatives for wastewater treatment plant processes. In the past, one of the proposed projects may have qualified for Green Project Reserve. Project No. 3 (described further in Section 2.2.3.3), the existing screens, conveyors, and compactors will be replaced with updated, more efficient models. This may result in greater energy efficiency for the CWP.

2.2 Identification of Principal Alternatives

2.2.1 Project No. 1: PFAS Debris Removal

2.2.1.1 No Action

The grinding action of the comminutors is believed to result in PFAS release from debris into the water. The PFAS can subsequently pass through the downstream treatment processes and into the environment. The no action alternative would not address the current discharge of PFAS into the environment and would increase the risk of contamination to waters of the State. Therefore, the no action alternative was not considered further.

2.2.1.2 Replace Comminutors

Replacing the comminutors in kind would increase the life of the equipment and decrease maintenance. However, the potential for releasing PFAS into the environment would remain. Therefore, this alternative was not considered further.

2.2.1.3 Remove Comminutors and Install Coarse Screens

This alternative includes removal of the comminutors and installation of coarse screens in the existing channels. The coarse bar screens would capture debris while protecting downstream screw pumps. The organics would be washed from the screenings prior to being compacted/dewatered and deposited in a dumpster for landfill disposal. The coarse screens would remove PFAS laden debris from the wastewater.

The screens and associated screenings handling system would be housed in a masonry building constructed over the existing channels to prevent freezing. The washer compactor would utilize CWP effluent and the building would be connected to the existing odor control biofilter. The controls for the equipment would be located in the existing Electrical Room in the Headworks Building.

2.2.2 Project No. 2: PFAS Filter Building

2.2.2.1 No Action

The effluent at the CWP is currently passing PFAS through the treatment facility and into the Grand River. Current PFAS test results show the facility will not meet its anticipated NPDES discharge limits. Therefore, the no action alternative was not considered further.

2.2.2.2 Pressure Filters

This alternative would require media filters with 12 MGD instantaneous capacity. A building with appropriate climate control would need to be constructed to house the pressure filters. It would require filter pumps to reach recommended pressure in the filters and backwash pumps to clean the media. Valves and piping for lead-lag operation are included in this alternative. A backwash system would need to be installed, including a basin to store fresh backwash water and an equalization basin to gradually return dirty backwash water to CWP headworks.

2.2.2.3 Gravity Filter Bed

The Gravity Filter Bed alternative would provide tertiary treatment. This alternative includes a concrete chamber and thick bed of activated carbon. The rate of biofouling in activated carbon gravity filter beds would be too fast compared to the rate of adsorption to allow proper filtration and PFAS removal. Required backwashing frequency makes this alternative impractical.

Additionally, resin was investigated to determine whether it would provide a faster method of removing PFAS. It was determined that media retention was difficult and the cost of regenerating and replacing resin was too high to be practicable. Therefore, this alternative was not considered further.

2.2.2.4 Upflow Fluidized Bed Filter

This alternative would require air piping and pumping. It would also require water pumping and a media regeneration or disposal system. However, investigation determined that activated carbon would degrade in a fluidized bed and conversations with suppliers revealed there is no large-diameter resin media currently on the market. The available small-diameter media would be washed out of the fluidized bed. Therefore, this alternative was not considered further.

2.2.2.5 Upflow Bed Reactor

An upflow bed reactor would require media retention with an overflow sieve. There is no durable, large-diameter media that could be removed by the sieve currently on the market. Therefore, this alternative was not considered further.

2.2.3 Project No. 3: Fine Screens, Conveyors, and Compactors

2.2.3.1 No Action

Screens are showing wear and O&M efforts are costly to maintain. The screening process is critical to protect the membranes downstream. The conveyor system used to transport the captured screenings does not have built-in redundancy and is a weak point in the screening process. The shaftless auger in the conveyor is expensive to replace and has a very long lead time. Taking no action would perpetuate the risk of system failure and continued unreliability. Therefore, taking no action was not considered further.

2.2.3.2 Replacement in Kind

The existing fine screens and associated screenings handling equipment was manufactured by a company that previously declared bankruptcy. Parts and equipment have become obsolete. Therefore, service and spare parts have become difficult to obtain for the equipment and replacement in kind is not a viable alternative.

2.2.3.3 Replacement with New

The fine screen process would be replaced with more reliable equipment and redundancy added. The rotating drum screens, conveyors, and compactors would be replaced with similar equipment from a reputable manufacturer. Parallel conveyors would be installed for redundancy.

2.2.4 Project No. 4: Peak Flow Accommodation

2.2.4.1 No Action

The CWP currently has minimal flow equalization capability to buffer peak flows during heavy wet weather events. High influent flows associated with flooding of the Grand River could exceed the intended firm capacity of the membranes and cause the equipment to reach maximum capacity. The no action alternative would not address the current capacity issue at the plant and would subject the membrane filtration process to flows beyond its design capacity. If the flow limitation is not addressed, the flow restriction could lead to wastewater overflows in the upstream collection system, risking contamination to the natural environment and waters of the State. Therefore, this alternative was not considered further.

2.2.4.2 Increase Membrane Filtration Capacity

The membrane filtration process was designed for expandability. There are also two empty membrane tanks that could be populated. This alternative includes installing additional membranes and associated pumps, valves, and piping to increase membrane filtration average day capacity by approximately 3.0 MGD. An additional blower would also be installed to service the new membrane train. Increasing membrane filtration capacity would decrease the likelihood of collection system backups.

2.2.4.3 Equalization Basin and Chemical System

For this alternative, a 1.5 million gallon equalization basin would be constructed north of the existing Headworks Building. The tank would accept de-gritted and screened wastewater during high influent flow events to be stored until the flows decreased below the capacity of the membrane filtration process. Then the basin would drain by gravity back to the influent of the headworks processes. The equalization basin would be equipped with flushing units that would utilize effluent water to flush solids from the bottom of the tank when not in use.

The equalization basin would buffer the downstream processes from being overwhelmed by excessive flows. In the event that high influent flows are sustained and the equalization basin is filled, overflow piping would connect the equalization basin to the

CWP effluent piping. Chlorination and dechlorination systems would be added to the piping disinfect the overflow.

2.2.4.4 Bioreactor No. 4

The Bioreactor process was designed to be expandable. There is room on the site for three more bioreactors south of the existing bioreactor tanks. For this alternative the perimeter walls of a fourth bioreactor tank would be constructed, but the internal baffle walls would not be constructed, and the mixers and aeration diffusers would not be installed. Instead, the tank would serve as a wide spot in the activated sludge process to buffer/store 1.5 million gallons of mixed liquor suspended solids (MLSS) during high flow events. When the peak flows have subsided and the membrane filtration process is able to accommodate the flow, the tank would be allowed to drain to a new submersible lift station that would pump the MLSS back to the inlet channel of the bioreactor tanks or back to the Headworks.

Temporarily storing MLSS would buffer the downstream processes from being overwhelmed by most I/I excessive flows. However, there would still be a chance that collection system equalization may be needed.

2.2.5 Project No. 5: Machine Building Humidity Control

2.2.5.1 No Action

Humidity from the aerated membrane process is accumulating on the walls and ceiling of the Membrane Building causing safety, aesthetic, and roofing challenges. The tank covers and a fan are necessary to direct the humidity outdoors and prevent further damage to the facility. The no action alternative would allow preventable roofing damage and safety concerns to occur. This would put the equipment inside the Machine Building at risk, therefore the no action alternative was not considered further.

2.2.5.2 Aluminum Sheeting and Exhaust Fan System

Aluminum sheeting could be tied onto the existing grating. However, suppliers did not offer an existing product of this type, therefore this alternative was not considered further.

2.2.5.3 Fiberglass Reinforced Plastic (FRP) Covers and Exhaust Fan System

FRP covers are durable and long-lasting. This alternative would involve the installation of new panels. However, fiberglass is not recommended for use near membranes due to “needle-like” fiberglass material properties. This alternative was not considered further.

2.2.5.4 Aluminum Membrane Tank Covers and Exhaust Fan System

Aluminum is lightweight and resists corrosion. This alternative would involve the installation of new panels. Installing aluminum covers and an exhaust system is the only viable alternative.

2.3 Analysis of Principal Alternatives

2.3.1 Monetary Evaluation

Detailed cost estimates for each alternative are included in Appendix D. A present worth analysis is required for each project and its alternatives as part of the project plan application. The present worth analysis seeks to show a monetary comparison of costs for viable alternatives and the direct impact to sewer users. Factors that are included in the analysis are:

- Capital Costs
- Capitalized Interest Costs
- Operation, Maintenance, and Replacement (OM&R) Costs
- Energy Cost Savings
- Salvage Value of Capital
- Discount Rate Set by the EPA

Several of the factors above are fixed known costs (Capital, Interest, and Salvage Value). Several other factors are variable and are estimated based on best available data (OM&R and Energy Cost Savings). Estimates are used but actual costs will not be known until the work has been completed and real data is available.

Appendix E shows the present worth analysis for each option discussed. Only SRF eligible costs are included in the present worth analysis. The cost estimates include all costs associated with engineering, construction, and mitigation cost if necessary.

2.3.1.1 Project No. 1: PFAS Debris Removal

2.3.1.1.1 Alternative No. 1: Remove Comminutors and Install Coarse Screens

The two comminutors will be replaced with two coarse screens to remove PFAS-laden materials. Since the existing comminutors are in an open structure, a building will be constructed to shelter the proposed screens. This project includes compactors that will place screenings in a dumpster for disposal.

The total project cost is estimated at $2,179,000. There are no other viable alternatives.

2.3.1.2 Project No. 2: PFAS Treatment

2.3.1.2.1 Alternative No. 1: Pressure Filters

This alternative includes pressurized activated carbon filters, including the necessary booster pumps and backwashing system. The filters will be in large, steel tanks.

The total project cost is estimated at $26,763,000. Annual O&M is estimated at $1,000,000 and the activated carbon consumed per year is estimated at $2,000,000. This may not be cost feasible for the community; however, it is the only option available to remove PFAS.

2.3.1.3 Project No. 3: Fine Screens, Conveyors, and Compactors

2.3.1.3.1 Alternative No. 1: Replacement with New

This alternative includes replacement of the existing screens, conveyors, and compactors. The new system will be set up with three screens, two long conveyors, and two short conveyors. It will have odor control ductwork along with a control panel and SCADA integration.

The total project cost is estimated at $3,028,000. This is the only viable alternative.

2.3.1.4 Project No. 4: Peak Flow Accommodation

2.3.1.4.1 Alternative No. 1: Increase Membrane Filtration Capacity

This alternative includes the membranes and cassettes to populate the last two membrane tanks. The aeration equipment including blower, air piping, and valves necessary for the membranes is also included. Coating to prevent corrosion caused during chemical cleans is included in the pricing. The total project cost is estimated at $5,779,500.

2.3.1.4.2 Alternative No. 2: Equalization Basin and Chemical System

The equalization basin alternative includes the construction of both a basin and a chemical feed system. The Equalization Basin includes the overflow piping and outlet weirs necessary to control water level. It also has a chemical system of chlorination and dichlorination for disinfection. A tank flushing system would be installed. This basin would be integrated into and controlled by supervisory control and data acquisition (SCADA). The total project cost is estimated at $4,459,200.

2.3.1.4.3 Alternative No. 3: Bioreactor No. 4

This alternative includes the installation of another concrete bioreactor. This tank includes a tipping trough flushing system. An inlet gate and drain valve will be installed to control flow in and out of the bioreactor. The system will be integrated into SCADA. Necessary piping, controls, and appetences will be included.

Since the bioreactor would be situated at a lower elevation to catch overflows, a lift station would need to be installed. The costs include excavation of the wet well and installation of the necessary pump and piping. The total project cost is estimated at $4,373,000.

2.3.1.5 Project No. 5: Machine Building Humidity Control

2.3.1.5.1 Alternative No. 1: Aluminum Membrane Tank Covers and Exhaust Fan System

Aluminum tank covers are recommended for the membrane tanks since they are lightweight and resistant to corrosion. This alternative includes material and installation of the covers, including access hatches and removal points. It also includes the installation of air piping from the tanks with a fan and louver to create suction. The air header may follow the existing blower header and exit out of the north wall.

The total project cost is estimated at $777,000. This is the only viable alternative.

2.3.2 Environmental Evaluation

EGLE requires an equivalency applicant to make contact with several organizations to determine if there will be cultural or natural environmental impact due to the proposed construction activities. Since this project is not pursuing equivalency until further notice, correspondence to these cultural and environmental agencies – indicating the location and scope of the proposed work activities – was not completed. Below is a brief initial discussion of the potential impacts the proposed projects will have on cultural and environmental resources, if any, based on available preliminary information. For the purposes of the environmental evaluation, the study area was assumed to be the CWP site, where the proposed projects are located.

2.3.2.1 Cultural Resources

The proposed projects are fully located on the CWP site, which was previously disturbed by construction and filled in 2006. The proposed projects will not impact historic structures since the structures nearby work areas were constructed between 2006-2008. Therefore, no historic or archaeological sites will be impacted by the construction of the proposed project.

2.3.2.2 Natural Environment

2.3.2.2.1 Climate

Normal climatological information for the study area was obtained from the National Weather Service Forecast Office located in Northern Indiana.

Averages	Spring	Summer	Fall	Winter
High Temperature	56	79	60	33
Low Temperature	37	58	42	20
Mean Temperature	46	70	52	30
Precipitation (inches)	9.57	10.26	10.55	6.73
Seasonal Snowfall (inches)	8.7	0	3.7	72.1

2.3.2.2.2 Air Quality

It is not anticipated that the proposed projects would facilitate the growth of residential or commercial development as the projects are either rehabilitating or replacing existing wastewater treatment infrastructure. Therefore, these projects will not negatively impact the air quality in the affected areas.

2.3.2.2.3 Wetlands

The project area is outside of and removed from wetlands areas. The work will be conducted on the CWP site, which was filled and raised in 2006. Therefore, the proposed projects will not impact wetlands.

2.3.2.2.4 Coastal Zones

None of the proposed projects will take place in Coastal Zones.

2.3.2.2.5 Floodplains

There are no floodplains within the project area. This site is 1 foot above the 100-year floodplain and does not contain wetlands, so the proposed projects are unlikely to impact floodplains. Upon authorization and completion of detailed design, if there are floodplain impacts identified, a mitigation plan will be developed. Applicable and necessary permits will be obtained from the EGLE.

2.3.2.2.6 Inland Lakes and Streams

None of the proposed projects will take place near inland lakes and streams. No bodies of water will be modified during the proposed projects.

2.3.2.2.7 Natural or Wild and Scenic Rivers

No designated wild, scenic or natural rivers exist within the study area. The proposed projects are located within the Grand River watershed.

2.3.2.2.8 National Natural Landmarks

The lists of National Natural Landmarks in Michigan on EGLE's website and the National Parks Service website were reviewed to determine whether there are listed landmarks that could be impacted by project construction or operation. It was determined that no national natural landmarks exist within the study area.

2.3.2.2.9 Recreational Facilities

Each of the communities served have areas designated for parks and recreation, but these areas will not be impacted by construction.

2.3.2.2.10 Topography

The study area is located in a developed plot, and the site has been leveled to a relatively flat elevation. The elevation of the site is approximately 626 feet in elevation, one foot above the 500-year floodplain.

2.3.2.2.11 Geology

The natural geological structures or formations are not affecting the choice of alternatives. The site was filled and raised in 2006. The site was previously disturbed when the CWP was erected. No undisturbed geology will be affected by the proposed projects, including the excavation for the equalization basin.

2.3.2.2.12 Soils

The natural soils at the CWP site are dominated by sandy soils in the Boyer-Riddles-Marlette Association, as depicted by the Soil Association Map produced by Michigan State University and the U.S. Department of Agriculture Soil Conservation Service in 1981. The natural soil was previously disturbed due to construction of the CWP at the site. The surface soil at the site consists of fill that was placed in 2006. No undisturbed soil will be affected by the proposed projects, including the excavation for the proposed equalization basin.

2.3.2.2.13 Agricultural Resources

The areas of construction are located at the CWP site and will not impact prime, unique, statewide, or locally important farmland.

2.3.2.2.14 Fauna and Flora

The proposed projects are located within a developed site and construction is limited to inside/near existing structures at the CWP. The site was evaluated for fauna and flora during site development in 2006. It is unlikely that sensitive fauna or flora would be affected by these projects. The US Fish and Wildlife Service was not contacted, since there is no suitable habitat within the project areas.

2.3.2.2.15 Contaminated Sites

There is no known contamination on the CWP site where the proposed projects will be constructed. There are a few Superfund sites within the service area of the Authority.

During the operation of the PFAS removal system, there will be a necessity for specialized disposal of carbon used to capture PFAS. Further investigations into available disposal and destruction sites will be completed once funding is awarded.

This site may require groundwater dewatering during construction. During design, publicly available site contamination information will be reviewed.

2.3.2.2.16 Navigable Waters

None of the proposed work is located in navigable waters under the jurisdiction of the United States Army Corps of Engineers (USACE).

3 SELECTED ALTERNATIVE

3.1 Description of the Selected Alternative

A summary of the selected alternatives including brief descriptions and cost estimates is included in Table 4.

General scopes of work were developed in this project plan and are included in the project cost estimates to make a preliminary determination of project eligibility. Detailed scopes of work and bases of design were not developed as part of this planning document. Detailed bases of design, including existing and proposed flows and capacities will be provided for proposed projects when a funding source has been identified and design engineering has been undertaken.

Project No. 1: **PFAS Debris Removal, Alternative 1: Remove Comminutors and Install Coarse Screens.** This project includes the installation of 2 screens and the associated conveyors, compactors, controls, and appurtenances. A building would be constructed over the screens and dumpster. See Figure 3 for details.

The estimated project cost is $2,179,000.

Project No. 2: **PFAS Filter Building, Alternative 1: Pressure Filters.** This project includes the installation of pressure filters for removing PFAS in the process stream with associated piping, pumping, and backwash system. See Figure 4 for details.

The estimated project cost is $26,763,000.

Project No. 3: **Fine Screens, Conveyors, and Compactors, Alternative 1: Replacement with New**. This project includes the replacement of the existing screens and solid screenings handling system. See Figure 5 for details.

The estimated project cost is $3,028,000.

Project No. 4: **Peak Flow Accommodation, Alternative 3: Bioreactor No. 4.** This includes installation of an additional bioreactor tank to provide flow equalization. The project includes installation of necessary pumping, piping, controls and appurtenances. See Figure 6 for details.

The estimated project cost is $4,373,000.

Project No. 5: **Machine Building Humidity Control, Alternative 1: Aluminum Membrane Tank Covers and Exhaust Fan System.** This project includes installation of an aluminum cover for the membrane tanks and a fan to remove entrapped air containing high humidity. The project includes installation of necessary piping, controls and appurtenances. See Figure 7 for details.

The estimated project cost is $777,000.

Project Schedule:

The table below is a schedule for the proposed CWP improvement Projects No. 1, 3, and 5. The Authority anticipates funding in the four-and-a-half quarter of fiscal year 2023. The remaining projects No. 2 and 4 are to be constructed in the future with the exact schedule to be determined.

SRF Project (4 ½ Quarter 2023)
Proposed Project Schedule

Milestone	Date
Hold Public Hearing	May 19, 2022
Submit Final Project Plan to EGLE	June 1, 2022
Receive Approval of Project Plan	August 29, 2022
User Charge System Approved	April 2023
Plans and Specifications Approved	May 2023
Receive Construction Permit	May 2023
Receive Construction Bids	June 2023
SRF Loan Closing	September 2023
Begin Construction	November 2023
Construction Completed	June 2025

3.2 Cost Estimates

Appendix D contains cost estimates for the proposed wastewater system improvements. The project costs include construction costs and approximately 30% for construction contingencies, legal, administrative, and project engineering costs.

3.3 Authority to Implement the Selected Alternatives

Implementation of the proposed project is based on the assumption that the project will be financed by a low-interest loan from the SRF program. The Authority has the necessary legal, institutional, financial, and managerial resources available to ensure the construction, operation and maintenance of the proposed facilities. The proposed work will be carried out on the CWP site, so no Joint Agreements are required.

3.3.1 Financials

An Asset Management Plan was developed as part of the SAW grant program. The Authority has a budget for construction and improvements that is billed to the municipalities based on flow. The current budget and subsequent budgets are based on planned rate increases of 3%

every year for the foreseeable future. Maintenance is supported by the municipalities based on percentage contributions. Payments on SRF loans are expected to be covered through rate adjustments in excess of the planned rate adjustments.

3.3.2 Design/Permits

Projects will be submitted for necessary permits prior to required deadlines during the design phase.

3.4 Users Costs

Project plan process requires the applicant to perform a Present Worth analysis of the various options. The Present Worth analysis (Appendix E) uses discount factors that reduce the annual expenses compared to what the annual bond payment would be. Appendix F contains the annual cost summary and provides the worst-case scenario where the proposed bond payment will not be reduced by anticipated discounts related to salvage value, reduction in OM&R, energy savings, and principal forgiveness.

The Authority is planning on funding the FY2023 projects with an estimated $5,984,000 SRF loan at a 1.875% interest rate for a 20-year period. The Authority is interested in receiving principal forgiveness that may be associated with PFAS funding. It is understood that principal forgiveness is not guaranteed, varies annually, and the amount will not be determined until several months after the SRF Project Plan is submitted.

The expected annual debt service based on the SRF 20-year loan criteria will be approximately $362,000 per year for the FY2023 projects.

The increase due to the proposed FY2023 projects translates to an annual cost of approximately $17.22 per REU, or $1.43 per month per REU. The average user cost of the future projects is estimated at $18.66 per month per REU. The actual cost paid by a given user will vary by community, because Authority costs are paid by the member municipalities based on total flow for the municipality. Those costs are in turn paid by individual users through their sewer billings.

3.5 Green Project Reserve

Green Project Reserve principal forgiveness is not offered this year, but Project No. 3 including the replacement of existing screens, conveyors, and compactors with updated, more efficient models may have qualified for Green Project Reserve funding.

3.6 Useful Life

The Authority intends to pay back the SRF loan on a 20-year amortization schedule. EGLE guidance requires that the loan terms must not exceed the useful life of the project.

Project No. 1 includes the replacement of the existing comminutors with screens. The associated components of the screens and screenings handling equipment have useful lives of 20 to 30 years. The building and piping connections have a service life of approximately 50 years. Therefore, the useful life of this project exceeds the length of the loan terms.

Project No. 2 includes the construction of pressure filters and piping with a service life of approximately 50 years. The constructed building has a useful life that exceeds 50 years. The expected useful life of the process piping and valves is estimated at 20 to 30 years. Therefore, the useful life of this project exceeds the length of the loan terms.

Project No. 3 includes replacement of the existing screens and screening solids disposal equipment. The associated components of the screens and equipment have useful lives of 20 to 30 years. Piping and odor control ductwork have a service life of 20 years. Therefore, the useful life of this project exceeds the length of the loan terms.

Project No. 4 includes the construction of Bioreactor No. 4 to provide equalization. The concrete basin has a service life of approximately 50 years. The expected useful life of the process piping and valves is estimated at 20 to 30 years. The electrical and pump components have a service life of approximately 20 years. Therefore, the useful life of this project exceeds the length of the loan terms.

Project No. 5 includes the installation of new cover panels for the aerated membrane tanks with a service life of over 20 years. The fan has a service life of over 20 years. Therefore, the useful life of this project exceeds the length of the loan terms.

4 EVALUATION OF ENVIRONMENTAL IMPACTS

4.1 General

The anticipated environmental impacts resulting from the construction of the selected plan include beneficial and adverse, short and long-term, and irreversible and irretrievable. The following is a discussion of the anticipated environmental impacts of the selected plan.

4.1.1 Beneficial Impacts

- Construction activities associated with the wastewater plant improvements would occur exclusively on Authority-owned property at the existing CWP site. This will minimize disturbance to residents.
- Construction and equipment manufacturing related jobs would be generated.
- Local contractors would have an equal opportunity to bid on the construction contracts.
- Water quality would be improved by the reduction of PFAS.
- No additional development of land would be necessary due to the proposed wastewater system improvements.
- No construction of new roads would be necessary.
- Improvement of existing equipment and processes within CWP site.
- No disruption to fish and wildlife.
- No detrimental impacts on air quality.
- Increased energy efficiency.
- No negative impact on the surrounding groundwater.
- No anticipated impact on historic sites, archaeological sites, cultural sites, or recreational areas.
- No anticipated impact on threatened or endangered species.
- More reliable and resilient wastewater treatment system to accommodate variations in wastewater flows and emerging contaminants.
- No work in wetlands or in floodplain because the site is 1 ft above the 100-year floodplain.

4.1.2 Adverse Impacts

- Noise and dust would be generated during construction of the project.
- Minor traffic disruptions may occur during construction.
- Use of energy and natural resources.

4.1.3 Short and Long-Term Impacts

The short-term adverse impacts associated with construction activities would be minimal, and mitigable, in comparison to the resulting long-term beneficial impacts.

4.1.3.1 Short Term Adverse Impacts

- Traffic disruption.
- Dust and noise.
- Use of energy and natural resources.
- Construction safety hazards – the projects will be designed with the overall health and safety of construction workers and operators in mind, although construction site safety is the Contractor's responsibility.

4.1.3.2 Short Term Beneficial Impacts

- Construction activities associated with the CWP improvements would occur exclusively on Authority-owned property at the existing CWP site; this will minimize disturbance to residents.
- No disruption to fishing and recreational boating.
- No disruption to fish and wildlife.
- Construction and equipment manufacturing related jobs would be generated.
- Local contractors would have an equal opportunity to bid on the construction contracts.
- No additional development of land would be necessary due to the proposed system improvements.
- No detrimental impacts on air quality.
- No negative impact on the surrounding groundwater.
- No impact on historical sites, archaeological sites, cultural sites, or recreational areas.

- No impact on threatened or endangered species.
- No impact on prime or unique agricultural lands.
- Reduced consumption of energy due to improved process efficiencies.
- More reliable wastewater treatment system.

4.1.3.3 Long Term Adverse Impacts

- Possible increased natural resource use for the removal of PFAS.
- Additional, technologically advanced equipment requires additional, advanced maintenance.

4.1.3.4 Long Term Beneficial Impacts

- A more reliable and resilient CWP that can address emerging contaminants and extreme flows.
- Improved water quality.
- Reduced risk of sanitary sewer overflows and contamination of surface waters.
- Minimal increased stormwater runoff, since most proposed projects are within existing buildings.
- No anticipated impact on historical sites, archaeological sites, cultural sites, or recreational areas.
- No anticipated impact on threatened or endangered species.
- PFAS removed that would previously be released into the receiving stream.
- Greater protection for sensitive membrane processes.

4.2 Analysis of Impacts

4.2.1 Direct Impacts

The proposed projects are unlikely to affect water quality, air quality, wetlands, endangered species, or wild and scenic rivers. Projects are unlikely to affect historical, archaeological, geographic, cultural, or recreational areas, as construction activities will be confined to an existing, currently developed site. Previously referenced figures give an idea of the proposed construction for each project.

4.2.1.1 Construction Impacts

The main direct impact of the proposed project will be noise and dust at the CWP. Traffic will not be significantly disrupted because the construction will occur a distance from existing roads. The use of energy and natural resources in construction is unavoidable. The potential for effects on habitat and stormwater will be avoided as much as possible during earthmoving work to install Projects No. 2 and 4. Proposed Project No. 2 PFAS system requires tank installation and construction of a filter building. The Project No. 4 excavation required will be approximately 20 feet deep, 40 feet wide, and 300 feet long. Dewatering will likely be required for both projects, but efforts will be taken to minimize environmental impact. Since the proposed project area is less than an acre and proposed projects occur within existing buildings, additional stormwater discharges will be minimal.

4.2.1.2 Operational Impacts

The replacement of equipment will be planned in such a way that wastewater service can be maintained without interim discharges. The existing structures and activated carbon air filters are designed to keep odors and noise to a minimum. The proposed projects will not significantly affect plant aesthetics.

4.2.1.3 Social Impacts

If SRF funding is provided for the proposed projects, user rates will require an increase. This is a burdensome cost to the communities served. The most expensive project will be the PFAS filtration, but this project is necessary to comply with anticipated NPDES effluent PFAS concentrations. See the User Cost estimates in Appendix E. The proposed work will be carried out on the existing CWP site. Residents will have access to their home and business during construction.

4.2.2 Indirect Impacts

The proposed wastewater facilities are sized to provide service for 20 years of future growth in the study area, based on current trends. Future growth in the study area will not greatly alter the character of the area. Future development would be subject to conformance with the land use and zoning plans for the service areas. No expansion of the service district is proposed.

4.2.3 Cumulative Impacts

Providing more reliable wastewater treatment with updated equipment and structures to the customers of the system would be the primary cumulative impact anticipated from the construction of the project.

5 MITIGATION

5.1 Mitigation of Potential Short-Term Impacts

Standard practices used in the construction industry will be included in the construction contract documents to mitigate construction activities.

5.1.1 Traffic Disruption

Standard traffic and safety control devices will be in place to warn and protect residents if construction activities affect roadway travel.

5.1.2 Dust and Noise

Dust control methods such as water and/or brine will be used to keep dust to a minimum. Haul roads and public roadways will be swept and maintained to assure residents access to the area. Construction equipment will be maintained in good condition to decrease noise.

5.1.3 Soil Erosion

Catch basins will be protected where earth changing activities will take place. Soil erosion and sedimentation control measures such as straw bales, sedimentation basins, and silt fence, will be part of the construction activities to prevent soil release and protect streams and wetlands.

5.1.4 Wastewater Service Disruption

Construction will be carefully planned so that each grinder can be replaced while maintaining CWP operation.

5.1.5 Working in Wetland

No work is proposed in the wetland.

5.1.6 Working in Floodplain

No work is proposed in the floodplain.

5.1.7 Potential Loss of Wildlife / Habitat

The proposed projects are located within the previously developed CWP site. It is unlikely that construction would impact habitats of the endangered and threatened species. If trees must be removed to install the equalization basin or other CWP improvements, safe and sustainable tree cutting practices will be used.

5.2 Mitigation of Potential Long-Term Impacts

General mitigation of construction activities for CWP improvements will prohibit the disposal of soils in wetlands, floodplains, or other sensitive areas.

5.2.1 Siting Decisions

The proposed projects will be located on the CWP site, which was filled and developed in 2006. This location is unlikely to cause impacts to environmental, historical, and sensitive features.

5.2.2 Operational Impacts

Safe practices will be utilized to prevent chemical spills.

5.2.3 Use of Natural Resources

As a result of the anticipated construction, natural resources such as gravel, sands, oil, and fuels will be utilized and consumed. The long-term benefits for most of the proposed projects will result in reduced use of natural resources.

5.2.4 Energy Use

The use of energy is inevitable in operating a wastewater CWP and producing materials used for construction. Using recycled or natural eco-friendly products as part of the construction process instead of nonrenewable resources will not completely mitigate the use of energy, but it will offset a small percent. Increases in equipment efficiency will also offset long-term energy usage.

5.3 Mitigation of Indirect Impacts

As the proposed project alternatives are confined to the existing treatment plant site, significant or undirected new development is not likely to be facilitated by this project. Existing planning and zoning maps will not be affected. Ordinances are neither affected nor needed. Construction staging will be carefully planned to maintain functionality and operability of the CWP during the construction of proposed improvements.

Tables

Table 1 - Flow Allocations

Community	Existing Flow (MGD)	% of Total	Future Growth (MGD)	% of Total	Future Average Daily Flow (MG)
Alpine Township	0.754	21.2%	1.91	26.9%	2.66
Cannon Township	0.305	8.6%	0.43	7.5%	0.74
Courtland Township*	0.075	2.1%	0.08	1.5%	0.15
Plainfield Township	1.865	52.4%	3.41	53.3%	5.28
City of Rockford	0.560	15.7%	0.52	10.9%	1.08
Total	3.558	100%	6.35	100%	9.91

Note: Future Growth is based on the 2013 Sewer Flow Study and Existing Flows are based on 2021 Sewer Flow Study.
*Courtland Township Future Average Daily Flow is based on REU calculation and 2021 unit flow per REU.

Table 2 - Historical and Projected Population

	Actual Census Figures		Forecasted Population**				
Location*	**2010**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**
Alpine Township	13,336	14,079	15,045	15,441	15,799	16,135	16,488
Cannon Township	13,336	14,379	15,384	15,684	15,945	16,184	16,443
Courtland Township	7,678	9,005	8,897	9,051	9,184	9,306	9,438
Plainfield Township	30,952	33,535	36,302	37,507	38,616	39,669	40,763
City of Rockford	5,719	6,142	6,651	6,827	6,986	7,135	7,292

*Communities contributing to the Wastewater Facility Flows.

**Population Projections from the Grand Valley Metropolitan Council (GVMC) using base year 2015.

Table 3 - Service Population REU Predictions

	REU	Forecasted REU*				
Location*	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**
Alpine Township	6,099	7,065	7,461	7,819	8,155	8,508
Cannon Township	2,415	3,420	3,720	3,981	4,220	4,479
Courtland Township	563	455	609	742	864	996
Plainfield Township	13,763	16,530	17,735	18,844	19,897	20,991
City of Rockford	2,319	2,828	3,004	3,163	3,312	3,469

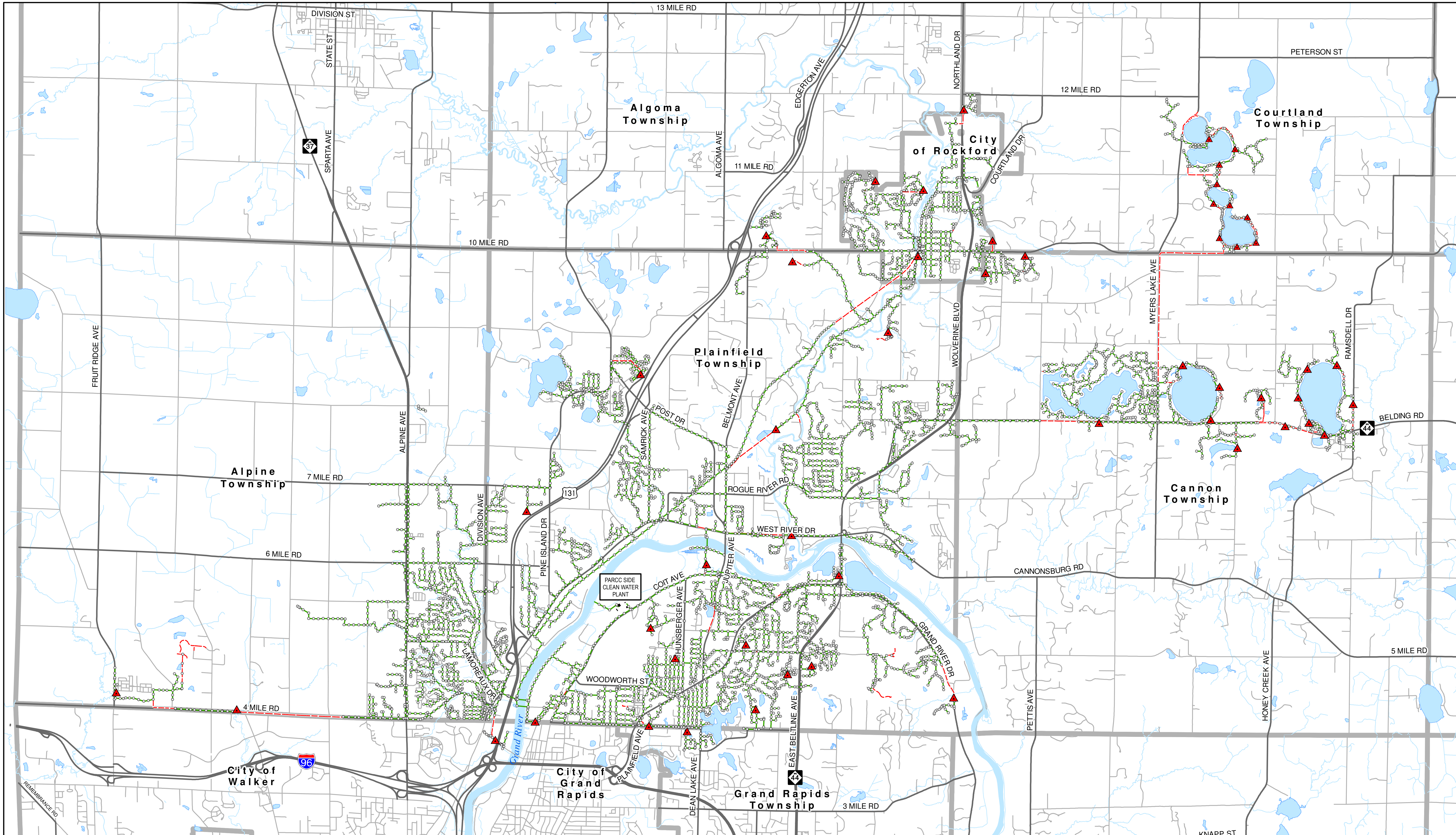
*REU forecast based on population growth.

Note: 2020 REU figures are based on the 2020 and 2021 billing data.

Table 4 - Summary of Selected Alternatives

Project No.	Year	Project Title	Project Description	Total Cost Estimate
1.	FY2023	Remove Comminutors and Install Coarse Screens	Demolition of the existing comminutors and installation of screens to remove PFAS-laden materials.	$2,179,000
2.	Future	Pressure Filters	Installation of a PFAS filter and the necessary pumps, piping, valves, and control appurtenances.	$26,763,000
3.	FY2023	Fine Screens, Conveyors, and Compactors	Replace the existing screens, conveyors, and compactor with new.	$3,028,000
4.	Future	Bioreactor No. 4	Construction of the perimeter walls of a fourth bioreactor tank in addition to the control and cleaning mechanisms.	$4,373,000
5.	FY2023	Aluminum Membrane Tank Covers and Exhaust Fan System	This project includes the installation of aluminum tank covers in addition to air header and fan to remove humidity.	$777,000
			Total FY2023 Cost:	$5,984,000
			Total Future Cost:	$31,136,000

Figures



SCALE: 1 " = 6,000 '

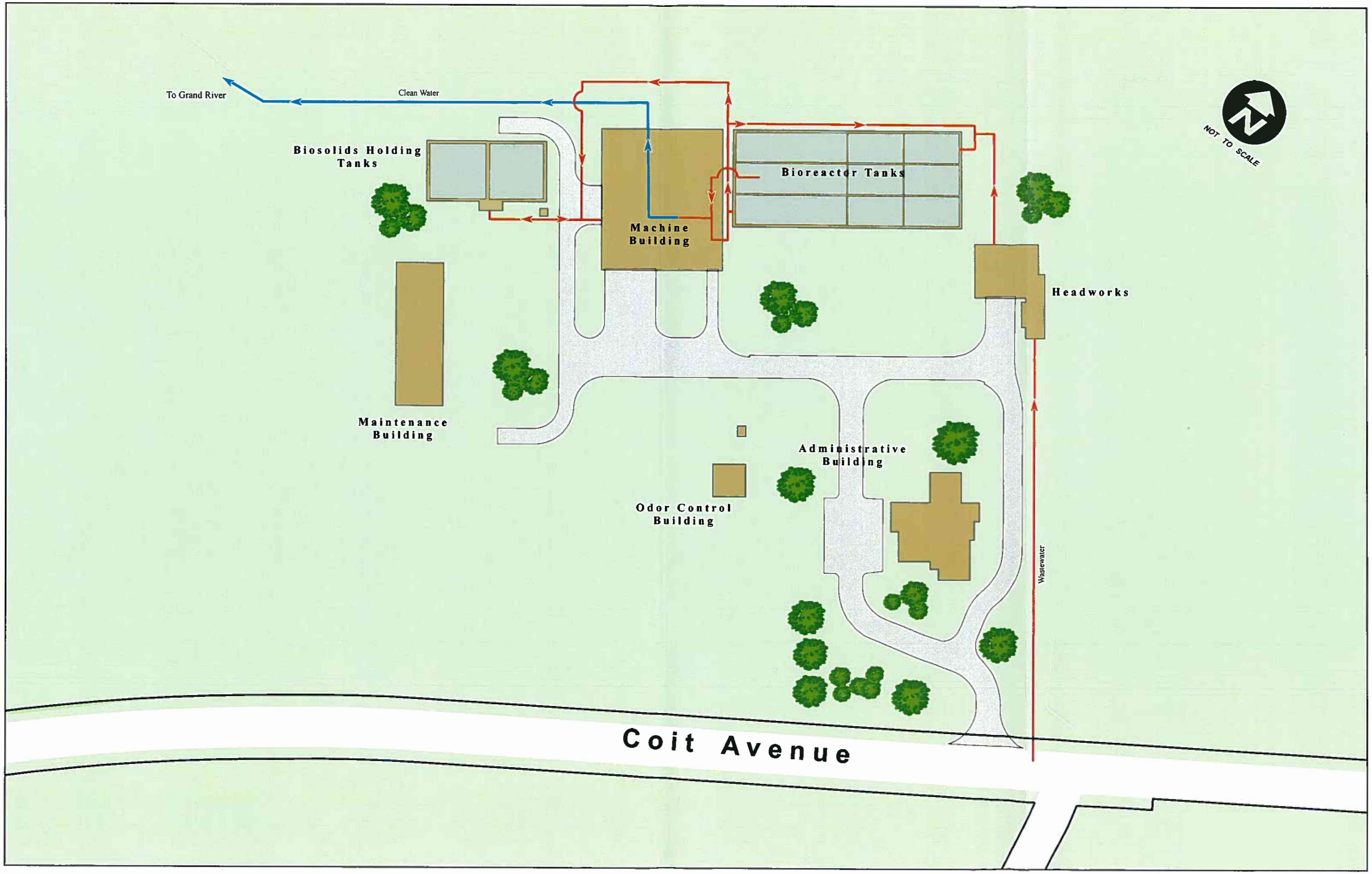
LEGEND

- Lift Station
- Manhole
- Force Main
- Gravity Main

NORTH KENT SEWER AUTHORITY
KENT COUNTY, MICHIGAN

SERVICE AREA

FIGURE 1
MARCH 2022
Prein&Newhof
2220316



NORTH KENT SEWER AUTHORITY

KENT COUNTY, MICHIGAN

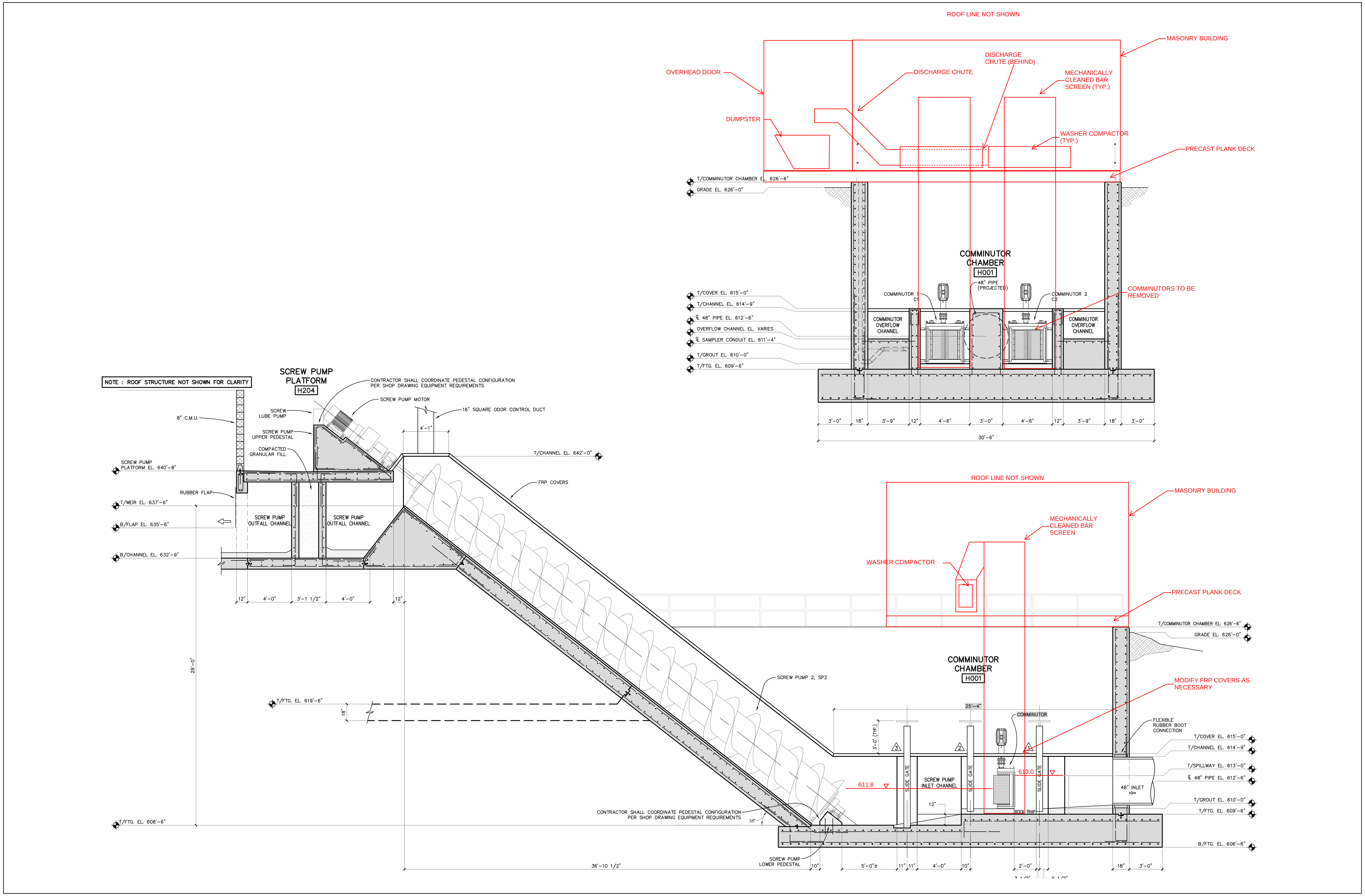
PARCC SIDE TREATMENT FACILITY LAYOUT

FIGURE 2

MARCH 2022

Prein&Newhof

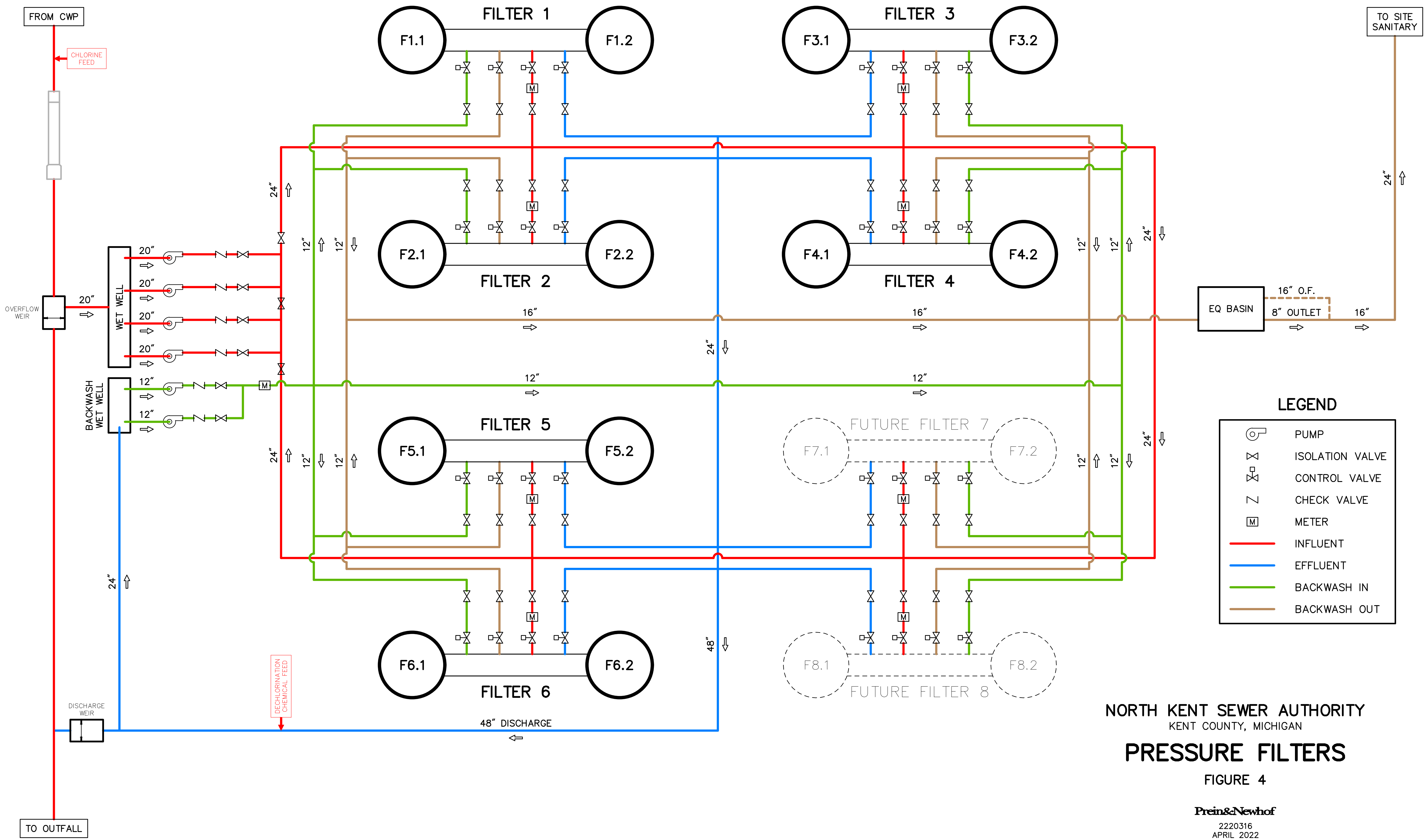
2220316



NORTH KENT SEWER AUTHORITY
KENT COUNTY, MICHIGAN

REMOVE COMMINUTORS AND INSTALL COARSE SCREENS

FIGURE 3
MARCH 2022
Prein&Newhof
2220316

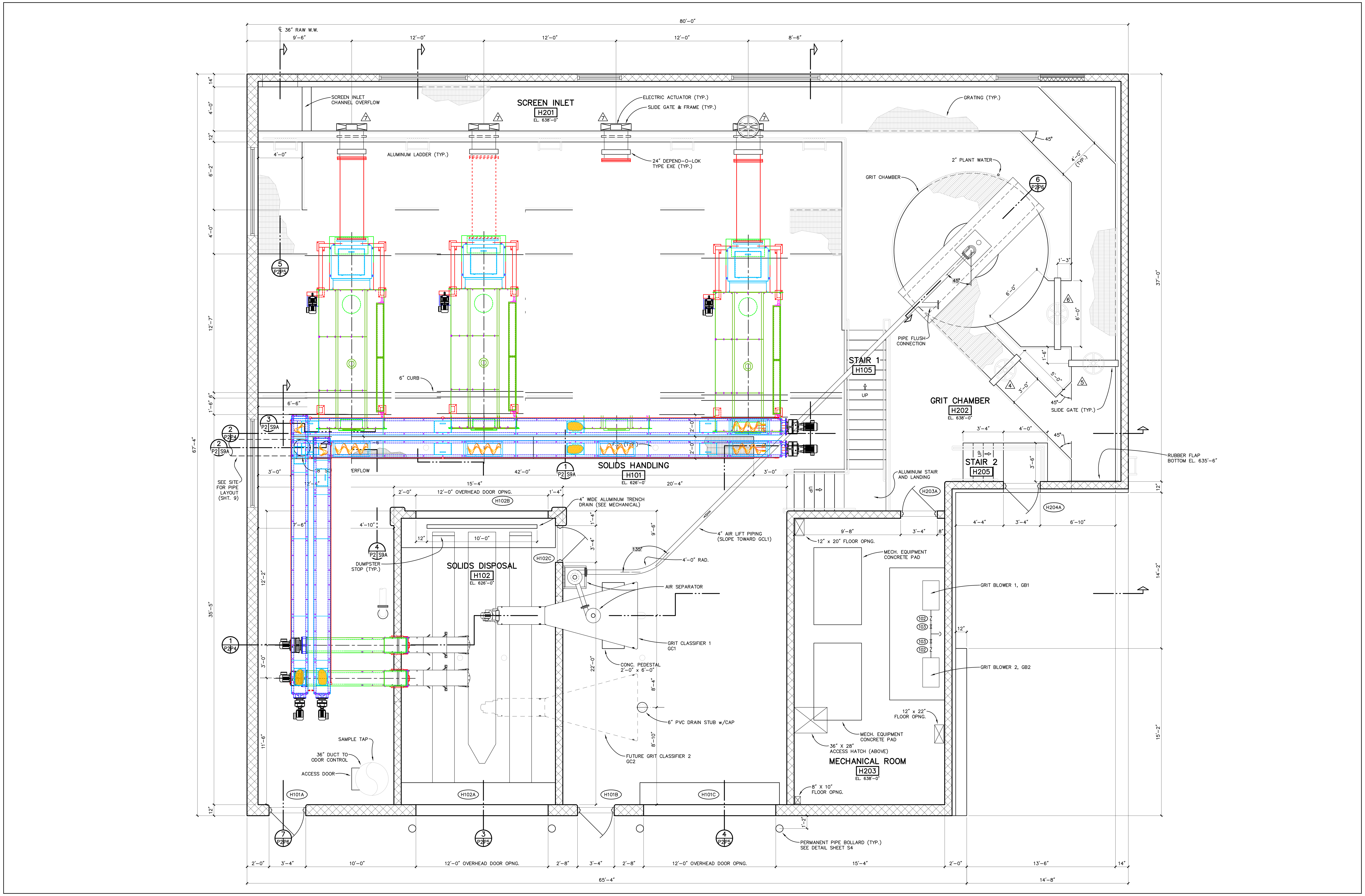


NORTH KENT SEWER AUTHORITY
KENT COUNTY, MICHIGAN

PRESSURE FILTERS

FIGURE 4

Prein&Newhof
2220316
APRIL 2022



NORTH KENT SEWER AUTHORITY
KENT COUNTY, MICHIGAN

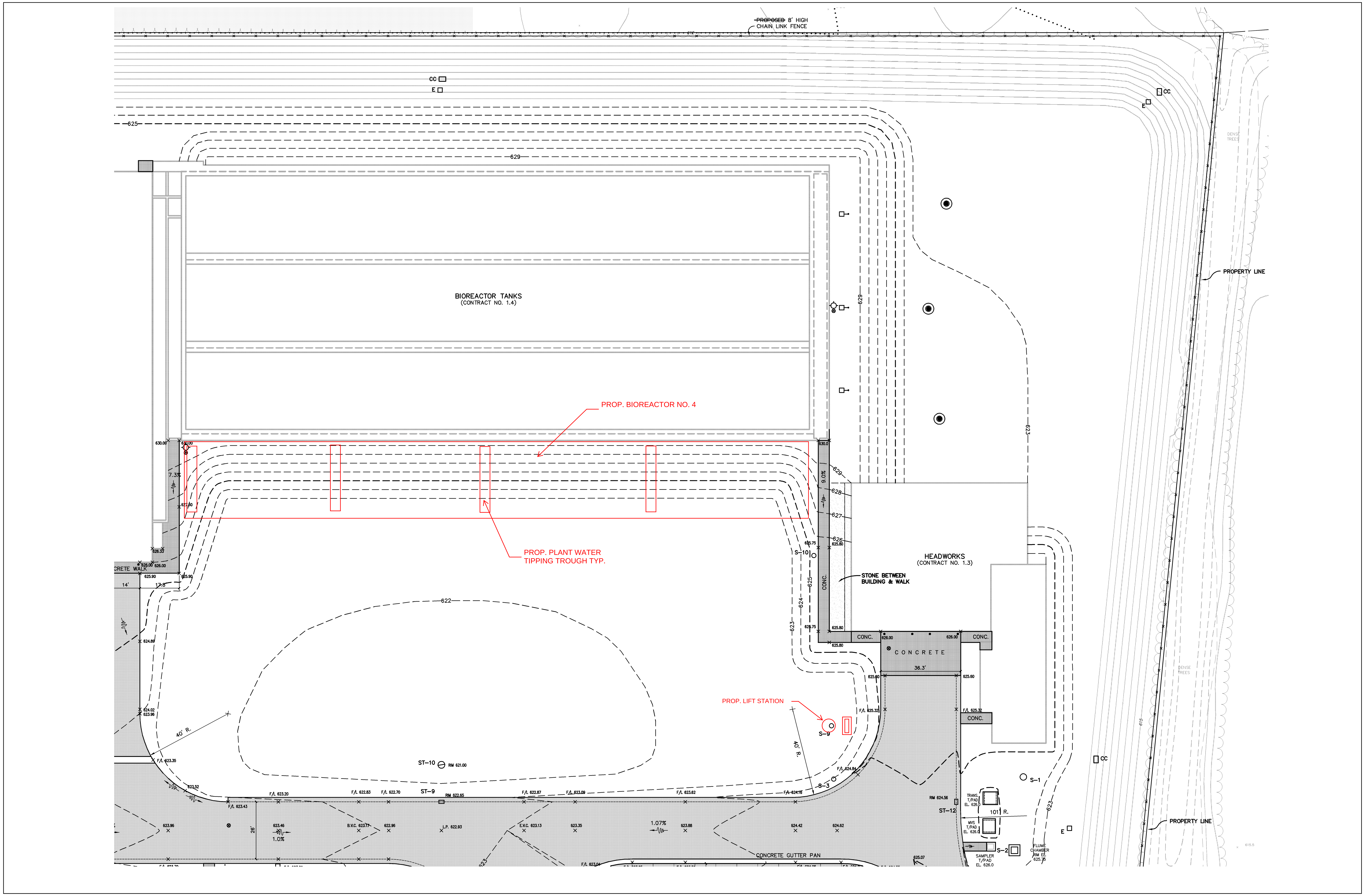
FINE SCREENS, CONVEYORS, AND COMPACTORS

FIGURE 5

MARCH 2022

Prein&Newhof

2220316



NORTH KENT SEWER AUTHORITY
KENT COUNTY, MICHIGAN

BIOREACTOR NO. 4

FIGURE 6

MARCH 2022

Prein&Newhof

2220316

North

NORTH KENT SEWER AUTHORITY
KENT COUNTY, MICHIGAN

MEMBRANE TANK COVERS AND EXHAUST FAN SYSTEM

FIGURE 7

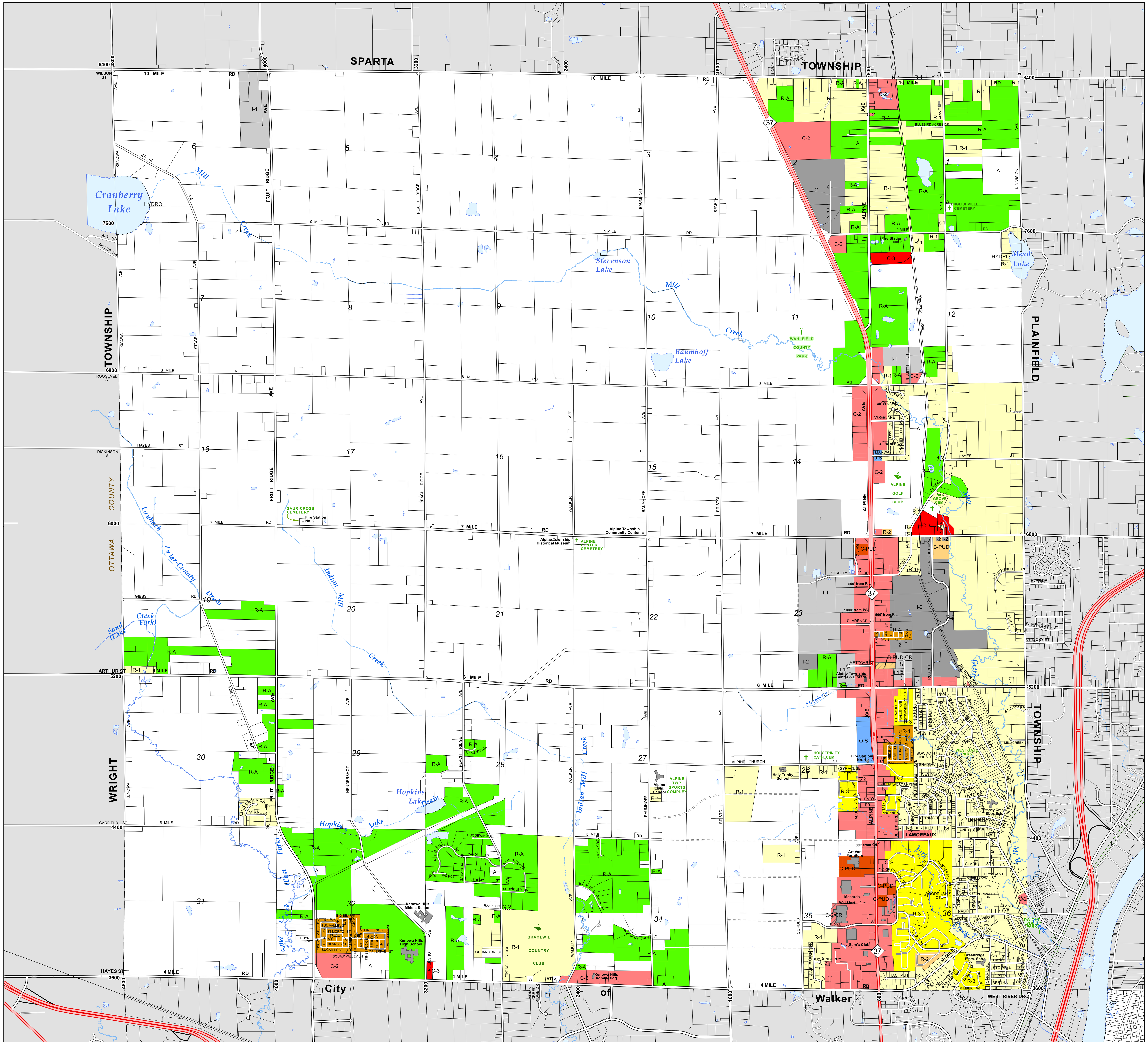
MARCH 2022

Prein&Newhof

2220316

Appendix A

Service Area Zoning Maps



Alpine Township

2018 Zoning Map

Adopted by the Alpine Township Board April 16, 2018

Ord. No. 18-04

ZONING LEGEND

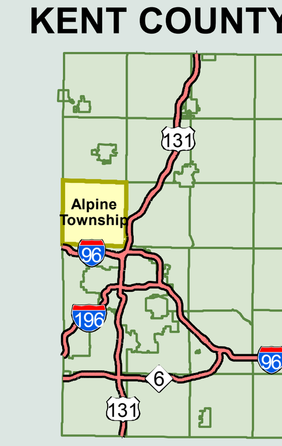
- Agricultural (A)
- Rural Agricultural (R-A)
- Low Density Residential (R-1)
- Medium Density Residential (R-2)
- High Density Residential (R-3)
- Mobile Home Park (R-4)
- Residential Open Space Preservation PUD (ROSP-PUD)
- Open Space Neighborhood PUD (OSN-PUD)
- Mixed Use PUD (M-PUD)
- Office and Service (O-S)
- Commercial (C-1)
- Commercial (C-2)
- Alpine Township, B-PUD-CR
- Commercial/Conditional Rezoning (C-2/CR)
- Commercial (C-3)
- Business PUD (B-PUD)
- Commercial PUD (C-PUD)
- Light Industrial (I-1)
- General Industrial (I-2)

MAP LEGEND

Roads & Streets

- Freeway
- Freeway Ramp
- Highway
- Primary
- Secondary
- Proposed/Under Construction
- Private
- **Railroads**
- Section Lines
- Parcels
- **Major Buildings**
- **Municipal Boundaries**
- Parks, Cemeteries, Etc.
- **Lakes & Ponds**
- **Rivers & Streams**

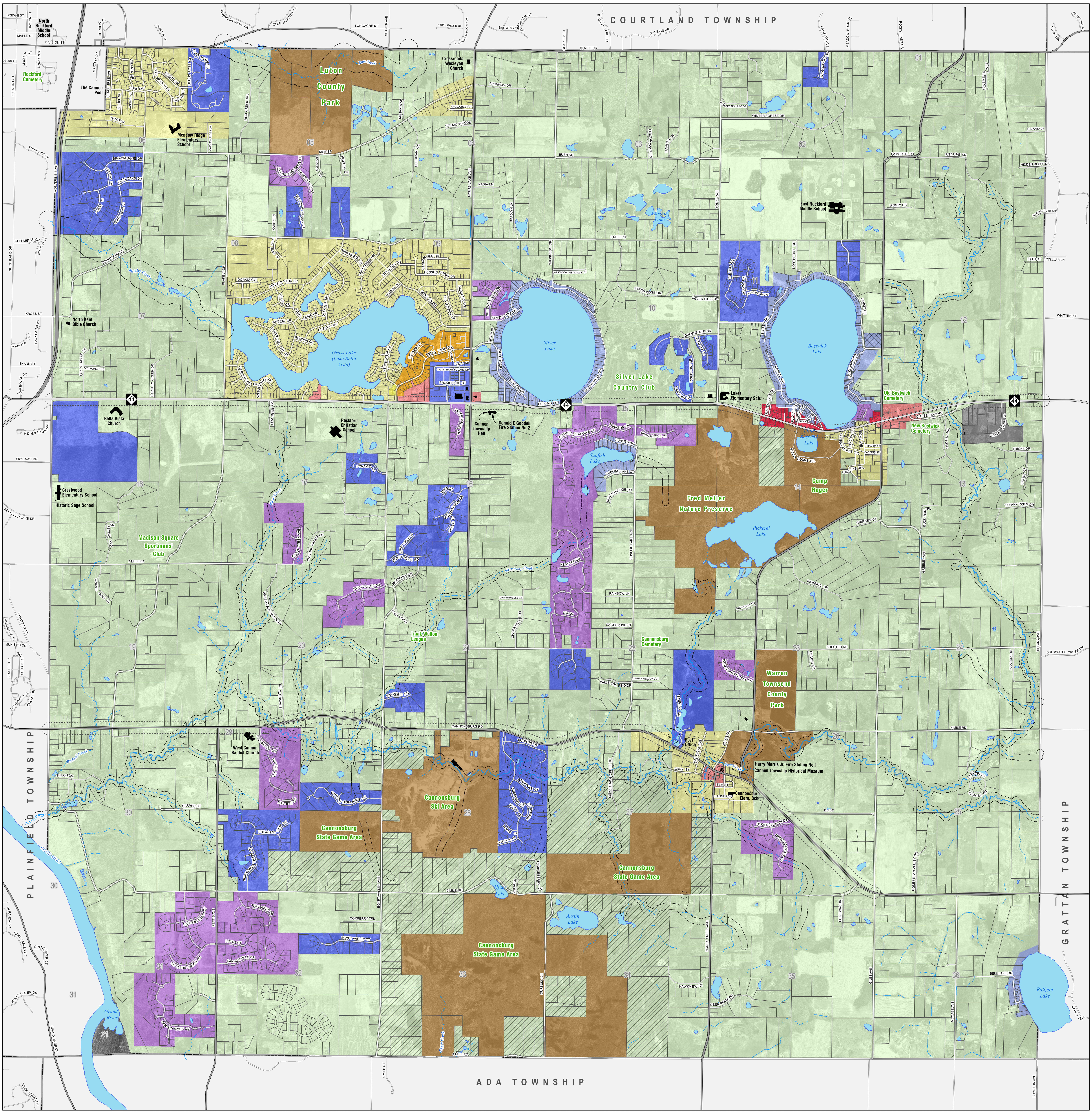
KENT COUNTY, MI.



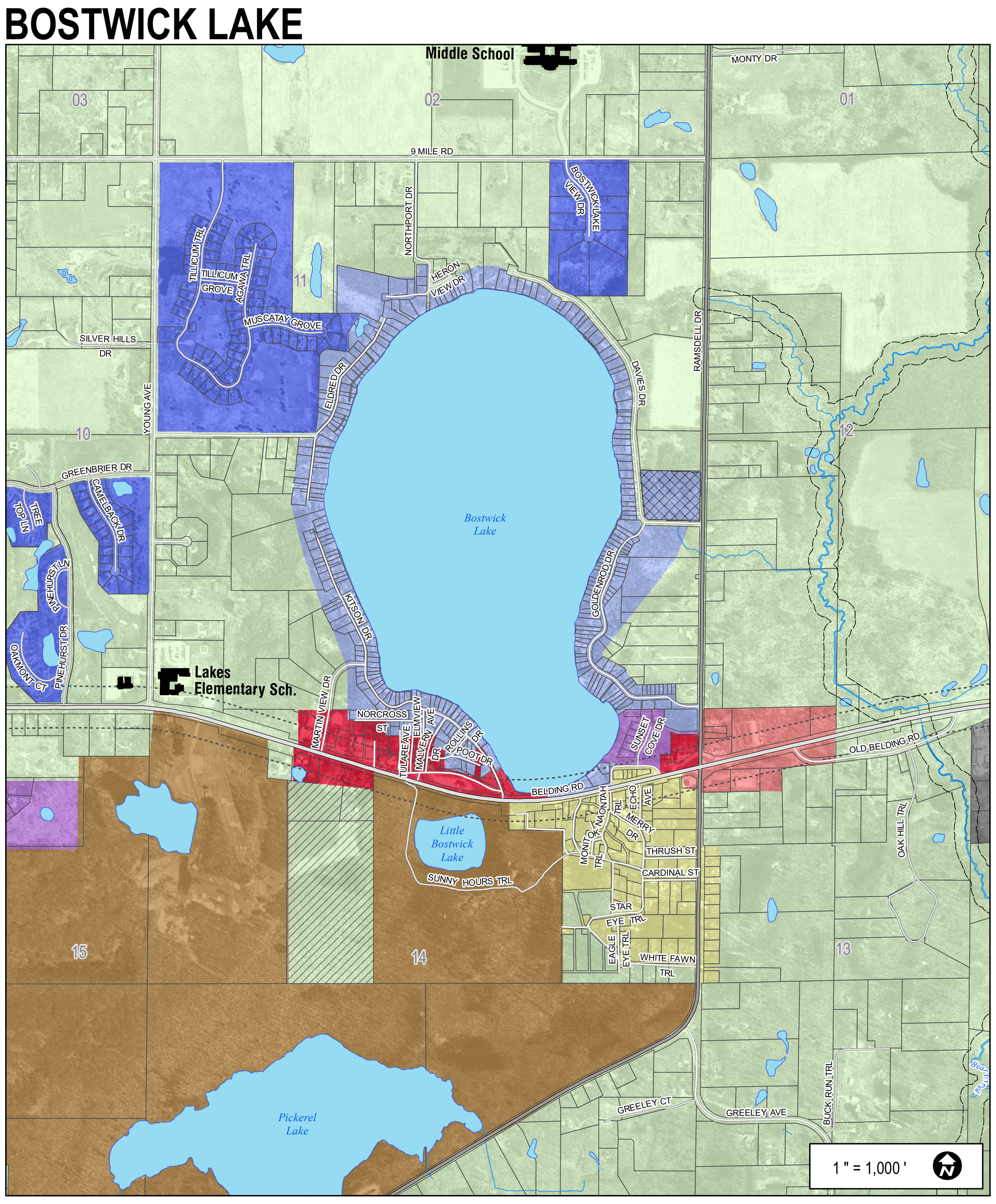
Created September 2008 within REGIS (Regional Geographic Information System) from data supplied by Alpine Township, the Kent County Road Commission and other official sources.
© Date: 10/2/2018Alpine Township and the REGIS Agency. All Rights Reserved.

0 750 1,500 3,000 4,500 6,000 Feet

MAP SCALE 1:21,000



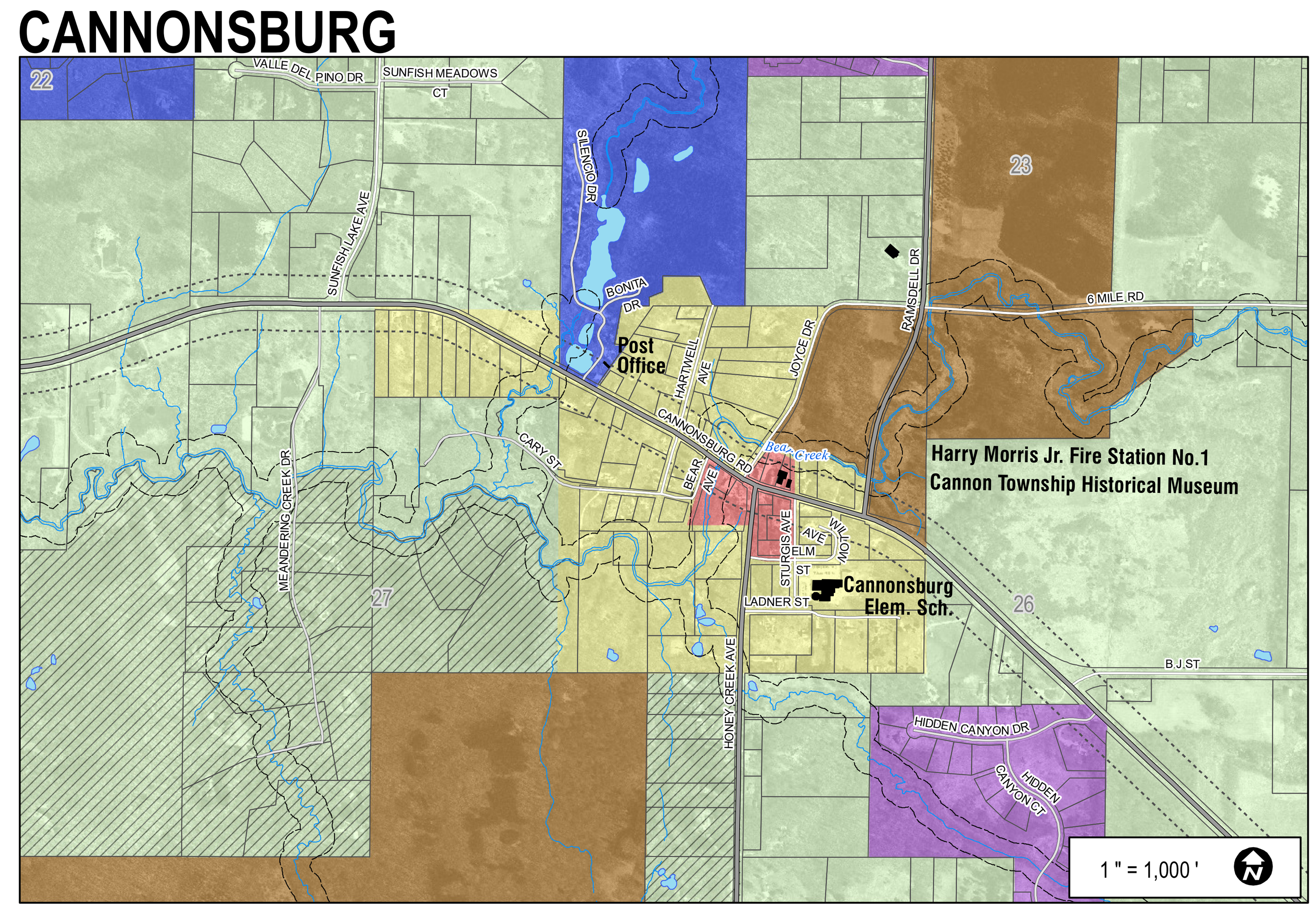
BOSTWICK LAKE



LEGEND

- RR - Rural Residential/Agricultural
- R-1 - Low Density Residential
- R-2 - Medium Density Residential
- R-3 - High Density Residential
- LR - Lake Residential
- PUD - Planned Unit Development
- OS-PUD - Open Space PUD
- B-1 - Neighborhood Business District
- B-2 - General Business District
- I - Industrial District
- Unique Recreation Resource Area Overlay District - 1
- Unique Recreation Resource Area Overlay District - 2
- Conditional Zoning
- Rogue River/Natural River Overlay
- Bear Creek Watershed Protection Overlay
- Access Management Overlay

CANNONSBURG



Cannon Township

KENT COUNTY, MICHIGAN

ZONING MAP

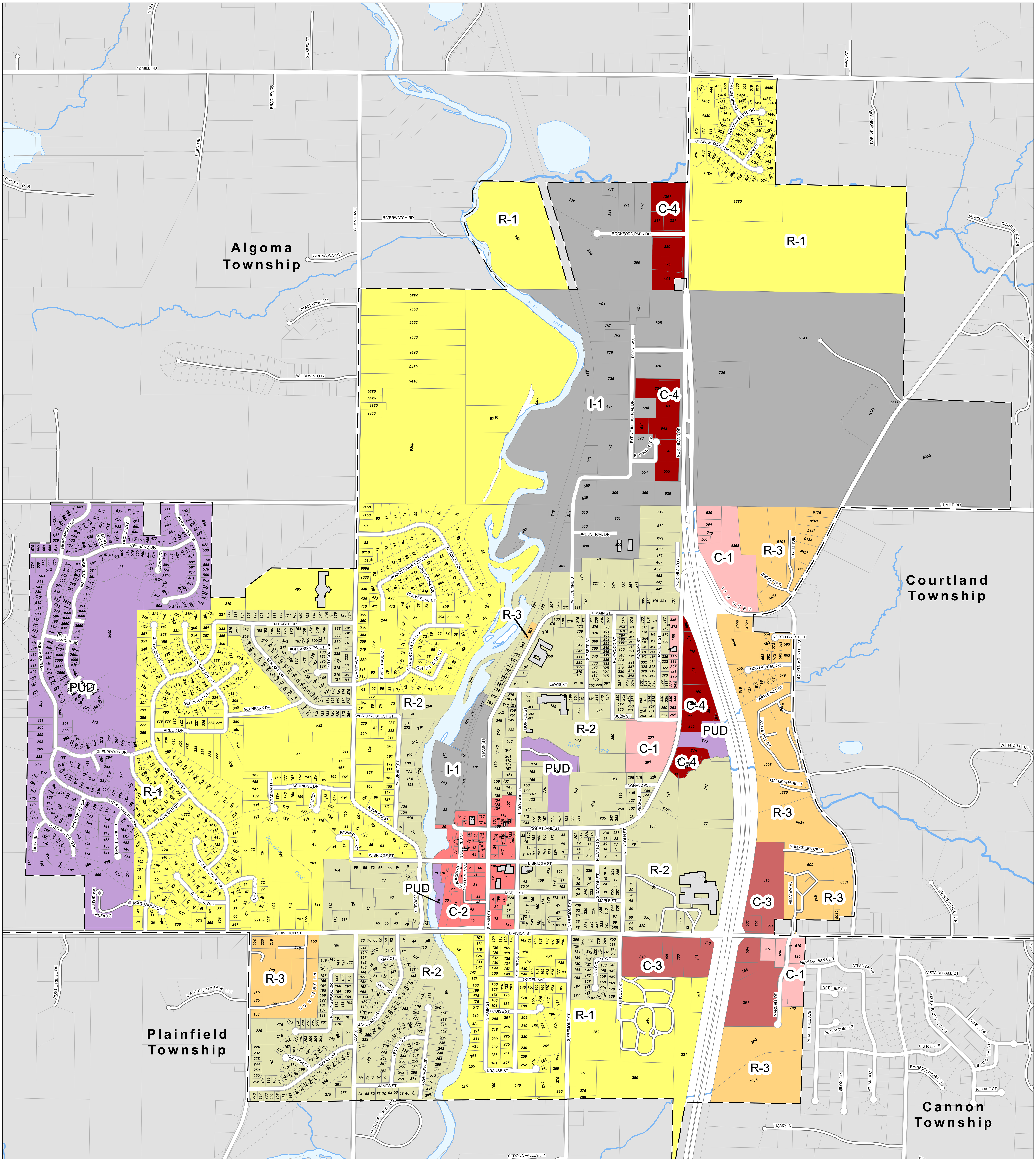
DRAFT

MARCH 2019

0 0.125 0.25 0.5

Miles

Prein&Newhof



Legend

- R-1 - Low Density Residential
- R-2 - Medium Density Residential
- R-3 - High Density Residential
- C-1 - Office Commercial
- C-2 - Central Business
- C-3 - General Commercial
- C-4 - Highway Commercial
- I-1 - Industrial
- PUD - Planned Unit Development

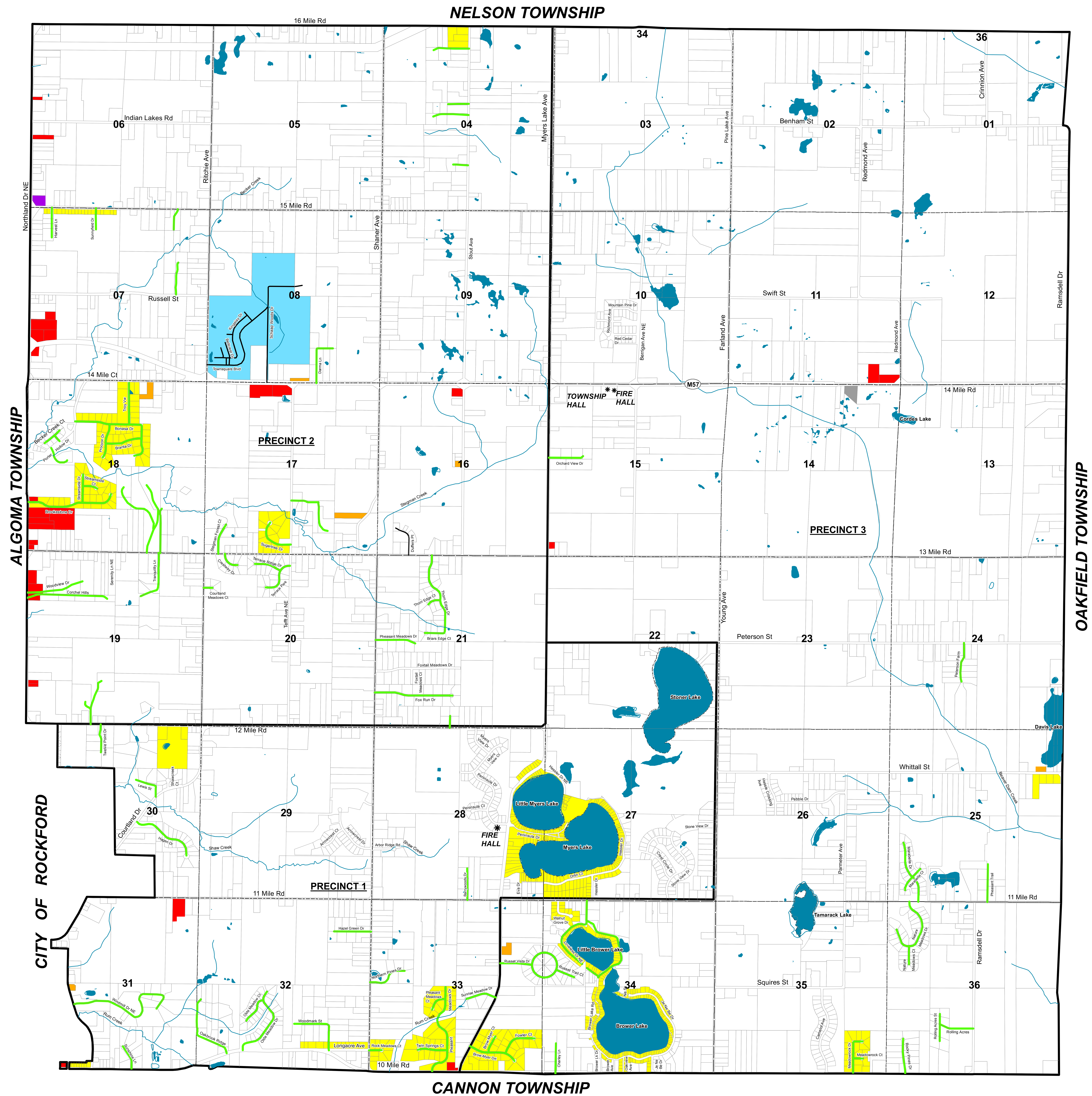
CITY OF ROCKFORD
KENT COUNTY, MICHIGAN
ZONING MAP

0 750 1,500 3,000 Feet

Mayor: ______________________ Date:__________

Christine Bedford, City Clerk: ______________________ Date: __________

REGIS



COURTLAND TOWNSHIP ZONING MAP

KENT COUNTY, MICHIGAN
ADOPTED OCTOBER 1, 2014

THIS IS TO CERTIFY THAT THIS IS THE OFFICIAL ZONING MAP REFERRED TO IN THE COURTLAND TOWNSHIP ZONING ORDINANCE AS AMENDED

ZONING LEGEND

- RR - RURAL RESIDENTIAL
- R-1 - SINGLE FAMILY RESIDENTIAL
- "MANUFACTURED HOUSING COMMUNITY" (ZONED RR - RURAL RESIDENTIAL; MANUFACTURED HOUSING COMMUNITY PERMITTED BY CONSENT JUDGMENT DATED OCTOBER 11, 2000)
- R-2 - TWO FAMILY AND MULTIPLE FAMILY
- C - COMMERCIAL
- LC - LIGHT COMMERCIAL
- INDUSTRIAL

LEGEND

- PUBLIC ROADS
- PRIVATE ROADS
- PRECINCTS

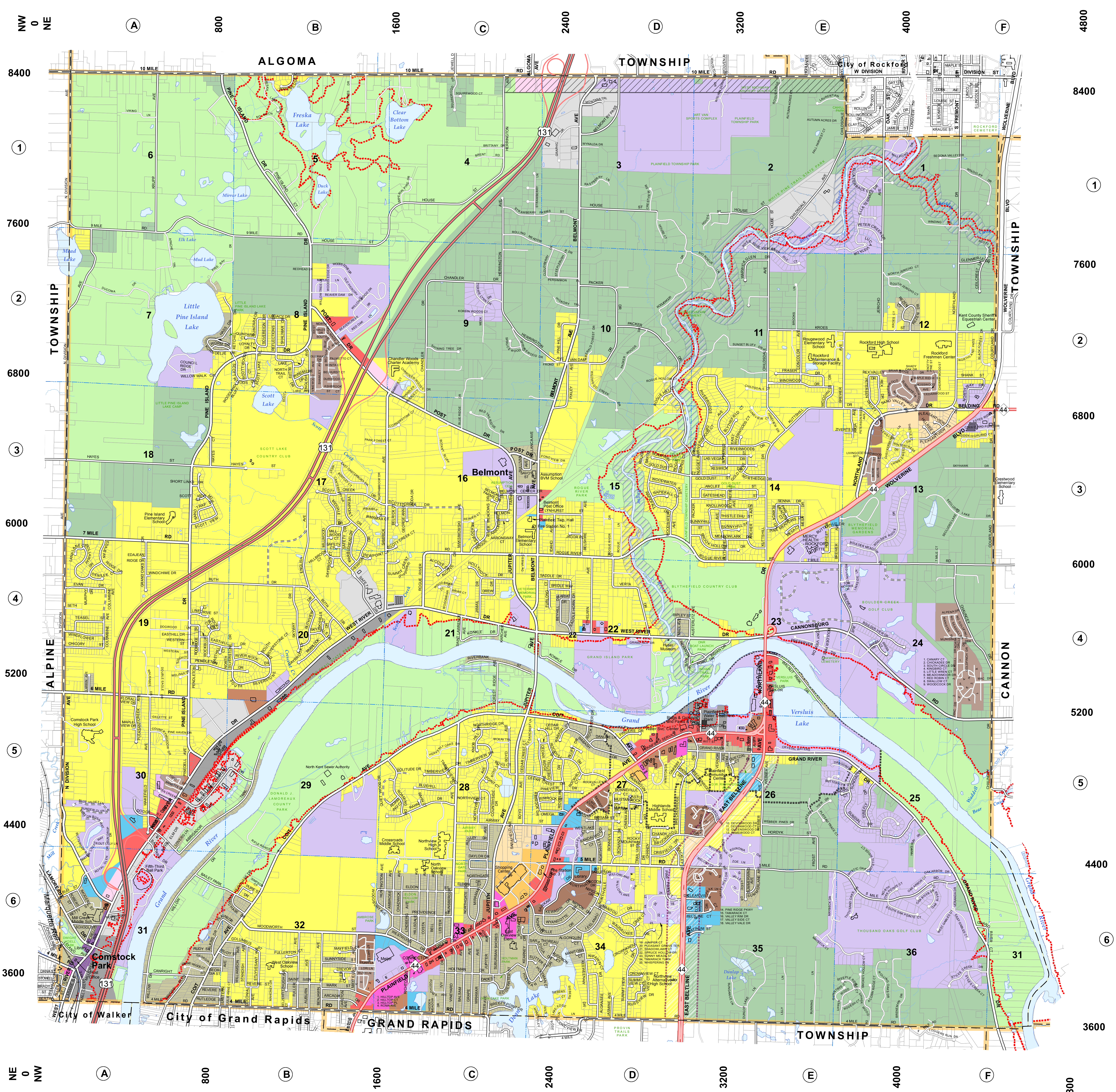
N
NO SCALE

progressive ae
1811 4 Mile Rd NE
Grand Rapids, MI 49525
616 361 2664 OFFICE
616 361 1493 FAX
www.progressiveae.com

Plainfield Charter Township

Zoning Map

Rolling Plains and Beautiful Fields



ZONING MAP

OFFICAL UPDATE: SEPTEMBER 12, 2018

Updated July 2014 within REGIS (Regional Geographic Information System) from data supplied by Plainfield Charter Township, the Kent County Road Commission and other official sources.

MAP SCALE 1:27,575

0 900 1,800 3,600 5,400 7,200 Feet

MAP LEGEND

Street Centerlines
- Freeway;/Highway
- Freeway Ramp
- Primary & Residential
- Private
- Other
- Railroads
- Section Lines
- Major Buildings
- Parcels
- Lakes and Ponds
- Rivers and Streams
- Municipal Boundaries

ZONING LEGEND

- Well Head Protection Overlay
- Flood Zone Overlay
- 10 Mile Road Overlay
- Natural Rivers Overlay
- Northeast Beltline Overlay
- C-1, Commercial
- C-2, Commercial
- C-3, Commercial
- C-4, Commercial
- C-5, Commercial
- I, Industrial
- LI, Light Industrial
- O, Office
- PUD, Planned Unit Development
- R-1, Residential
- R-1A, Residential
- R-2, Residential
- R-3, Residential
- R-4, Residential
- RE, Rural Estate
- RP, Rural Preserve
- VC, Village Commercial

REGIS

Appendix B

CWP NPDES Permit

PERMIT NO. MI0057419

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act (33 U.S.C. 1251 *et seq*., as amended; the "Federal Act"); Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA); Part 41, Sewerage Systems, of the NREPA; and Michigan Executive Order 2011-1,

North Kent Sewer Authority
4775 Coit Avenue, NE
Grand Rapids, Michigan 49525

is authorized to discharge from the **PARCC Side Clean Water Plant** located at

4775 Coit Avenue
Grand Rapids, Michigan 49525

designated as **North Kent SA WWTP**

to the receiving water named the Grand River in accordance with effluent limitations, monitoring requirements, and other conditions set forth in this permit.

This permit is based on a complete application submitted on March 26, 2013 as amended through April 15, 2015.

This permit takes effect on September 1, 2015. The provisions of this permit are severable. After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked in whole or in part during its term in accordance with applicable laws and rules. On its effective date this permit shall supersede NPDES Permit No. MI0057419, expiring October 1, 2013.

This permit and the authorization to discharge shall expire at midnight, **October 1, 2018**. In order to receive authorization to discharge beyond the date of expiration, the permittee shall submit an application which contains such information, forms, and fees as are required by the Department of Environmental Quality (Department) by **April 4, 2018**.

Issued _____

____
Philip Argiroff, Chief
Permits Section
Water Resources Division

PERMIT FEE REQUIREMENTS

In accordance with Section 324.3120 of the NREPA, the permittee shall make payment of an annual permit fee to the Department for each October 1 the permit is in effect regardless of occurrence of discharge. The permittee shall submit the fee in response to the Department's annual notice. The fee shall be postmarked by January 15 for notices mailed by December 1. The fee is due no later than 45 days after receiving the notice for notices mailed after December 1.

Annual Permit Fee Classification: Municipal Major, less than 10 MGD (Individual Permit)

In accordance with Section 324.3132 of the NREPA, the permittee shall make payment of an annual biosolids land application fee to the Department if the permittee land applies biosolids. In response to the Department's annual notice, the permittee shall submit the fee, which shall be postmarked no later than January 31 of each year.

CONTACT INFORMATION

Unless specified otherwise, all contact with the Department required by this permit shall be made to the Grand Rapids District Supervisor of the Water Resources Division. The Grand Rapids District Office is located at the State Office Building, Fifth Floor, 350 Ottawa N.W., Unit 10, Grand Rapids, Michigan 49503-2341, Telephone: 616-356-0500, Fax: 616-356-0202.

CONTESTED CASE INFORMATION

Any person who is aggrieved by this permit may file a sworn petition with the Michigan Administrative Hearing System within the Michigan Department of Licensing and Regulatory Affairs, c/o the Michigan Department of Environmental Quality, setting forth the conditions of the permit which are being challenged and specifying the grounds for the challenge. The Department of Licensing and Regulatory Affairs may reject any petition filed more than 60 days after issuance as being untimely.

PART I

Section A. Limitations and Monitoring Requirements

1. Final Effluent Limitations, Monitoring Point 001A

During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the permittee is authorized to discharge treated municipal wastewater from Monitoring Point 001A through Outfall 001. Outfall 001 discharges to the Grand River. Such discharge shall be limited and monitored by the permittee as specified below.

	Maximum Limits for Quantity or Loading				Maximum Limits for Quality or Concentration					
Parameter	**Monthly**	**7-Day**	**Daily**	**Units**	**Monthly**	**7-Day**	**Daily**	**Units**	**Monitoring Frequency**	**Sample Type**
Flow	(report)	---	(report)	MGD	---	---	---	---	5x/week	Report Total Daily Flow
Carbonaceous Biochemical Oxygen Demand ($CBOD_5$)										
5/1-11/30	270	670	---	lbs/day	4	---	10	mg/l	5x/week	24-Hr Composite
12/1-4/30	1700	2700	---	lbs/day	25	40	---	mg/l	5x/week	24-Hr Composite
Total Suspended Solids										
5/1-11/30	1300	2000	---	lbs/day	20	30	---	mg/l	5x/week	24-Hr Composite
12/1-4/30	2000	3000	---	lbs/day	30	45	---	mg/l	5x/week	24-Hr Composite
Ammonia Nitrogen (as N)										
5/1-11/30	30	130	---	lbs/day	0.5	---	2.0	mg/l	5x/week	24-Hr Composite
12/1-4/30	---	---	---	---	---	---	(report)	mg/l	5x/week	24-Hr Composite
Total Phosphorus (as P)	67	---	---	lbs/day	1.0	---	---	mg/l	5x/week	24-Hr Composite
Fecal Coliform Bacteria	---	---	---	---	200	400	---	cts/100 ml	5x/week	Grab
Acute Toxicity										
Ceriodaphnia dubia	---	---	---	---	---	---	1.0	TU_A	Monthly	24-Hr Composite
Chronic Toxicity										
Ceriodaphnia dubia	---	---	---	---	18.4	---	---	TU_C	Monthly	24-Hr Composite
Total Mercury										
– Corrected	(report)	---	---	lbs/day	(report)	---	---	ng/l	Quarterly	Calculation
– Uncorrected	(report)	---	---	lbs/day	(report)	---	---	ng/l	Quarterly	Grab
– Field Duplicate	---	---	---	---	(report)	---	---	ng/l	Quarterly	Grab
– Field Blank	---	---	---	---	(report)	---	---	ng/l	Quarterly	Preparation
– Laboratory Method Blank		---	---	---	(report)	---	---	ng/l	Quarterly	Preparation
	Rolling Average				**Rolling Average**					
Total Mercury	0.00027	---	---	lbs/day	4.0	---	---	ng/l	Quarterly	Calculation
					Minimum Monthly					
$CBOD_5$ Minimum % Removal										
12/1-4/30	---	---	---	---	85	---	---	%	Monthly	Calculation
Total Suspended Solids Minimum % Removal										
12/1-4/30	---	---	---	---	85	---	---	%	Monthly	Calculation

PART I

Section A. Limitations and Monitoring Requirements

					Minimum Daily		Maximum Daily			
pH	---	---	---	---	6.5	---	9.0	S.U.	5x/week	Grab
Dissolved Oxygen	---	---	---	---	3.0	---	---	mg/l	5x/week	Grab

The following design flow was used in determining the above limitations, but is not to be considered a limitation or actual capacity: 8.0 MGD.

a. Narrative Standard
The receiving water shall contain no turbidity, color, oil films, floating solids, foams, settleable solids, or deposits as a result of this discharge in unnatural quantities which are or may become injurious to any designated use.

b. Sampling Locations
Samples for or $CBOD_5$, Total Suspended Solids, Ammonia Nitrogen, Acute and Chronic Toxicity, and Total Phosphorus shall be taken prior to disinfection. Samples for Dissolved Oxygen, Fecal Coliform Bacteria, Total Mercury, and pH shall be taken after disinfection. The Department may approve alternate sampling locations which are demonstrated by the permittee to be representative of the effluent.

c. Quarterly Monitoring
Quarterly samples shall be taken during the months of January, April, July, and October. If the facility does not discharge during these months, the permittee shall sample the next discharge occurring during that quarter. If the facility does not discharge during a quarter, a sample is not required for that quarter. For any month in which a sample is not taken, the permittee shall enter "*G" on the Discharge Monitoring Report.

d. Ultraviolet Disinfection
It is understood that ultraviolet light will be used to achieve compliance with the fecal coliform limitations. If disinfection other than ultraviolet light will be used, the permittee shall notify the Department in accordance with Part II.C.12. - Changes in Facility Operations.

e. Percent Removal Requirements
These requirements shall be calculated based on the monthly (30-day) effluent $CBOD_5$ and Total Suspended Solids concentrations and the monthly influent concentrations for approximately the same period.

PART I

Section A. Limitations and Monitoring Requirements

f. Final Effluent Limitation for Total Mercury
The final limit for total mercury is the Discharge Specific Level Currently Achievable (LCA) based on a multiple discharger variance from the water quality-based effluent limit of 1.3 ng/l, pursuant to Rule 323.1103(9) of the Water Quality Standards. Compliance with the LCA shall be determined as a 12-month rolling average, the calculation of which may be done using blank-corrected sample results. The 12-month rolling average shall be determined by adding the present monthly average result to the preceding 11 monthly average results then dividing the sum by 12. For facilities with quarterly monitoring requirements for total mercury, quarterly monitoring shall be equivalent to 3 months of monitoring in calculating the 12-month rolling average. Facilities that monitor more frequently than monthly for total mercury must determine the monthly average result, which is the sum of the results of all data obtained in a given month divided by the total number of samples taken, in order to calculate the 12-month rolling average. If the 12-month rolling average for any quarter is less than or equal to the LCA, the permittee will be considered to be in compliance for total mercury for that quarter, provided the permittee is also in full compliance with the Pollutant Minimization Program for Total Mercury, set forth in Part I.A.3.

g. Total Mercury Testing and Additional Reporting Requirements
The analytical protocol for total mercury shall be in accordance with EPA Method 1631, Revision E, "Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry," EPA-821-R-02-019, August 2002. The quantification level for total mercury shall be 0.5 ng/l, unless a higher level is appropriate because of sample matrix interference. Justification for higher quantification levels shall be submitted to the Department within 30 days of such determination.

The use of clean technique sampling procedures is required unless the permittee can demonstrate to the Department that an alternative sampling procedure is representative of the discharge. Guidance for clean technique sampling is contained in EPA Method 1669, "Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels," EPA-821-R96-001, July 1996. Information and data documenting the permittee's sampling and analytical protocols and data acceptability shall be submitted to the Department upon request.

In order to demonstrate compliance with EPA Method 1631E and EPA Method 1669, the permittee shall report, on the daily sheet, the analytical results of all field blanks and field duplicates collected in conjunction with each sampling event, as well as laboratory method blanks when used for blank correction. The permittee shall collect at least one (1) field blank and at least one (1) field duplicate per sampling event. If more than ten (10) samples are collected during a sampling event, the permittee shall collect at least one (1) additional field blank AND field duplicate for every ten (10) samples collected. Only field blanks or laboratory method blanks may be used to calculate a concentration lower than the actual sample analytical results (i.e. a blank correction). Only one (1) blank (field OR laboratory method) may be used for blank correction of a given sample result, and only if the blank meets the quality control acceptance criteria. If blank correction is not performed on a given sample analytical result, the permittee shall report under 'Total Mercury – Corrected' the same value reported under 'Total Mercury – Uncorrected.' The field duplicate is for quality control purposes only; its analytical result shall not be averaged with the sample result.

PART I

Section A. Limitations and Monitoring Requirements

h. Whole Effluent Toxicity Final Requirements
Test species shall include *Ceriodaphnia dubia*. Testing and reporting procedures shall follow procedures contained in EPA/600/4-91/002, "Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms (Fourth Edition)." When the effluent ammonia nitrogen (as N) concentration is greater than 3 mg/l, the pH of the toxicity test shall be maintained at a pH of 8 Standard Units. The acute toxic unit value (TU_A) and chronic toxic unit value (TU_C) shall be reported on the Discharge Monitoring Report (DMR). If multiple chronic toxicity tests are performed during the month, the maximum TU_A value and monthly average TU_C value shall be reported. Completed toxicity test reports for each test conducted shall be retained by the permittee in accordance with the requirements of Part II.B.5. of this permit and shall be available for review by the Department upon request. After eighteen (18) months of toxicity testing and upon approval from the Department, the monitoring frequency may be reduced if the test data indicate that the toxicity requirements of Rule 323.1219 of the Michigan Administrative Code are consistently being met. Toxicity test data acceptability is contingent upon validation of the test method by the testing laboratory. Such validation shall be submitted to the Department upon request.

1) When monitoring shows persistent exceedance of the 18.4 TU_C limit or the 1.0 TU_A limit for effluent toxicity, the Department will determine whether the permittee must implement the toxicity control program requirements specified in 2) below.

2) Upon written notification by the Department, the following conditions apply. Within 90 days of the notification, the permittee shall implement a Toxicity Reduction Evaluation (TRE). The objective of the TRE shall be to reduce the toxicity of the final effluent from Monitoring Point 001A to $\leq$ 18.4 TU_C and $\leq$ 1.0 TU_A. The following documents are available as guidance to reduce toxicity to acceptable levels: Phase I, EPA/600/6-91/005F (chronic), EPA/600/6-91/003 (acute); Phase II, EPA/600/R-92/080 (acute and chronic); Phase III, EPA/600/R-92/081 (acute and chronic); and Publicly Owned Treatment Works (POTWs), EPA/833B-99/002. Annual reports shall be submitted to the Department within 30 days of the completion of the last test of each annual cycle.

2. Additional Monitoring Requirements

As a condition of this permit, the permittee shall monitor the discharge from Monitoring Point 001A for the constituents identified below. This monitoring is an application requirement of 40 CFR 122.21(j), effective December 2, 1999. Testing shall be conducted in October 2015, August 2016, May 2017, and March 2018. Grab samples shall be collected for available cyanide, total phenols, and the Volatile Organic Compounds identified below. For all other parameters, 24-hour composite samples shall be collected.

The results of such additional monitoring shall be submitted with the application for reissuance (see the cover page of this permit for the application due date). The permittee shall notify the Department within 14 days of completing the monitoring for each month specified above in accordance with Part II.C.5. Additional reporting requirements are specified in Part II.C.11. If, upon review of the analysis, it is determined that additional requirements are needed to protect the receiving waters in accordance with applicable water quality standards, the permit may then be modified by the Department in accordance with applicable laws and rules.

Hardness
calcium carbonate

Metals (Total Recoverable), Cyanide and Total Phenols (Quantification levels in parentheses)

antimony (1 µg/l)	arsenic (1 µg/l)	available cyanide (2 µg/l) using Method OIA – 1677	
barium (5 µg/l)	beryllium (1 µg/l)	boron (20 µg/l)	cadmium (0.2 µg/l)
chromium (5 µg/l)	copper (1 µg/l)	lead (1 µg/l)	nickel (5 µg/l)
selenium (1 µg/l)	silver (0.5 µg/l)	thallium (1 µg/l)	zinc (5 µg/l)
total phenolic compounds			

PART I

Section A. Limitations and Monitoring Requirements

Volatile Organic Compounds

acrolein	acrylonitrile	benzene	bromoform
carbon tetrachloride	chlorobenzene	chlorodibromomethane	chloroethane
2-chloroethylvinyl ether	chloroform	dichlorobromomethane	1,1-dichloroethane
1,2-dichloroethane	trans-1,2-dichloroethylene	1,1-dichloroethylene	1,2-dichloropropane
1,3-dichloropropylene	ethylbenzene	methyl bromide	methyl chloride
methylene chloride	1,1,2,2,-tetrachloroethane	tetrachloroethylene	toluene
1,1,1-trichloroethane	1,1,2-trichloroethane	trichloroethylene	vinyl chloride

Acid-Extractable Compounds

p-chloro-m-cresol	2-chlorophenol	2,4-dichlorophenol	2,4-dimethylphenol
4,6-dinitro-o-cresol	2,4-dinitrophenol	2-nitrophenol	4-nitrophenol
Pentachlorophenol	phenol	2,4,6-trichlorophenol	

Base/Neutral Compounds

acenaphthene	acenaphthylene	anthracene	benzidine
benzo(a)anthracene	benzo(a)pyrene	3,4-benzofluoranthene	benzo(ghi)perylene
benzo(k)fluoranthene	bis(2-chloroethoxy)methane	bis(2-chloroethyl)ether	bis(2-chloroisopropyl)ether
bis(2-ethylhexyl)phthalate	4-bromophenyl phenyl ether	butyl benzyl phthalate	2-chloronaphthalene
4-chlorophenyl phenyl ether	chrysene	di-n-butyl phthalate	di-n-octyl phthalate
dibenzo(a,h)anthracene	1,2-dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene
3,3'-dichlorobenzidine	diethyl phthalate	dimethyl phthalate	2,4-dinitrotoluene
2,6-dinitrotoluene	1,2-diphenylhydrazine	fluoranthene	fluorene
Hexachlorobenzene	hexachlorobutadiene	hexachlorocyclo-pentadiene	hexachloroethane
indeno(1,2,3-cd)pyrene	isophorone	naphthalene	nitrobenzene
n-nitrosodi-n-propylamine	n-nitrosodimethylamine	n-nitrosodiphenylamine	phenanthrene
pyrene	1,2,4-trichlorobenzene		

3. Pollutant Minimization Program for Total Mercury

The goal of the Pollutant Minimization Program is to maintain the effluent concentration of total mercury at or below 1.3 ng/l. The permittee shall develop and implement a Pollutant Minimization Program in accordance with the following schedule.

On or before December 31, 2015, the permittee shall submit to the Department an approvable Pollutant Minimization Program for mercury designed to proceed toward the goal. The Pollutant Minimization Program shall include the following:

a. an annual review and semi-annual monitoring of potential sources of mercury entering the wastewater collection system;

b. a program for quarterly monitoring of influent for mercury; and

c. implementation of reasonable cost-effective control measures when sources of mercury are discovered. Factors to be considered include significance of sources, economic considerations, and technical and treatability considerations.

The Pollutant Minimization Program shall be implemented upon approval by the Department.

On or before March 31 of each year following approval of the Pollutant Minimization Program, the permittee shall submit a status report for the previous calendar year to the Department that includes 1) the monitoring results for the previous year, 2) an updated list of potential mercury sources, and 3) a summary of all actions taken to reduce or eliminate identified sources of mercury.

PART I

Section A. Limitations and Monitoring Requirements

Any information generated as a result of the Pollutant Minimization Program set forth in this permit may be used to support a request to modify the approved program or to demonstrate that the Pollutant Minimization Program requirement has been completed satisfactorily.

A request for modification of the approved program and supporting documentation shall be submitted in writing to the Department for review and approval. The Department may approve modifications to the approved program (approval of a program modification does not require a permit modification), including a reduction in the frequency of the requirements under items a. and b.

This permit may be modified in accordance with applicable laws and rules to include additional mercury conditions and/or limitations as necessary.

4. Untreated or Partially Treated Sewage Discharge Reporting and Testing Requirements

In accordance with Section 324.3112a of the NREPA, if untreated sewage, including sanitary sewer overflows (SSO) and combined sewer overflows (CSO), or partially treated sewage is directly or indirectly discharged from a sewer system onto land or into the waters of the state, the entity responsible for the sewer system shall immediately, but not more than 24 hours after the discharge begins, notify, by telephone, the Department, local health departments, a daily newspaper of general circulation in the county in which the permittee is located, and a daily newspaper of general circulation in the county or counties in which the municipalities whose waters may be affected by the discharge are located that the discharge is occurring.

The permittee shall also annually contact municipalities, including the superintendent of a public drinking water supply with potentially affected intakes, whose waters may be affected by the permittee's discharge of combined sewage, and if those municipalities wish to be notified in the same manner as specified above, the permittee shall provide such notification. Such notification shall also include a daily newspaper in the county of the affected municipality.

At the conclusion of the discharge, written notification shall be submitted in accordance with and on the "Report of Discharge Form" available via the internet at: http://www.deq.state.mi.us/csosso/, or, alternatively for combined sewer overflow discharges, in accordance with notification procedures approved by the Department.

In addition, in accordance with Section 324.3112a of the NREPA, each time a discharge of untreated sewage or partially treated sewage occurs, the permittee shall test the affected waters for *Escherichia coli* to assess the risk to the public health as a result of the discharge and shall provide the test results to the affected local county health departments and to the Department. The testing shall be done at locations specified by each affected local county health department but shall not exceed 10 tests for each separate discharge event. The affected local county health department may waive this testing requirement, if it determines that such testing is not needed to assess the risk to the public health as a result of the discharge event. The results of this testing shall be submitted with the written notification required above, or, if the results are not yet available, submit them as soon as they become available. This testing is not required, if the testing has been waived by the local health department, or if the discharge(s) did not affect surface waters.

Permittees accepting sanitary or municipal sewage from other sewage collection systems are encouraged to notify the owners of those systems of the above reporting and testing requirements.

PART I

Section A. Limitations and Monitoring Requirements

5. Facility Contact

The "Facility Contact" was specified in the application. The permittee may replace the facility contact at any time, and shall notify the Department in writing within 10 days after replacement (including the name, address and telephone number of the new facility contact).

a. The facility contact shall be (or a duly authorized representative of this person):
- for a corporation, a principal executive officer of at least the level of vice president; or a designated representative if the representative is responsible for the overall operation of the facility from which the discharge originates, as described in the permit application or other NPDES form,
- for a partnership, a general partner,
- for a sole proprietorship, the proprietor, or
- for a municipal, state, or other public facility, either a principal executive officer, the mayor, village president, city or village manager or other duly authorized employee.

b. A person is a duly authorized representative only if:
- the authorization is made in writing to the Department by a person described in paragraph a. of this section; and
- the authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the facility (a duly authorized representative may thus be either a named individual or any individual occupying a named position).

Nothing in this section obviates the permittee from properly submitting reports and forms as required by law.

6. Monthly Operating Reports

Part 41 of Act 451 of 1994 as amended, specifically Section 324.4106 and associated R 299.2953, requires that the permittee file with the Department, on forms prescribed by the Department, reports showing the effectiveness of the treatment facility operation and the quantity and quality of liquid wastes discharged into waters of the state.

Since this permit includes modifications to the monitoring requirements in the previously-issued permit, the previously approved treatment facility monitoring program shall be revised. Within sixty (60) days of the effective date of this permit, the permittee shall submit to the Department a revised treatment facility monitoring program to meet this requirement. Upon approval by the Department the permittee shall implement the revised treatment facility monitoring program. The reporting forms and guidance are available on the DEQ web site at http://www.michigan.gov/deq/0,1607,7-135-3313_44117---,00.html. The permittee may use alternative operating forms if they are consistent with the approved monitoring program. These forms shall be maintained on site and shall be provided to the Department for review upon request. These treatment facility monitoring records shall be maintained for a minimum of three years.

7. Asset Management

The requirements of an Asset Management Program function to achieve the goals of effective performance, adequate funding, and adequate operator staffing and training. Asset management is a planning process for ensuring that optimum value is gained for each asset and that financial resources are available to rehabilitate and replace those assets when necessary. Asset management is centered on a framework of five (5) core elements: the current state of the assets; the required sustainable level of service; the assets critical to sustained performance; the minimum life-cycle costs; and the best long-term funding strategy.

a. Asset Management Program Requirements
On or before March 31, 2016, the permittee shall submit to the Department an Asset Management Plan for review and approval. An approvable Asset Management Plan shall contain a schedule for the

PART I

Section A. Limitations and Monitoring Requirements

development and implementation of an Asset Management Program that meets the requirements outlined below. A copy of any Asset Management Program requirements already completed by the permittee should be submitted as part of the Asset Management Plan. Upon approval by the Department the permittee shall implement the Asset Management Plan.

1) *Maintenance Staff.* The permittee shall provide an adequate staff to carry out the operation, maintenance, repair, and testing functions required to ensure compliance with the terms and conditions of this permit.

2) *Collection System Map.* The permittee shall complete a map of the sewer collection system owned by the permittee. The map shall be of sufficient detail and at a scale to allow easy interpretation. The collection system information shown on the map shall be based on current conditions and shall be kept up-to-date and available for review by the Department. Such map(s) shall include but not be limited to the following:

a) all sanitary sewer lines and related manholes;

b) all outfalls, including the treatment plant outfall(s);

e) all pump stations and force mains;

f) the wastewater treatment facility(ies), including all treatment processes;

g) all surface waters (labeled);

h) other major appurtenances such as inverted siphons and air release valves;

i) a numbering system which uniquely identifies manholes, catch basins, and outfalls;

j) the scale and a north arrow;

k) the pipe diameter, type of material, approximate age, distance between manholes, and the direction of flow; and

l) the manhole interior material, rim elevation, and invert elevations.

3) *Inventory and assessment of fixed assets.* The permittee shall complete an inventory and assessment of operations-related fixed assets. Capitalized fixed assets will include buildings and fixed equipment with a replacement value greater than $5,000. The inventory and assessment shall be based on current conditions and shall be updated periodically and available for review by the Department.

a) The fixed asset inventory shall include the following:

(1) a brief description of the fixed asset with tag number, its design capacity (e.g., pump: 120 gallons per minute), and its level of redundancy;

(2) the location of the fixed asset;

(3) the year the fixed asset was installed;

(4) the present condition of the fixed asset (e.g., excellent, good, fair, poor);

(5) the depreciated value of the fixed asset in dollars for year specified in accordance with approved schedules; and

(6) the current replacement cost of the fixed asset in dollars for year specified in accordance with approved schedules;

PART I

Section A. Limitations and Monitoring Requirements

b) The fixed asset assessment shall include an evaluation of expected useful life and the criticality of the fixed asset based on a methodology to be determined by the permittee and acceptable to the Authorities Financial counsel and Board of Directors (Board), as defined in the Articles of Incorporation of North Kent Sewer Authority.

4) *Operation, Maintenance & Replacement (OM&R) Budget.* The permittee shall complete an annual assessment of its Operational Fund Budget, Debit Fund Budget, and Capital Replacement Fund Budget, including the following:

a) beginning and end dates of fiscal year;

b) name of the Board that approves OM&R Budgets and date of approval;

c) audits will include all fund balances and will be provided to the Department;

d) Capital Improvement Budget indicating a five-year projected replacement schedule with funding provided to the Department;

e) the permittee shall provide the calculation on how the rates are set for each constituent municipality;

f) the permittee's OM&R budget for the fiscal year, including revenues to be charged to all constituent municipalities, to meet projected expenses will be provided; and

g) rate calculation demonstrating sufficient revenues to cover OM&R expenses will be provided by the permittee. The ultimate goal of the Asset Management Program is to ensure sufficient revenues to cover OM&R expenses.

b. Reporting
The permittee shall develop a written report that summarizes asset management activities completed during the previous year and planned for the upcoming year. The written report shall be submitted to the Department on or before <u>January 31 of each year</u>. The written report shall include:

1) a description of the staffing levels maintained during the year;

2) a printout summation and a brief description of the number of preventative and corrective work orders completed during the previous year;

3) a summary of assets scheduled for replacement in the upcoming year based on the accepted methodology in Part I.A.7.a.3.b. of this permit;

4) budget reports indicating the permittee's treatment and collection system maintenance expenditures for the fiscal year;

5) approved budgets and updated CIP budgets for the upcoming year, and an updated asset inventory; and

6) an updated OM&R budget with an updated rate schedule that includes the amount of insufficient revenues, if any.

PART I

Section B. Storm Water Pollution Prevention

Section B. Storm Water Pollution Prevention is not required for this permit.

PART I

Section C. Industrial Waste Pretreatment Program

1. Federal Industrial Pretreatment Program

a. The permittee shall implement the Federal Industrial Pretreatment Program approved on January 10, 2011, and any subsequent modifications approved up to the issuance of this permit. Approval of substantial program modifications after the issuance of this permit shall be incorporated into this permit by minor modification in accordance with 40 CFR 122.63.

b. The permittee shall comply with R 323.2301 through R 323.2317 of the Michigan Administrative Code (Part 23 Rules), the General Pretreatment Regulations for Existing and New Sources of Pollution (40 CFR Part 403), and the approved Federal Industrial Pretreatment Program.

c. The permittee shall have the legal authority and necessary interjurisdictional agreements that provide the basis for the implementation and enforcement of the approved Federal Industrial Pretreatment Program throughout the service area. The legal authority and necessary interjurisdictional agreements shall include, at a minimum, the authority to carry out the activities specified in R 323.2306(a).

d. The permittee shall develop procedures which describe, in sufficient detail, program commitments which enable implementation of the approved Federal Industrial Pretreatment Program, 40 CFR Part 403, and the Part 23 Rules in accordance with R 323.2306(c).

e. The permittee shall establish an interjurisdictional agreement (or comparable document) with all tributary governmental jurisdictions. Each interjurisdictional agreement shall contain, at a minimum, the following:

1) identification of the agency responsible for the implementation and enforcement of the approved Federal Industrial Pretreatment Program within the tributary governmental jurisdiction's boundaries; and

2) the provision of the legal authority which provides the basis for the implementation and enforcement of the approved Federal Industrial Pretreatment Program within the tributary governmental jurisdiction's boundaries.

f. The permittee shall prohibit discharges that:

1) cause, in whole or in part, the permittee's failure to comply with any condition of this permit or the NREPA;

2) restrict, in whole or in part, the permittee's management of biosolids;

3) cause, in whole or in part, operational problems at the treatment facility or in its collection system;

4) violate any of the general or specific prohibitions identified in R 323.2303(1) and (2);

5) violate categorical standards identified in R 323.2311; and

6) violate local limits established in accordance with R 323.2303(4).

g. The permittee shall maintain a list of its nondomestic users that meet the criteria of a significant industrial user as identified in R 323.2302(cc).

h. The permittee shall develop an enforcement response plan which describes, in sufficient detail, program commitments which will enable the enforcement of the approved Federal Industrial Pretreatment Program, 40 CFR Part 403, and the Part 23 Rules in accordance with R 323.2306(g).

PART I

Section C. Industrial Waste Pretreatment Program

i. The Department may require modifications to the approved Federal Industrial Pretreatment Program which are necessary to ensure compliance with 40 CFR Part 403 and the Part 23 Rules in accordance with R 323.2309.

j. The permittee shall not implement changes or modifications to the approved Federal Industrial Pretreatment Program without notification to the Department. Any substantial modification shall be subject to Department public noticing and approval in accordance with R 323.2309.

k. The permittee shall maintain an adequate revenue structure and staffing level for effective implementation of the approved Federal Industrial Pretreatment Program.

l. The permittee shall develop and maintain, for a minimum of three (3) years, all records and information necessary to determine nondomestic user compliance with 40 CFR Part 403, Part 23 Rules and the approved Federal Industrial Pretreatment Program. This period of retention shall be extended during the course of any unresolved enforcement action or litigation regarding a nondomestic user or when requested by the Department or the United States Environmental Protection Agency. All of the aforementioned records and information shall be made available upon request for inspection and copying by the Department and the United States Environmental Protection Agency.

m. The permittee shall evaluate the approved Federal Industrial Pretreatment Program for compliance with the 40 CFR Part 403, Part 23 Rules and the prohibitions stated in item f. (above). Based upon this evaluation, the permittee shall propose to the Department all necessary changes or modifications to the approved Federal Industrial Pretreatment Program no later than the next Industrial Pretreatment Program Annual Report due date (see item o. below).

n. The permittee shall develop and enforce local limits to implement the prohibitions listed in item f above. Local limits shall be based upon data representative of actual conditions demonstrated in a maximum allowable headworks loading analysis. An evaluation of whether the existing local limits need to be revised shall be submitted to the Department by <u>October 1, 2016</u>. The submittal shall provide a technical evaluation of the basis upon which this determination was made which includes information regarding the maximum allowable headworks loading, collection system protection criteria, and worker health and safety, based upon data collected since the last local limits review.

The following pollutants shall be evaluated:

1) Arsenic, Cadmium, Chromium, Copper, Cyanide, Lead, Mercury, Nickel, Silver, and Zinc;

2) Pollutants that are subject to limits or monitoring in this permit;

3) Pollutants that have an existing local limit; and,

4) Other pollutants of concern which would reasonably be expected to be discharged or transported by truck or rail or otherwise introduced into the POTW.

o. On or before <u>April 1st of each year</u>, the permittee shall submit to the Department, as required by R 323.2310(8), an Industrial Pretreatment Program Annual Report on the status of program implementation and enforcement activities. The reporting period shall begin on January 1st and end on December 31st. At a minimum, the Industrial Pretreatment Program Annual Report shall contain the following items:

1) additions, deletions, and any other modifications to the permittee's previously submitted nondomestic user inventory (R 323.2306(c)(i));

2) additions, deletions, and any other modifications to the permittee's approved Significant Industrial User List (R 323.2306(h));

PART I

Section C. Industrial Waste Pretreatment Program

3) a listing of the names of Significant Industrial Users not inspected by the permittee at least once during the reporting period or at the frequency committed to in the approved Federal Industrial Pretreatment Program;

4) a listing of the names of Significant Industrial Users not sampled for all required pollutants by the permittee at least once during the reporting period or at the frequency committed to in the approved Federal Industrial Pretreatment Program;

5) a listing of the names of Significant Industrial Users without a permit at any time during the reporting period;

6) a listing of the names of nondomestic industrial users in significant noncompliance for each of the criteria as defined in R 323.2302(dd)(i)-(viii);

7) proof of publication of all nondomestic users in significant noncompliance in the largest daily newspaper in the permittee's area;

8) a summary of the enforcement activities by the permittee during the report period. This Summary shall include:

a) a listing of the names of nondomestic users which were the subject of an enforcement action;

b) the enforcement action taken and the date the action was taken; and

c) whether the nondomestic user returned to compliance by the end of the reporting period (include date nondomestic user returned to compliance).

9) a listing of the names of Significant Industrial Users who did not submit pretreatment reports in accordance with requirements specified in their permit during the reporting period;

10) a listing of the names of Significant Industrial Users who did not self-monitor in accordance with requirements specified in their permit during the reporting period;

11) a summary of results of all the sampling and analyses performed of the wastewater treatment plant’s influent, effluent, and biosolids conducted in accordance with approved methods during the reporting period. The summary shall include the monthly average, daily maximum, quantification level, and number of samples analyzed for each pollutant. At a minimum, the results of analyses for all locally limited parameters for at least one monitoring event that tests influent, effluent and biosolids during the reporting period shall be submitted with each report, unless otherwise required by the Department. Sample collection shall be at intervals sufficient to provide pollutant removal rates, unless the pollutant is not measurable; and

12) any other relevant information as requested by the Department.

PART I

Section D. Residuals Management Program

2. Residuals Management Program for Land Application of Biosolids

A permittee seeking authorization to land-apply bulk biosolids or prepare bulk biosolids for land application shall develop and submit a Residuals Management Program (RMP) to the Department (see Part I.D.1.e) for approval. Effective upon Department approval of the permittee's RMP, the permittee is authorized to land-apply bulk biosolids or prepare bulk biosolids for land application in accordance with the requirements established in R 323.2401 through R 323.2418 of the Michigan Administrative Code (Part 24 Rules) which can be obtained via the internet (http://www.michigan.gov/deq/ and on the left side of the screen click on Water, Biosolids & Industrial Pretreatment, Biosolids, then click on Biosolids Laws and Rules Information which is under the Laws & Rules banner in the center of the screen). The permittee's approved RMP, and any approved modifications thereto, are enforceable requirements of this permit. Incineration, landfilling and other residual disposal activities shall be conducted in accordance with Part II.D.7. of this permit.

a. RMP Approval and Implementation
A permittee seeking approval of an RMP shall submit the RMP to the Department (see Part I.D.1.e) at least <u>180 days prior to</u> the land application of biosolids. The permittee may utilize the RMP Electronic Form which can be obtained via the internet (http://www.michigan.gov/deq/ and on the left side of the screen click on Water, Biosolids & Industrial Pretreatment, Biosolids then click on RMP Electronic Form which is under the Downloads banner in the center of the screen) or obtain detailed requirements from the Department. The RMP shall become effective and shall be implemented by the permittee upon written approval by the Department.

b. Annual Report
On or before <u>October 30 of each year</u>, the permittee shall submit an annual report to the Biosolids Program, Water Resources Division, Department of Environmental Quality, P.O. Box 30458, Lansing, MI 48909-7958 for the previous fiscal year of October 1 through September 30. At a minimum, the report shall contain:

1) a certification that current residuals management practices are in accordance with the approved RMP, or a proposal for modification to the approved RMP; and

2) a completed Biosolids Annual Report Form which can be obtained via the internet (http:/www.michigan.gov/deq/ and on the left side of the screen click on Water, Biosolids & Industrial Pretreatment, Biosolids then click on Biosolids Annual Report Form which is under the Downloads banner in the center of the screen) or from the Department.

c. Modifications to the Approved RMP
Prior to implementation of modifications to the RMP, the permittee shall submit proposed modifications to the Department (see Part I.D.1.e.) for approval. The approved modification shall become effective upon the date of approval. Upon written notification, the Department may impose additional requirements and/or limitations to the approved RMP as necessary to protect public health and the environment from any adverse effect of a pollutant in the biosolids.

d. Record Keeping
Records required by the Part 24 Rules shall be kept for a minimum of five years. However, the records documenting cumulative loading for sites subject to cumulative pollutant loading rates shall be kept as long as the site receives biosolids.

e. Contact Information
RMP related submittals to the Department shall be to the Grand Rapids District Supervisor of the Water Resources Division. The Grand Rapids District Office is located at the State Office Building, Fifth Floor, 350 Ottawa N.W., Unit 10, Grand Rapids, Michigan 49503-2341, Telephone: 616-356-0500, Fax: 616-356-0202.

PART II

Part II may include terms and /or conditions not applicable to discharges covered under this permit.

Section A. Definitions

Acute toxic unit (TU_A) means $100/LC_{50}$ where the LC_{50} is determined from a whole effluent toxicity (WET) test which produces a result that is statistically or graphically estimated to be lethal to 50% of the test organisms.

Annual monitoring frequency refers to a calendar year beginning on January 1 and ending on December 31. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

Authorized public agency means a state, local, or county agency that is designated pursuant to the provisions of section 9110 of Part 91 of the NREPA to implement soil erosion and sedimentation control requirements with regard to construction activities undertaken by that agency.

Best management practices (BMPs) means structural devices or nonstructural practices that are designed to prevent pollutants from entering into storm water, to direct the flow of storm water, or to treat polluted storm water.

Bioaccumulative chemical of concern (BCC) means a chemical which, upon entering the surface waters, by itself or as its toxic transformation product, accumulates in aquatic organisms by a human health bioaccumulation factor of more than 1000 after considering metabolism and other physiochemical properties that might enhance or inhibit bioaccumulation. The human health bioaccumulation factor shall be derived according to R 323.1057(5). Chemicals with half-lives of less than 8 weeks in the water column, sediment, and biota are not BCCs. The minimum bioaccumulation concentration factor (BAF) information needed to define an organic chemical as a BCC is either a field-measured BAF or a BAF derived using the biota-sediment accumulation factor (BSAF) methodology. The minimum BAF information needed to define an inorganic chemical as a BCC, including an organometal, is either a field-measured BAF or a laboratory-measured bioconcentration factor (BCF). The BCCs to which these rules apply are identified in Table 5 of R 323.1057 of the Water Quality Standards.

Biosolids are the solid, semisolid, or liquid residues generated during the treatment of sanitary sewage or domestic sewage in a treatment works. This includes, but is not limited to, scum or solids removed in primary, secondary, or advanced wastewater treatment processes and a derivative of the removed scum or solids.

Bulk biosolids means biosolids that are not sold or given away in a bag or other container for application to a lawn or home garden.

Certificate of Coverage (COC) is a document, issued by the Department, which authorizes a discharge under a general permit.

Chronic toxic unit (TU_C) means 100/MATC or $100/IC_{25}$, where the maximum acceptable toxicant concentration (MATC) and IC_{25} are expressed as a percent effluent in the test medium.

Class B biosolids refers to material that has met the Class B pathogen reduction requirements or equivalent treatment by a Process to Significantly Reduce Pathogens (PSRP) in accordance with the Part 24 Rules. Processes include aerobic digestion, composting, anaerobic digestion, lime stabilization and air drying.

Combined sewer system is a sewer system in which storm water runoff is combined with sanitary wastes.

PART II

Section A. Definitions

Daily concentration is the sum of the concentrations of the individual samples of a parameter divided by the number of samples taken during any calendar day. If the parameter concentration in any sample is less than the quantification limit, regard that value as zero when calculating the daily concentration. The daily concentration will be used to determine compliance with any maximum and minimum daily concentration limitations (except for pH and dissolved oxygen). When required by the permit, report the maximum calculated daily concentration for the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the Discharge Monitoring Reports (DMRs).

For pH, report the maximum value of any *individual* sample taken during the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs and the minimum value of any *individual* sample taken during the month in the "MINIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs. For dissolved oxygen, report the minimum concentration of any *individual* sample in the "MINIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs.

Daily loading is the total discharge by weight of a parameter discharged during any calendar day. This value is calculated by multiplying the daily concentration by the total daily flow and by the appropriate conversion factor. The daily loading will be used to determine compliance with any maximum daily loading limitations. When required by the permit, report the maximum calculated daily loading for the month in the "MAXIMUM" column under "QUANTITY OR LOADING" on the DMRs.

Daily monitoring frequency refers to a 24-hour day. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

Department means the Michigan Department of Environmental Quality.

Detection level means the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated level of probability.

Discharge means the addition of any waste, waste effluent, wastewater, pollutant, or any combination thereof to any surface water of the state.

Discharge point is the location where the point source discharge is directed to surface waters of the state or to a separate storm sewer. It includes the location of all point source discharges where storm water exits the facility, including *outfalls* which discharge directly to surface waters of the state, and *points of discharge* which discharge directly into separate storm sewer systems.

EC_{50} means a statistically or graphically estimated concentration that is expected to cause 1 or more specified effects in 50% of a group of organisms under specified conditions.

Fecal coliform bacteria monthly
FOR WWSLs THAT COLLECT AND STORE WASTEWATER AND ARE AUTHORIZED TO DISCHARGE ONLY IN THE SPRING AND/OR FALL ON AN INTERMITTENT BASIS – Fecal coliform bacteria monthly is the geometric mean of all daily concentrations determined during a discharge event. Days on which no daily concentration is determined shall not be used to determine the calculated monthly value. The calculated monthly value will be used to determine compliance with the maximum monthly fecal coliform bacteria limitations. When required by the permit, report the calculated monthly value in the "AVERAGE" column under "QUALITY OR CONCENTRATION" on the DMR. If the period in which the discharge event occurred was partially in each of two months, the calculated monthly value shall be reported on the DMR of the month in which the last day of discharge occurred.

FOR ALL OTHER DISCHARGES – Fecal coliform bacteria monthly is the geometric mean of all daily concentrations determined during a reporting month. Days on which no daily concentration is determined shall not be used to determine the calculated monthly value. The calculated monthly value will be used to determine compliance with the maximum monthly fecal coliform bacteria limitations. When required by the permit, report the calculated monthly value in the "AVERAGE" column under "QUALITY OR CONCENTRATION" on the DMR.

PART II

Section A. Definitions

Fecal coliform bacteria 7-day
FOR WWSLs THAT COLLECT AND STORE WASTEWATER AND ARE AUTHORIZED TO DISCHARGE ONLY IN THE SPRING AND/OR FALL ON AN INTERMITTENT BASIS – Fecal coliform bacteria 7-day is the geometric mean of the daily concentrations determined during any 7 consecutive days of discharge during a discharge event. If the number of daily concentrations determined during the discharge event is less than 7 days, the number of actual daily concentrations determined shall be used for the calculation. Days on which no daily concentration is determined shall not be used to determine the value. The calculated 7-day value will be used to determine compliance with the maximum 7-day fecal coliform bacteria limitations. When required by the permit, report the maximum calculated 7-day geometric mean value for the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs. If the 7-day period was partially in each of two months, the value shall be reported on the DMR of the month in which the last day of discharge occurred.

FOR ALL OTHER DISCHARGES – Fecal coliform bacteria 7-day is the geometric mean of the daily concentrations determined during any 7 consecutive days in a reporting month. If the number of daily concentrations determined is less than 7, the actual number of daily concentrations determined shall be used for the calculation. Days on which no daily concentration is determined shall not be used to determine the value. The calculated 7-day value will be used to determine compliance with the maximum 7-day fecal coliform bacteria limitations. When required by the permit, report the maximum calculated 7-day geometric mean for the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs. The first calculation shall be made on day 7 of the reporting month, and the last calculation shall be made on the last day of the reporting month.

Flow-proportioned sample is a composite sample with the sample volume proportional to the effluent flow.

General permit means a National Pollutant Discharge Elimination System permit issued authorizing a category of similar discharges.

Geometric mean is the average of the logarithmic values of a base 10 data set, converted back to a base 10 number.

Grab sample is a single sample taken at neither a set time nor flow.

IC_{25} means the toxicant concentration that would cause a 25% reduction in a nonquantal biological measurement for the test population.

Illicit connection means a physical connection to a municipal separate storm sewer system that primarily conveys non-storm water discharges other than uncontaminated groundwater into the storm sewer; or a physical connection not authorized or permitted by the local authority, where a local authority requires authorization or a permit for physical connections.

Illicit discharge means any discharge to, or seepage into, a municipal separate storm sewer system that is not composed entirely of storm water or uncontaminated groundwater. Illicit discharges include non-storm water discharges through pipes or other physical connections; dumping of motor vehicle fluids, household hazardous wastes, domestic animal wastes, or litter; collection and intentional dumping of grass clippings or leaf litter; or unauthorized discharges of sewage, industrial waste, restaurant wastes, or any other non-storm water waste directly into a separate storm sewer.

Individual permit means a site-specific NPDES permit.

Inlet means a catch basin, roof drain, conduit, drain tile, retention pond riser pipe, sump pump, or other point where storm water or wastewater enters into a closed conveyance system prior to discharge off site or into waters of the state.

PART II

Section A. Definitions

Interference is a discharge which, alone or in conjunction with a discharge or discharges from other sources, both: 1) inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal; and 2) therefore, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or, of the prevention of sewage sludge use or disposal in compliance with the following statutory provisions and regulations or permits issued thereunder (or more stringent state or local regulations): Section 405 of the Clean Water Act, the Solid Waste Disposal Act (SWDA) (including Title II, more commonly referred to as the Resource Conservation and Recovery Act (RCRA), and including state regulations contained in any state sludge management plan prepared pursuant to Subtitle D of the SWDA), the Clean Air Act, the Toxic Substances Control Act, and the Marine Protection, Research and Sanctuaries Act. [This definition does not apply to sample matrix interference].

Land application means spraying or spreading biosolids or a biosolids derivative onto the land surface, injecting below the land surface, or incorporating into the soil so that the biosolids or biosolids derivative can either condition the soil or fertilize crops or vegetation grown in the soil.

LC_{50} means a statistically or graphically estimated concentration that is expected to be lethal to 50% of a group of organisms under specified conditions.

Maximum acceptable toxicant concentration (MATC) means the concentration obtained by calculating the geometric mean of the lower and upper chronic limits from a chronic test. A lower chronic limit is the highest tested concentration that did not cause the occurrence of a specific adverse effect. An upper chronic limit is the lowest tested concentration which did cause the occurrence of a specific adverse effect and above which all tested concentrations caused such an occurrence.

Maximum extent practicable means implementation of best management practices by a public body to comply with an approved storm water management program as required by a national permit for a municipal separate storm sewer system, in a manner that is environmentally beneficial, technically feasible, and within the public body’s legal authority.

MGD means million gallons per day.

Monthly concentration is the sum of the daily concentrations determined during a reporting period divided by the number of daily concentrations determined. The calculated monthly concentration will be used to determine compliance with any maximum monthly concentration limitations. Days with no discharge shall not be used to determine the value. When required by the permit, report the calculated monthly concentration in the “AVERAGE” column under “QUALITY OR CONCENTRATION” on the DMR.

For minimum percent removal requirements, the monthly influent concentration and the monthly effluent concentration shall be determined. The calculated monthly percent removal, which is equal to 100 times the quantity [1 minus the quantity (monthly effluent concentration divided by the monthly influent concentration)], shall be reported in the "MINIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs.

Monthly loading is the sum of the daily loadings of a parameter divided by the number of daily loadings determined during a reporting period. The calculated monthly loading will be used to determine compliance with any maximum monthly loading limitations. Days with no discharge shall not be used to determine the value. When required by the permit, report the calculated monthly loading in the “AVERAGE” column under “QUANTITY OR LOADING” on the DMR.

Monthly monitoring frequency refers to a calendar month. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

Municipal separate storm sewer means a conveyance or system of conveyances designed or used for collecting or conveying storm water which is not a combined sewer and which is not part of a publicly-owned treatment works as defined in the Code of Federal Regulations at 40 CFR 122.2.

PART II

Section A. Definitions

Municipal separate storm sewer system (MS4) means all separate storm sewers that are owned or operated by the United States, a state, city, village, township, county, district, association, or other public body created by or pursuant to state law, having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under state law, such as a sewer district, flood control district, or drainage district, or similar entity, or a designated or approved management agency under Section 208 of the Federal Act that discharges to the waters of the state. This term includes systems similar to separate storm sewer systems in municipalities, such as systems at military bases, large hospital or prison complexes, and highways and other thoroughfares. The term does not include separate storm sewers in very discrete areas, such as individual buildings.

National Pretreatment Standards are the regulations promulgated by or to be promulgated by the Federal Environmental Protection Agency pursuant to Section 307(b) and (c) of the Federal Act. The standards establish nationwide limits for specific industrial categories for discharge to a POTW.

No observed adverse effect level (NOAEL) means the highest tested dose or concentration of a substance which results in no observed adverse effect in exposed test organisms where higher doses or concentrations result in an adverse effect.

Noncontact cooling water is water used for cooling which does not come into direct contact with any raw material, intermediate product, by-product, waste product or finished product.

Nondomestic user is any discharger to a POTW that discharges wastes other than or in addition to water-carried wastes from toilet, kitchen, laundry, bathing or other facilities used for household purposes.

Outfall is the location at which a point source discharge enters the surface waters of the state.

Part 91 agency means an agency that is designated by a county board of commissioners pursuant to the provisions of section 9105 of Part 91 of the NREPA; an agency that is designated by a city, village, or township in accordance with the provisions of section 9106 of Part 91 of the NREPA; or the Department for soil erosion and sedimentation activities under Part 615, Part 631, or Part 632 pursuant to the provisions of section 9115 of Part 91 of the NREPA.

Part 91 permit means a soil erosion and sedimentation control permit issued by a Part 91 agency pursuant to the provisions of Part 91 of the NREPA.

Partially treated sewage is any sewage, sewage and storm water, or sewage and wastewater, from domestic or industrial sources that is treated to a level less than that required by the permittee's National Pollutant Discharge Elimination System permit, or that is not treated to national secondary treatment standards for wastewater, including discharges to surface waters from retention treatment facilities.

Point of discharge is the location of a point source discharge where storm water is discharged directly into a separate storm sewer system.

Point source discharge means a discharge from any discernible, confined, discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, or rolling stock. Changing the surface of land or establishing grading patterns on land will result in a point source discharge where the runoff from the site is ultimately discharged to waters of the state.

Polluting material means any material, in solid or liquid form, identified as a polluting material under the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code).

POTW is a publicly owned treatment work.

Pretreatment is reducing the amount of pollutants, eliminating pollutants, or altering the nature of pollutant properties to a less harmful state prior to discharge into a public sewer. The reduction or alteration can be by physical, chemical, or biological processes, process changes, or by other means. Dilution is not considered pretreatment unless expressly authorized by an applicable National Pretreatment Standard for a particular industrial category.

PART II

Section A. Definitions

Public (as used in the MS4 individual permit) means all persons who potentially could affect the authorized storm water discharges, including, but not limited to, residents, visitors to the area, public employees, businesses, industries, and construction contractors and developers.

Public body means the United States; the state of Michigan; a city, village, township, county, school district, public college or university, or single-purpose governmental agency; or any other body which is created by federal or state statute or law.

Qualifying storm event means a storm event causing greater than 0.1 inch of rainfall and occurring at least 72 hours after the previous measurable storm event that also caused greater than 0.1 inch of rainfall.

Quantification level means the measurement of the concentration of a contaminant obtained by using a specified laboratory procedure calculated at a specified concentration above the detection level. It is considered the lowest concentration at which a particular contaminant can be quantitatively measured using a specified laboratory procedure for monitoring of the contaminant.

Quarterly monitoring frequency refers to a three month period, defined as January through March, April through June, July through September, and October through December. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

Regional Administrator is the Region 5 Administrator, U.S. EPA, located at R-19J, 77 W. Jackson Blvd., Chicago, Illinois 60604.

Regulated area means the permittee's urbanized area, where urbanized area is defined as a place and its adjacent densely-populated territory that together have a minimum population of 50,000 people as defined by the United States Bureau of the Census and as determined by the latest available decennial census.

Secondary containment structure means a unit, other than the primary container, in which significant materials are packaged or held, which is required by State or Federal law to prevent the escape of significant materials by gravity into sewers, drains, or otherwise directly or indirectly into any sewer system or to the surface or ground waters of this state.

Separate storm sewer system means a system of drainage, including, but not limited to, roads, catch basins, curbs, gutters, parking lots, ditches, conduits, pumping devices, or man-made channels, which is not a combined sewer where storm water mixes with sanitary wastes, and is not part of a POTW.

Significant industrial user is a nondomestic user that: 1) is subject to Categorical Pretreatment Standards under 40 CFR 403.6 and 40 CFR Chapter I, Subchapter N; or 2) discharges an average of 25,000 gallons per day or more of process wastewater to a POTW (excluding sanitary, noncontact cooling and boiler blowdown wastewater); contributes a process waste stream which makes up five (5) percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant; or is designated as such by the permittee as defined in 40 CFR 403.12(a) on the basis that the industrial user has a reasonable potential for adversely affecting the POTW's treatment plant operation or violating any pretreatment standard or requirement (in accordance with 40 CFR 403.8(f)(6)).

Significant materials Significant Materials means any material which could degrade or impair water quality, including but not limited to: raw materials; fuels; solvents, detergents, and plastic pellets; finished materials such as metallic products; hazardous substances designated under Section 101(14) of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (see 40 CFR 372.65); any chemical the facility is required to report pursuant to Section 313 of Emergency Planning and Community Right-to-Know Act (EPCRA); polluting materials as identified under the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code); Hazardous Wastes as defined in Part 111 of the NREPA; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with storm water discharges.

Significant spills and significant leaks means any release of a polluting material reportable under the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code).

PART II

Section A. Definitions

Special-use area means secondary containment structures required by state or federal law; lands on Michigan's List of Sites of Environmental Contamination pursuant to Part 201, Environmental Remediation, of the NREPA; and/or areas with other activities that may contribute pollutants to the storm water for which the Department determines monitoring is needed.

Stoichiometric means the quantity of a reagent calculated to be necessary and sufficient for a given chemical reaction.

Storm water means storm water runoff, snow melt runoff, surface runoff and drainage, and non-storm water included under the conditions of this permit.

SWPPP means the Storm Water Pollution Prevention Plan prepared in accordance with this permit.

Tier I value means a value for aquatic life, human health or wildlife calculated under R 323.1057 of the Water Quality Standards using a tier I toxicity database.

Tier II value means a value for aquatic life, human health or wildlife calculated under R 323.1057 of the Water Quality Standards using a tier II toxicity database.

Total maximum daily loads (TMDLs) are required by the Federal Act for waterbodies that do not meet water quality standards. TMDLs represent the maximum daily load of a pollutant that a waterbody can assimilate and meet water quality standards, and an allocation of that load among point sources, nonpoint sources, and a margin of safety.

Toxicity reduction evaluation (TRE) means a site-specific study conducted in a stepwise process designed to identify the causative agents of effluent toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in effluent toxicity.

Water Quality Standards means the Part 4 Water Quality Standards promulgated pursuant to Part 31 of the NREPA, being R 323.1041 through R 323.1117 of the Michigan Administrative Code.

Weekly monitoring frequency refers to a calendar week which begins on Sunday and ends on Saturday. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

WWSL is a wastewater stabilization lagoon.

WWSL discharge event is a discrete occurrence during which effluent is discharged to the surface water up to 10 days of a consecutive 14 day period.

3-portion composite sample is a sample consisting of three equal-volume grab samples collected at equal intervals over an 8-hour period.

PART II

Section A. Definitions

7-day concentration
FOR WWSLs THAT COLLECT AND STORE WASTEWATER AND ARE AUTHORIZED TO DISCHARGE ONLY IN THE SPRING AND/OR FALL ON AN INTERMITTENT BASIS – The 7-day concentration is the sum of the daily concentrations determined during any 7 consecutive days of discharge during a WWSL discharge event divided by the number of daily concentrations determined. If the number of daily concentrations determined during the WWSL discharge event is less than 7 days, the number of actual daily concentrations determined shall be used for the calculation. The calculated 7-day concentration will be used to determine compliance with any maximum 7-day concentration limitations. When required by the permit, report the maximum calculated 7-day concentration for the WWSL discharge event in the “MAXIMUM” column under “QUALITY OR CONCENTRATION” on the DMR. If the WWSL discharge event was partially in each of two months, the value shall be reported on the DMR of the month in which the last day of discharge occurred.

FOR ALL OTHER DISCHARGES – The 7-day concentration is the sum of the daily concentrations determined during any 7 consecutive days in a reporting month divided by the number of daily concentrations determined. If the number of daily concentrations determined is less than 7, the actual number of daily concentrations determined shall be used for the calculation. The calculated 7-day concentration will be used to determine compliance with any maximum 7-day concentration limitations in the reporting month. When required by the permit, report the maximum calculated 7-day concentration for the month in the “MAXIMUM” column under “QUALITY OR CONCENTRATION” on the DMR. The first 7-day calculation shall be made on day 7 of the reporting month, and the last calculation shall be made on the last day of the reporting month.

7-day loading
FOR WWSLs THAT COLLECT AND STORE WASTEWATER AND ARE AUTHORIZED TO DISCHARGE ONLY IN THE SPRING AND/OR FALL ON AN INTERMITTENT BASIS – The 7-day loading is the sum of the daily loadings determined during any 7 consecutive days of discharge during a WWSL discharge event divided by the number of daily loadings determined. If the number of daily loadings determined during the WWSL discharge event is less than 7 days, the number of actual daily loadings determined shall be used for the calculation. The calculated 7-day loading will be used to determine compliance with any maximum 7-day loading limitations. When required by the permit, report the maximum calculated 7-day loading for the WWSL discharge event in the “MAXIMUM” column under “QUANTITY OR LOADING” on the DMR. If the WWSL discharge event was partially in each of two months, the value shall be reported on the DMR of the month in which the last day of discharge occurred

FOR ALL OTHER DISCHARGES – The 7-day loading is the sum of the daily loadings determined during any 7 consecutive days in a reporting month divided by the number of daily loadings determined. If the number of daily loadings determined is less than 7, the actual number of daily loadings determined shall be used for the calculation. The calculated 7-day loading will be used to determine compliance with any maximum 7-day loading limitations in the reporting month. When required by the permit, report the maximum calculated 7-day loading for the month in the “MAXIMUM” column under “QUANTITY OR LOADING” on the DMR. The first 7-day calculation shall be made on day 7 of the reporting month, and the last calculation shall be made on the last day of the reporting month.

24-hour composite sample is a flow-proportioned composite sample consisting of hourly or more frequent portions that are taken over a 24-hour period. A time-proportioned composite sample may be used upon approval of the Department if the permittee demonstrates it is representative of the discharge.

PART II

Section B. Monitoring Procedures

1. Representative Samples

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. Test Procedures

Test procedures for the analysis of pollutants shall conform to regulations promulgated pursuant to Section 304(h) of the Federal Act (40 CFR Part 136 – Guidelines Establishing Test Procedures for the Analysis of Pollutants), unless specified otherwise in this permit. **Test procedures used shall be sufficiently sensitive to determine compliance with applicable effluent limitations**. Requests to use test procedures not promulgated under 40 CFR Part 136 for pollutant monitoring required by this permit shall be made in accordance with the Alternate Test Procedures regulations specified in 40 CFR 136.4. These requests shall be submitted to the Chief of the Permits Section, Water Resources Division, Michigan Department of Environmental Quality, P.O. Box 30458, Lansing, Michigan, 48909-7958. The permittee may use such procedures upon approval.

The permittee shall periodically calibrate and perform maintenance procedures on all analytical instrumentation at intervals to ensure accuracy of measurements. The calibration and maintenance shall be performed as part of the permittee’s laboratory Quality Control/Quality Assurance program.

3. Instrumentation

The permittee shall periodically calibrate and perform maintenance procedures on all monitoring instrumentation at intervals to ensure accuracy of measurements.

4. Recording Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information: 1) the exact place, date, and time of measurement or sampling; 2) the person(s) who performed the measurement or sample collection; 3) the dates the analyses were performed; 4) the person(s) who performed the analyses; 5) the analytical techniques or methods used; 6) the date of and person responsible for equipment calibration; and 7) the results of all required analyses.

5. Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation shall be retained for a minimum of three (3) years, or longer if requested by the Regional Administrator or the Department.

PART II

Section C. Reporting Requirements

1. Start-up Notification

If the permittee will not discharge during the first 60 days following the effective date of this permit, the permittee shall notify the Department within 14 days following the effective date of this permit, and then 60 days prior to the commencement of the discharge.

2. Submittal Requirements for Self-Monitoring Data

Part 31 of the NREPA (specifically Section 324.3110(7)); and R 323.2155(2) of Part 21, Wastewater Discharge Permits, promulgated under Part 31 of the NREPA, allow the Department to specify the forms to be utilized for reporting the required self-monitoring data. Unless instructed on the effluent limitations page to conduct "Retained Self-Monitoring" the permittee shall submit self-monitoring data via the Department's Electronic Environmental Discharge Monitoring Reporting (e2-DMR) system.

The permittee shall utilize the information provided on the e2-Reporting website at https://secure1.state.mi.us/e2rs/ to access and submit the electronic forms. Both monthly summary and daily data shall be submitted to the Department no later than the 20th day of the month following each month of the authorized discharge period(s). The permittee may be allowed to submit the electronic forms after this date if the Department has granted an extension to the submittal date.

3. Retained Self-Monitoring Requirements

If instructed on the effluent limits page (or otherwise authorized by the Department in accordance with the provisions of this permit) to conduct retained self-monitoring, the permittee shall maintain a year-to-date log of retained self-monitoring results and, upon request, provide such log for inspection to the staff of the Department. Retained self-monitoring results are public information and shall be promptly provided to the public upon request.

The permittee shall certify, in writing, to the Department, on or before January 10th (April 1st for animal feeding operation facilities) of each year, that: 1) all retained self-monitoring requirements have been complied with and a year-to-date log has been maintained; and 2) the application on which this permit is based still accurately describes the discharge. With this annual certification, the permittee shall submit a summary of the previous year's monitoring data. The summary shall include maximum values for samples to be reported as daily maximums and/or monthly maximums and minimum values for any daily minimum samples.

Retained self-monitoring may be denied to a permittee by notification in writing from the Department. In such cases, the permittee shall submit self-monitoring data in accordance with Part II.C.2., above. Such a denial may be rescinded by the Department upon written notification to the permittee. Reissuance or modification of this permit or reissuance or modification of an individual permittee's authorization to discharge shall not affect previous approval or denial for retained self-monitoring unless the Department provides notification in writing to the permittee.

4. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Discharge Monitoring Report. Such increased frequency shall also be indicated.

Monitoring required pursuant to Part 41 of the NREPA or Rule 35 of the Mobile Home Park Commission Act (Act 96 of the Public Acts of 1987) for assurance of proper facility operation shall be submitted as required by the Department.

PART II

Section C. Reporting Requirements

5. Compliance Dates Notification

Within 14 days of every compliance date specified in this permit, the permittee shall submit a *written* notification to the Department indicating whether or not the particular requirement was accomplished. If the requirement was not accomplished, the notification shall include an explanation of the failure to accomplish the requirement, actions taken or planned by the permittee to correct the situation, and an estimate of when the requirement will be accomplished. If a written report is required to be submitted by a specified date and the permittee accomplishes this, a separate written notification is not required.

6. Noncompliance Notification

Compliance with all applicable requirements set forth in the Federal Act, Parts 31 and 41 of the NREPA, and related regulations and rules is required. All instances of noncompliance shall be reported as follows:

a. 24-Hour Reporting
Any noncompliance which may endanger health or the environment (including maximum and/or minimum daily concentration discharge limitation exceedances) shall be reported, verbally, within 24 hours from the time the permittee becomes aware of the noncompliance. A written submission shall also be provided within five (5) days.

b. Other Reporting
The permittee shall report, in writing, all other instances of noncompliance not described in a. above at the time monitoring reports are submitted; or, in the case of retained self-monitoring, within five (5) days from the time the permittee becomes aware of the noncompliance.

Written reporting shall include: 1) a description of the discharge and cause of noncompliance; and 2) the period of noncompliance, including exact dates and times, or, if not yet corrected, the anticipated time the noncompliance is expected to continue, and the steps taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.

7. Spill Notification

The permittee shall immediately report any release of any polluting material which occurs to the surface waters or groundwaters of the state, unless the permittee has determined that the release is not in excess of the threshold reporting quantities specified in the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code), by calling the Department at the number indicated on the second page of this permit (or, if this is a general permit, on the COC); or, if the notice is provided after regular working hours, call the Department's 24-hour Pollution Emergency Alerting System telephone number, 1-800-292-4706 (calls from **out-of-state** dial 1-517-373-7660).

Within ten (10) days of the release, the permittee shall submit to the Department a full written explanation as to the cause of the release, the discovery of the release, response (clean-up and/or recovery) measures taken, and preventative measures taken or a schedule for completion of measures to be taken to prevent reoccurrence of similar releases.

PART II

Section C. Reporting Requirements

8. Upset Noncompliance Notification

If a process "upset" (defined as an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee) has occurred, the permittee who wishes to establish the affirmative defense of upset, shall notify the Department by telephone within 24 hours of becoming aware of such conditions; and within five (5) days, provide in writing, the following information:

a. that an upset occurred and that the permittee can identify the specific cause(s) of the upset;

b. that the permitted wastewater treatment facility was, at the time, being properly operated and maintained (note that an upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation); and

c. that the permittee has specified and taken action on all responsible steps to minimize or correct any adverse impact in the environment resulting from noncompliance with this permit.

No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

In any enforcement proceedings, the permittee, seeking to establish the occurrence of an upset, has the burden of proof.

9. Bypass Prohibition and Notification

a. Bypass Prohibition
Bypass is prohibited, and the Department may take an enforcement action, unless:

1) bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

2) there were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass; and

3) the permittee submitted notices as required under 9.b. or 9.c. below.

b. Notice of Anticipated Bypass
If the permittee knows in advance of the need for a bypass, it shall submit prior notice to the Department, if possible at least ten (10) days before the date of the bypass, and provide information about the anticipated bypass as required by the Department. The Department may approve an anticipated bypass, after considering its adverse effects, if it will meet the three (3) conditions listed in 9.a. above.

c. Notice of Unanticipated Bypass
The permittee shall submit notice to the Department of an unanticipated bypass by calling the Department at the number indicated on the second page of this permit (if the notice is provided after regular working hours, use the following number: 1-800-292-4706) as soon as possible, but no later than 24 hours from the time the permittee becomes aware of the circumstances.

PART II

Section C. Reporting Requirements

d. Written Report of Bypass
A written submission shall be provided within five (5) working days of commencing any bypass to the Department, and at additional times as directed by the Department. The written submission shall contain a description of the bypass and its cause; the period of bypass, including exact dates and times, and if the bypass has not been corrected, the anticipated time it is expected to continue; steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass; and other information as required by the Department.

e. Bypass Not Exceeding Limitations
The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to ensure efficient operation. These bypasses are not subject to the provisions of 9.a., 9.b., 9.c., and 9.d., above. This provision does not relieve the permittee of any notification responsibilities under Part II.C.11. of this permit.

f. Definitions

1) Bypass means the intentional diversion of waste streams from any portion of a treatment facility.

2) Severe property damage means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

10. Bioaccumulative Chemicals of Concern (BCC)

Consistent with the requirements of R 323.1098 and R 323.1215 of the Michigan Administrative Code, the permittee is prohibited from undertaking any action that would result in a lowering of water quality from an increased loading of a BCC unless an increased use request and antidegradation demonstration have been submitted and approved by the Department.

11. Notification of Changes in Discharge

The permittee shall notify the Department, in writing, as soon as possible but no later than 10 days of knowing, or having reason to believe, that any activity or change has occurred or will occur which would result in the discharge of: 1) detectable levels of chemicals on the current Michigan Critical Materials Register, priority pollutants or hazardous substances set forth in 40 CFR 122.21, Appendix D, or the Pollutants of Initial Focus in the Great Lakes Water Quality Initiative specified in 40 CFR 132.6, Table 6, which were not acknowledged in the application or listed in the application at less than detectable levels; 2) detectable levels of any other chemical not listed in the application or listed at less than detection, for which the application specifically requested information; or 3) any chemical at levels greater than five times the average level reported in the complete application (see the first page of this permit, for the date(s) the complete application was submitted). Any other monitoring results obtained as a requirement of this permit shall be reported in accordance with the compliance schedules.

PART II

Section C. Reporting Requirements

12. Changes in Facility Operations

Any anticipated action or activity, including but not limited to facility expansion, production increases, or process modification, which will result in new or increased loadings of pollutants to the receiving waters must be reported to the Department by a) submission of an increased use request (application) and all information required under R 323.1098 (Antidegradation) of the Water Quality Standards or b) by notice if the following conditions are met: 1) the action or activity will not result in a change in the types of wastewater discharged or result in a greater quantity of wastewater than currently authorized by this permit; 2) the action or activity will not result in violations of the effluent limitations specified in this permit; 3) the action or activity is not prohibited by the requirements of Part II.C.10.; and 4) the action or activity will not require notification pursuant to Part II.C.11. Following such notice, the permit or, if applicable, the facility's COC may be modified according to applicable laws and rules to specify and limit any pollutant not previously limited.

13. Transfer of Ownership or Control

In the event of any change in control or ownership of facilities from which the authorized discharge emanates, the permittee shall submit to the Department 30 days prior to the actual transfer of ownership or control a written agreement between the current permittee and the new permittee containing: 1) the legal name and address of the new owner; 2) a specific date for the effective transfer of permit responsibility, coverage and liability; and 3) a certification of the continuity of or any changes in operations, wastewater discharge, or wastewater treatment.

If the new permittee is proposing changes in operations, wastewater discharge, or wastewater treatment, the Department may propose modification of this permit in accordance with applicable laws and rules.

14. Operations and Maintenance Manual

For wastewater treatment facilities that serve the public (and are thus subject to Part 41 of the NREPA), Section 4104 of Part 41 and associated Rule 2957 of the Michigan Administrative Code allow the Department to require an Operations and Maintenance (O&M) Manual from the facility. An up-to-date copy of the O&M Manual shall be kept at the facility and shall be provided to the Department upon request. The Department may review the O&M Manual in whole or in part at its discretion and require modifications to it if portions are determined to be inadequate.

At a minimum, the O&M Manual shall include the following information: permit standards; descriptions and operation information for all equipment; staffing information; laboratory requirements; record keeping requirements; a maintenance plan for equipment; an emergency operating plan; safety program information; and copies of all pertinent forms, as-built plans, and manufacturer's manuals.

Certification of the existence and accuracy of the O&M Manual shall be submitted to the Department at least sixty days prior to start-up of a new wastewater treatment facility. Recertification shall be submitted sixty days prior to start-up of any substantial improvements or modifications made to an existing wastewater treatment facility.

PART II

Section C. Reporting Requirements

15. Signatory Requirements

All applications, reports, or information submitted to the Department in accordance with the conditions of this permit and that require a signature shall be signed and certified as described in the Federal Act and the NREPA.

The Federal Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance, shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

The NREPA (Section 3115(2)) provides that a person who at the time of the violation knew or should have known that he or she discharged a substance contrary to this part, or contrary to a permit, COC, or order issued or rule promulgated under this part, or who intentionally makes a false statement, representation, or certification in an application for or form pertaining to a permit or COC or in a notice or report required by the terms and conditions of an issued permit or COC, or who intentionally renders inaccurate a monitoring device or record required to be maintained by the Department, is guilty of a felony and shall be fined not less than $2,500.00 or more than $25,000.00 for each violation. The court may impose an additional fine of not more than $25,000.00 for each day during which the unlawful discharge occurred. If the conviction is for a violation committed after a first conviction of the person under this subsection, the court shall impose a fine of not less than $25,000.00 per day and not more than $50,000.00 per day of violation. Upon conviction, in addition to a fine, the court in its discretion may sentence the defendant to imprisonment for not more than 2 years or impose probation upon a person for a violation of this part. With the exception of the issuance of criminal complaints, issuance of warrants, and the holding of an arraignment, the circuit court for the county in which the violation occurred has exclusive jurisdiction. However, the person shall not be subject to the penalties of this subsection if the discharge of the effluent is in conformance with and obedient to a rule, order, permit, or COC of the Department. In addition to a fine, the attorney general may file a civil suit in a court of competent jurisdiction to recover the full value of the injuries done to the natural resources of the state and the costs of surveillance and enforcement by the state resulting from the violation.

16. Electronic Reporting

Upon notice by the Department that electronic reporting tools are available for specific reports or notifications, the permittee shall submit electronically all such reports or notifications as required by this permit.

PART II

Section D. Management Responsibilities

1. Duty to Comply

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit, more frequently than, or at a level in excess of, that authorized, shall constitute a violation of the permit.

It is the duty of the permittee to comply with all the terms and conditions of this permit. Any noncompliance with the Effluent Limitations, Special Conditions, or terms of this permit constitutes a violation of the NREPA and/or the Federal Act and constitutes grounds for enforcement action; for permit or Certificate of Coverage (COC) termination, revocation and reissuance, or modification; or denial of an application for permit or COC renewal.

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

2. Operator Certification

The permittee shall have the waste treatment facilities under direct supervision of an operator certified at the appropriate level for the facility certification by the Department, as required by Sections 3110 and 4104 of the NREPA. Permittees authorized to discharge storm water shall have the storm water treatment and/or control measures under direct supervision of a storm water operator certified by the Department, as required by Section 3110 of the NREPA.

3. Facilities Operation

The permittee shall, at all times, properly operate and maintain all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance includes adequate laboratory controls and appropriate quality assurance procedures.

4. Power Failures

In order to maintain compliance with the effluent limitations of this permit and prevent unauthorized discharges, the permittee shall either:

a. provide an alternative power source sufficient to operate facilities utilized by the permittee to maintain compliance with the effluent limitations and conditions of this permit; or

b. upon the reduction, loss, or failure of one or more of the primary sources of power to facilities utilized by the permittee to maintain compliance with the effluent limitations and conditions of this permit, the permittee shall halt, reduce or otherwise control production and/or all discharge in order to maintain compliance with the effluent limitations and conditions of this permit.

5. Adverse Impact

The permittee shall take all reasonable steps to minimize or prevent any adverse impact to the surface waters or groundwaters of the state resulting from noncompliance with any effluent limitation specified in this permit including, but not limited to, such accelerated or additional monitoring as necessary to determine the nature and impact of the discharge in noncompliance.

PART II

Section D. Management Responsibilities

6. Containment Facilities

The permittee shall provide facilities for containment of any accidental losses of polluting materials in accordance with the requirements of the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code). For a Publicly Owned Treatment Work (POTW), these facilities shall be approved under Part 41 of the NREPA.

7. Waste Treatment Residues

Residuals (i.e. solids, sludges, biosolids, filter backwash, scrubber water, ash, grit, or other pollutants or wastes) removed from or resulting from treatment or control of wastewaters, including those that are generated during treatment or left over after treatment or control has ceased, shall be disposed of in an environmentally compatible manner and according to applicable laws and rules. These laws may include, but are not limited to, the NREPA, Part 31 for protection of water resources, Part 55 for air pollution control, Part 111 for hazardous waste management, Part 115 for solid waste management, Part 121 for liquid industrial wastes, Part 301 for protection of inland lakes and streams, and Part 303 for wetlands protection. Such disposal shall not result in any unlawful pollution of the air, surface waters or groundwaters of the state.

8. Right of Entry

The permittee shall allow the Department, any agent appointed by the Department, or the Regional Administrator, upon the presentation of credentials and, for animal feeding operation facilities, following appropriate biosecurity protocols:

a. to enter upon the permittee’s premises where an effluent source is located or any place in which records are required to be kept under the terms and conditions of this permit; and

b. at reasonable times to have access to and copy any records required to be kept under the terms and conditions of this permit; to inspect process facilities, treatment works, monitoring methods and equipment regulated or required under this permit; and to sample any discharge of pollutants.

9. Availability of Reports

Except for data determined to be confidential under Section 308 of the Federal Act and Rule 2128 (R 323.2128 of the Michigan Administrative Code), all reports prepared in accordance with the terms of this permit, shall be available for public inspection at the offices of the Department and the Regional Administrator. As required by the Federal Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Section 309 of the Federal Act and Sections 3112, 3115, 4106 and 4110 of the NREPA.

10. Duty to Provide Information

The permittee shall furnish to the Department, within a reasonable time, any information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or the facility’s COC, or to determine compliance with this permit. The permittee shall also furnish to the Department, upon request, copies of records required to be kept by this permit.

Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or information.

PART II

Section E. Activities Not Authorized by This Permit

1. Discharge to the Groundwaters

This permit does not authorize any discharge to the groundwaters. Such discharge may be authorized by a groundwater discharge permit issued pursuant to the NREPA.

2. POTW Construction

This permit does not authorize or approve the construction or modification of any physical structures or facilities at a POTW. Approval for the construction or modification of any physical structures or facilities at a POTW shall be by permit issued under Part 41 of the NREPA.

3. Civil and Criminal Liability

Except as provided in permit conditions on "Bypass" (Part II.C.9. pursuant to 40 CFR 122.41(m)), nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance, whether or not such noncompliance is due to factors beyond the permittee's control, such as accidents, equipment breakdowns, or labor disputes.

4. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee may be subject under Section 311 of the Federal Act except as are exempted by federal regulations.

5. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation under authority preserved by Section 510 of the Federal Act.

6. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize violation of any federal, state or local laws or regulations, nor does it obviate the necessity of obtaining such permits, including any other Department of Environmental Quality permits, or approvals from other units of government as may be required by law.

Appendix C

2020 SAW Capacity Analysis

PARCC Side Clean Water Plant Capacity Analysis

Prepared for

North Kent Sewer Authority

Revised November 2020

2130453

Contents

Tables

Figures

Appendices

1 INTRODUCTION

The North Kent Sewer Authority has committed to implementing an asset management program for its public wastewater system. As part of the asset management program, a capacity analysis of the North Kent Sewer Authority PARCC Side Clean Water Plant (CWP) was performed by Prein&Newhof to better understand current and future improvement needs. The capacity analysis is to be used in conjunction with the Wastewater System Evaluation to provide objective information upon which the asset management program can be developed.

The capacity analysis includes an evaluation of the hydraulic and treatment capacities of the CWP as well as a determination of the maximum allowable headworks loadings (MAHLs). Treatment efficiencies were analyzed using flow and sampling data from January 2015 through December 2017 (the study period).

2 EXISTING FACILITY

2.1 Process Descriptions

The CWP receives wastewater via the gravity collection system. The main processes of the CWP can be seen in the process schematic in Figure 1. The processes are generally described below.

2.1.1 Influent

The 48 inch influent gravity sewer conveys raw wastewater to the CWP. An influent flume chamber is used for flow measurement. The raw influent sampler is located at the flume chamber to provide continuous flow paced sampling.

2.1.2 Comminutors

After passing through the influent flume chamber, the flow is split in two channels, each equipped with a comminutor. Any large solids still present in the wastewater are reduced in size by this equipment. If desired, stop plates may be used to bypass either channel in order to perform maintenance. The channels are covered to provide odor control.

2.1.3 Influent Screw Pumps

Following the comminutors, the wastewater enters the screw pump inlet channel and is pumped up to the Headworks Building by three 60 inch screws. One screw pump is normally used with a second pump available during peak times. The third pump provides operational redundancy. Each screw pump can be isolated by stop plates as necessary. The screw pumps are covered to provide odor control.

2.1.4 Grit Removal

Grit particles settle out of the influent wastewater by gravity at the grit removal chamber located in the Headworks Building. A rotating paddle pushes the grit chamber contents in a circular motion which forces the high density grit to a central grit well while keeping the organics from settling. An air lift grit pump installed in a sump at the bottom of the tank sends the grit laden wastewater to a grit classifier. During this process, organic material is released through washing and drains to the influent by the site sanitary sewer. The collected grit is disposed of in a dumpster.

2.1.5 Screening

After passing through the grit removal chamber, the wastewater enters the screen inlet channel. Three rotating drum fine screens, located in the Headworks Building, remove particles larger than 1.5 mm. Flow control gates are used to either allow flow into or bypass the fine screens. Two screens are normally in operation with one in standby for redundancy. Plant water is used to clean the screens. The screenings are removed by a conveyor which are then compacted and disposed of in a roll-off dumpster.

2.1.6 Bioreactor Tanks

The flow from the Headworks Building enters the bioreactor distribution channel and is combined with the return activated sludge (RAS) from the membrane tanks. The flow is split evenly at the bioreactors. Each bioreactor has an anoxic zone, a swing zone, and two aerobic zones. Each tank has a weir wall on both the upstream and downstream side of the swing zone. A mixer is installed in both the anoxic zone and the swing zone. There are fine bubble diffusers in the swing zone and aerobic zones. Following the aerobic zones, the mixed liquor flows into the bioreactor collection channel, where it is conveyed to the RAS pumps to be pumped to the membrane distribution channel in the Machine Building.

2.1.7 Process Aeration

A primary function of the bioreactors is to reduce 5-day biochemical oxygen demand (BOD_5). The Process Aeration Blowers (PABs) include three centrifugal blowers and one turbo blower and are located in the Machine Building. The PABs provide air to fine bubble diffusers installed in the aerobic and swing zones of each bioreactor, which are used to create an aerobic environment to promote biological growth and achieve mixing. Air flow is varied by inlet throttling valves and a variable frequency drive (VFD) on the turbo blower in response to signals from the dissolved oxygen (DO) sensors in each bioreactor in order to maintain an adequate DO concentration and provide mixing in the aerated zones.

2.1.8 Membrane Tanks

The membrane tanks are located inside the Machine Building and include the membrane distribution channel and RAS collection channel. There are seven membrane tanks in parallel, of which five contain membrane cassettes.

2.1.9 Membranes

The mixed liquor from the bioreactors is permeated through membranes that provide a physical barrier to solids and pathogens. The membranes are arranged in cassettes in five membrane tanks. The tanks are sized to hold the required number of membranes for adequate filtration of the mixed liquor from the bioreactors. Particles larger than 0.04 μm are filtered out before the permeate is sent to ultraviolet (UV) disinfection.

2.1.10 Membrane Aeration

Air is supplied to the membrane tanks by three centrifugal Membrane Aeration Blowers (MABs) located in the blower room. The intent of the aeration is to maintain a mixing/scouring rate at the membrane surface to keep the membranes free of blockage. The air flow rate is adjusted by inlet throttling valves and is determined based on the influent wastewater flow rate.

2.1.11 Return Activated Sludge

The biosolids concentrated in the membrane tanks and sent to the outlet channel is called "activated" sludge because it contains live microorganisms employed in the consumption of organic waste. RAS is recirculated back to the bioreactor distribution channel.

2.1.12 Waste Activated Sludge

The biosolids that are pumped to the biosolids holding tanks, which are in excess of what is needed for treatment, is called waste activated sludge (WAS). The RAS and WAS processes are essential for activated sludge biological treatment at the CWP. They serve to keep a healthy population of microorganisms alive and reproducing in the bioreactor tanks.

2.1.13 Permeate Pumps

Membrane effluent, known as permeate, is drawn through the membranes and pumped to UV disinfection by five permeate pumps, one dedicated to each active membrane tank. Each permeate pump is sized to operate during periods of membrane backflushing and operates on VFDs to accommodate fluctuations in flow rate.

2.1.14 CIP/Backpulse Pumps

The membrane cassettes are periodically backflushed to remove fouling and facilitate efficient operating conditions. This is achieved by means of two clean-in-place (CIP)/backpulse pumps.

2.1.15 Disinfection

UV light is used to disinfect the membrane permeate prior to discharge. There are two banks installed in series in the UV channel, each consisting of 48 UV lamps. At a wavelength of 254 nm, UV light penetrates and modifies the genetic material of the microorganisms that remain in the wastewater, which renders the potentially harmful microorganisms incapable of reproducing. The number of UV banks in operation and UV lamp intensity in each bank can automatically adjust based on flow and transmissivity.

2.1.16 Outfall Piping

Following the UV channel, the final effluent flows through approximately 1,690 l.f. of 48 inch diameter gravity sewer to the plant outfall at the Grand River.

2.1.17 Plant Water

A portion of the final effluent water that has gone through each of the treatment processes is used throughout the CWP. Three plant water pumps distribute the flow and provide system pressure. A pressure tank allows the pumps to turn off at low or no flow while maintaining system pressure. Plant water is disinfected prior to distribution. Plant water is used as backwash water for the fine screens and the screw compactors, for polymer blending at the inclined screw presses, and for humidification and irrigation of the odor control biofilters, among other miscellaneous uses.

2.1.18 Compressed Air System

Compressed air is provided by two air compressors with receivers and desiccant dryers. Many systems in the Machine Building, including the membrane tanks, permeate pumps, PABs, and MABs, utilize pneumatic valves for flow control. The diaphragm pumps associated with chemical feed systems also use compressed air.

2.1.19 Biosolids Holding Tanks

The biosolids holding tanks are square tanks, open to the atmosphere, that are used to provide temporary storage and conditioning of biosolids prior to dewatering and disposal. Each tank is equipped with a decanter to return the supernatant to the headworks and medium bubble diffusers to condition the biosolids in addition to various instrumentation and controls assets. The biosolids tanks are built on pilings to allow the tanks to properly function during flood events.

Conditioned biosolids from the biosolids holding tanks are pumped to the inclined screw presses (ISPs) in the biosolids handling room of the Machine Building by submersible ISP pumps. The ISP pumps are located in the ISP wet well adjacent to the biosolids holding tanks. The three ISP pumps have a common header and two supply lines going to the Machine Building. The ISP supply lines are connected in a loop in the biosolids handling room to flush the line before startup of the ISPs.

2.1.20 Biosolids Aeration

The biosolids aeration process includes the medium bubble aeration system in the biosolids holding tanks, air supply piping, and the two positive displacement biosolids aeration blowers (BABs) located in the Machine Building. Aeration of the biosolids is used to keep the tanks mixed, prevent anaerobic conditions, and promote volatile solids destruction prior to disposal.

2.1.21 Inclined Screw Presses

Six ISPs, arranged in pairs, are used to dewater the biosolids prior to disposal. Each pair is connected to a common mixing manifold, flocculation tank reactor, and polymer feed system. Three polymer feed pumps blend polymer with plant water and supply the ISPs for coagulation of biosolids. A conveyor system delivers the dewatered biosolids to the solids disposal room, which contains three roll-off dumpsters.

2.1.22 Odor Control Biofilters

A biofilter odor control system biologically treats air removed from the Headworks Building and Machine Building solids disposal room. The system is intended to minimize nuisance odors resulting from gaseous hydrogen sulfide and other compounds normally present in wastewater. Air is sent to two biofilters by two blowers located in the Headworks Building and two blowers located in the Machine Building. The blowers utilize VFDs to control the air flow rate. The air is moistened as needed in a humidification chamber, filtered through the biofilter media, which is kept moist and clean by an internal irrigation system, and discharged through the exhaust stacks.

2.1.23 Sodium Aluminate Feed

Sodium aluminate is added to the treatment system at the membrane distribution channel near the RAS discharge to promote chemical phosphorus removal and provide required alkalinity. Sodium aluminate reacts with soluble phosphate to form solid precipitates that do not permeate through the membranes and can then be removed in the biosolids.

2.1.24 Sodium Hydroxide Feed

Sodium hydroxide (caustic soda) is not currently used at the CWP. The sodium hydroxide feed system was originally provided to restore alkalinity that had been depleted by nitrification and the addition of ferric chloride, which is also no longer used.

2.1.25 Citric Acid Feed

Citric Acid is added at the discharge of the CIP/Backpulse pumps to aid in cleaning of the membranes.

2.1.26 Sodium Hypochlorite Feed

Sodium hypochlorite is added at the CIP/Backpulse pumps to clean the membranes. Sodium hypochlorite is also added at the plant water discharge piping header in the Machine Building to disinfect and prevent biological growth in the plant water distribution system.

2.2 Influent Flows

The design average daily flow of the CWP is 8.0 MGD and the design maximum daily flow is 12.0 MGD, according to the 2006 Basis of Design, which is included as Appendix A.

The wastewater flows and loadings to the CWP were examined for the study period. The monthly maximum day, average day, and minimum day influent flows are plotted in Figure 2. The trend line on the figure indicates a slight increase in influent flows during the study period.

Average day flows ranged from 3.30 MGD to 4.41 MGD. The average influent flow observed, 3.70 MGD, is approximately 46% of the design average day flow. Maximum day flows ranged from 3.56 MGD to 5.61 MGD. Instantaneous flow data is displayed on the CWP SCADA system screens, but is not stored on the historian server. Only daily flow data is available for the study period. As a result, the maximum peak hourly flow and the peak hour to average day ratio were estimated based on available data from 4 Mile Lift Station and Forest Ridge Lift Station. By lift station proxy, the CWP peak hourly flow is approximately 9.35 MGD and the peak hour to average day ratio is 2.5. Table 1 provides a comparison of current influent flow conditions to the 2006 Basis of Design.

Two significant flooding events occurred in 2013 and 2018 which were outside the study period. During the February 2018 flood the CWP had its highest single day flow at 10 MGD.

2.3 Influent Loadings

The pollutants discussed herein include those which are monitored by the CWP in accordance with the National Pollutant Discharge Elimination System (NPDES) Permit, which is included as Appendix B. These include 5-day carbonaceous biochemical oxygen demand ($CBOD_5$), total suspended solids (TSS), total phosphorus, and ammonia nitrogen.

Table 1 shows the design influent loadings from the 2006 Basis of Design compared to the actual loadings to the CWP during the study period.

2.3.1 BOD_5

The CWP samples for BOD_5 at the influent and $CBOD_5$ at the effluent. The average influent BOD_5 loading was 10,352 lb/day, which is 63% of the design capacity of 16,500 lb/day. Figure 3 shows that the average influent BOD_5 trended slightly downward over the study period. The average monthly maximum day to average day ratio (max:avg) was 1.67.

2.3.2 TSS

The average influent TSS loading was 10,743 lb/day, which is 49% of the design capacity of 22,000 lb/day. Figure 4 shows that the average influent TSS decreased slightly over the study period. The average max:avg ratio was 1.85.

2.3.3 Total Phosphorus

The average influent total phosphorus loading was 207 lb/day, which is 28% of the design capacity of 735 lb/day. Figure 5 shows that the average influent phosphorus did not fluctuate much over the study period. The average max:avg ratio was 1.61.

2.3.4 Ammonia-Nitrogen

The average influent ammonia-nitrogen loading was 802 lb/day, which is 12% of the design capacity of 6,600 lb/day. Figure 6 shows that the average influent ammonia increased slightly over the study period. The max:avg ratio was 1.35.

2.4 Treatment Efficiency

During the study period, samples were taken by CWP staff at the influent, from the bioreactor collection channel, and at the UV rise well. Sample data were used to determine treatment efficiencies of individual processes and the CWP overall. Removal efficiencies were calculated by taking the arithmetic mean of the monthly removal percentages during the study period. This method does not account for lag associated with detention time. Seasonal discharge limits are imposed by the NPDES Permit for $CBOD_5$, TSS, and ammonia-nitrogen. Table 2 shows the treatment efficiencies and effluent concentrations of the pollutants through the applicable processes during each date range corresponding to the NPDES permit.

2.4.1 Clean Water Plant

The overall treatment efficiency of the CWP for the study period was analyzed by determining the percent removal from the influent to the final effluent. Effluent concentrations were compared to NPDES permit limits. As shown on the figures for removal efficiencies, the monthly NPDES permit limits were not exceeded during the study period.

2.4.1.1 $CBOD_5$

$CBOD_5$ removal was determined using influent BOD_5 and effluent $CBOD_5$. BOD_5 includes both the carbonaceous oxygen demand and the nitrogenous oxygen demand. The $CBOD_5$ fraction of the BOD_5 is more available as food to the microorganisms than the nitrogenous portion, so tracking influent BOD_5 and effluent $CBOD_5$ helps to monitor the CWP operating efficiency.

$CBOD_5$ removal data can be seen in Figure 7. The average $CBOD_5$ removal by the CWP was 99.4%, with an average final effluent concentration of less than 2 mg/L, which is the method detection limit. The $CBOD_5$ in the final effluent exceeded the daily permit limit of 10 mg/L once during the month of September 2017. This occurred during replacement of membrane modules and was immediately addressed by the operators.

The permit also mandates a minimum monthly $CBOD_5$ removal efficiency of 85% from December through April. The observed monthly removal efficiency was never below 99%.

2.4.1.2 TSS

TSS removal data can be seen in Figure 8. The average TSS removal by the CWP was greater than 99.4%, with an average final effluent concentration of less than 2 mg/L. For the entire study period, the effluent TSS concentrations were below the method detection limit and were reported as <2 mg/L on the Operator's Discharge Monitoring Report (DMR). For the purposes of calculating removal efficiency, a conservative approach was taken and values reported as <2 mg/L were calculated using a value 2 mg/L. Therefore, the reported TSS removal efficiencies are less than 100%, despite the final effluent having passed through a 0.04 micron membrane filter.

The TSS in the final effluent did not exceed permit limits during the study period. The permit also mandates a minimum monthly TSS removal efficiency of 85% from December through April. The observed monthly removal efficiency was never below 99%.

2.4.1.3 Phosphorus

Phosphorus removal data can be seen in Figure 9. The average phosphorus removal by the CWP was 93.8%, with an average final effluent concentration of 0.41 mg/L phosphorus. The phosphorus in the final effluent did not exceed permit limits during the study period.

2.4.1.4 Ammonia-Nitrogen

Ammonia-nitrogen removal data can be seen in Figure 10. The average ammonia-nitrogen removal by the CWP was 99.6%, with an average final effluent concentration of

0.12 mg/L ammonia-nitrogen. The ammonia-nitrogen in the final effluent did not exceed permit limits during the study period.

2.4.1.5 Other Treatment Considerations

The 2009 NPDES Permit specified numeric effluent limitations on total fecal coliform (TFC), pH, and DO. The 2015 NPDES Permit expanded the requirements to include numeric limitations on acute toxicity, chronic toxicity, and total mercury. Sample data for these parameters was not measured at the influent. Therefore, removal efficiencies by the CWP could not be calculated.

Total Fecal Coliform

The NPDES Permit monthly average requirement for TFC in the effluent is no more than 200 CFU/100 mL. 94% of samples taken for TFC during the study period were below the method detection limit of 1.0 CFU/100 mL. A conservative approach was taken to conduct statistical analysis; values reported as < 1.0 on the DMR were calculated using a value of 1.0. During the study period, the average count was 1.7 CFU/100 mL. The TFC in the final effluent did not exceed permit limits during the study period. Observed TFC values are shown in Figure 11. The observed spike in September 2017 was related to the replacement of membrane modules in Tanks 1 and 2.

Acute Toxicity

The NPDES Permit daily requirement for acute toxicity in the effluent is no more than 1.0 TU_C. During the study period, each sample for acute toxicity was 0.0 TU_A. The acute toxicity in the final effluent did not exceed permit limits during the study period. Effluent acute toxicity sample results are shown in Figure 12.

Chronic Toxicity

The NPDES Permit monthly average requirement for chronic toxicity in the effluent is no more than 18.4 TU_C. During the study period, only one sample for chronic toxicity was non-zero, at 1.29 TU_C. The chronic toxicity in the final effluent did not exceed permit limits during the study period. Effluent chronic toxicity sample results are shown in Figure 13.

Total Mercury

The NPDES Permit rolling average requirement for effluent mercury concentration is no more than 4.0 ng/l. During the study period, the average effluent mercury concentration was 0.54 ng/l. The mercury in the final effluent did not exceed permit limits during the study period. Observed effluent mercury concentrations are shown in Figure 14.

pH

The NPDES Permit daily requirement for effluent pH is greater than 6.5 and less than 9.0. During the study period, the effluent pH ranged from 6.52 to 7.59. The pH in the final effluent did not violate permit limits during the study period. Observed pH values are shown in Figure 15.

Dissolved Oxygen

The NPDES Permit daily requirement for effluent DO is no less than 3.0 mg/L. During the study period, the DO in the effluent ranged from 3.2 to 10.5 mg/L. The DO in the final effluent did not violate permit limits during the study period. Observed dissolved oxygen values are shown in Figure 16.

3 HYDRAULIC CAPACITY ANALYSIS

The hydraulic capacities of the CWP processes that have a hydraulic limitation were analyzed using applicable recommendations and requirements of the "Recommended Standards for Wastewater Facilities", 2014 Edition (Ten States Standards), as well as the limits set forth by the NPDES Permit. Unless noted otherwise, the CWP processes meet the criteria from the Ten States Standards. However, many of the processes associated with the membrane bioreactors (MBR) do not have recommendations for sizing in the Ten States Standards, and are instead compared to the Basis of Design and industry standards (if available). The hydraulic capacity for each process downstream of the bioreactors is assumed to be conservative, due to the buffering that occurs in tanks with detention time.

3.1 Influent

The influent sewer slope is greater than the Ten States Standards (Section 33) recommendation for minimum slope. The capacity of the 48 inch influent sewer upstream of the influent flume is 36.2 MGD when flowing full.

The influent flume is a 30 inch prefabricated Parshall flume rated for 24 MGD. Above this flow rate the influent flow sensor reading may be inaccurate.

3.2 Comminutors

The Ten States Standards (Section 62.32) recommend that comminutors be sized to handle the peak hourly flow. The capacity of each of the two comminutors is 16 MGD. This allows for redundancy in case either piece of equipment is taken out of service for maintenance. At the design maximum hour flow, a freeboard of 24 inches is maintained in the comminutor channels. In addition, there are two spillways that connect to overflow channels alongside the comminutor channels in case of emergency.

3.3 Influent Screw Pumps

The Ten States Standards (Section 42.31) indicate that pumping stations must be able to handle the peak hourly flow with the largest pump out of service. For a triplex station with three similar pumps, the firm capacity is the capacity produced with two pumps in simultaneous operation.

The three influent screw pumps are individually rated for 8.0 MGD and therefore the Headworks pumps have a firm capacity of 16.0 MGD.

3.4 Grit Removal

The Ten States Standards do not provide a recommendation for sizing of vortex-type grit chambers. According to the 2006 Basis of Design, the grit chamber has a maximum hydraulic capacity of 16.0 MGD.

The air lift grit pump is rated for 70 gallons per minute (gpm). The grit classifier lists a grit capacity of 120 cfh. There is no data to correlate the grit pump and grit classifier capacities to an allowable influent flow.

3.5 Screening

The Ten States Standards (Section 61.2) recommend sizing fine screens to treat the design peak instantaneous flow with one unit out of service. There are three drum screens each with a rated capacity of 8 MGD for a firm capacity of 16 MGD, which is the Phase 1/1A design peak instantaneous flow rate. The Ten States Standards also recommend that fine screens be preceded by a coarse bar screening device. The comminutors provide protection for the fine screens at the CWP.

3.6 Bioreactors and Membrane Tanks

The Ten States Standards (Section 92.323) require that aeration tanks have a minimum freeboard of 18 inches. The Ten States Standards do not offer guidance on typical design parameters for bioreactor sizing in an MBR process. According to the membrane manufacturer's Basis of Design, the sludge retention time (SRT) should be between 15 and 18 days and the hydraulic retention time (HRT) should be between 17.7 and 14.9 hours, at average day and maximum month flows, respectively. These times are guidelines for steady operation at the design mixed liquor concentration and not intended to be limitations. The recirculation rate of activated sludge from the membrane tanks to the bioreactor distribution channel is flow paced based on the effluent flow meter and designed to be 400% of influent flow.

The total combined volume of the three bioreactors and five membrane tanks at the CWP is 4,642,000 gal. The individual bioreactors each have a volume of 1,472,400 gal and a minimum freeboard of approximately 36 inches. The membrane tanks each have a volume of 44,920 gal and a freeboard of approximately 36 inches.

Five membrane tanks are equipped with membrane cassettes and in use. As currently operated, the average day flow could be as high as 6.29 MGD and still be within the recommended range for HRT, while the maximum month flow could be as high as 7.48 MGD and still be within the recommended range for HRT. If the CWP was equipped to operate all seven of the membrane tanks, the average day flow could be as high as 6.42 MGD and the maximum month flow could be as high as 7.62 MGD and still be within the recommended range for HRT.

During the study period two out of three of the bioreactors were online. The average HRT in the MBR was approximately 20.6 hours. The average SRT in the MBR was 19.7 days, which is slightly longer than the design value. The average recirculation rate was 2.92 times the plant flow, which is 27% less than the design ratio. The recirculation rate is used to maintain the MLSS concentration in the bioreactors, which was also approximately 30% less than the design concentration during the study period.

3.7 Membranes

3.7.1 General

The hydraulic capacities of the membranes are presented in Table 3. In September 2017, near the end of the study period, the CWP began replacement of the membrane modules in Tanks 1 and 2. This was the first phase of a three-year effort to replace 90% of all modules. The new membrane modules have a membrane surface area of 370 ft^2, which is 30 ft^2 more per module than the existing modules.

When the membrane module replacement project is complete, anticipated in fall of 2019, each train will consist of nine cassettes equipped with modules which have a membrane surface area of 370 ft^2 per module and one cassette equipped with modules which have a membrane surface area of 340 ft^2 per module. Once complete, the firm capacity at average day flow will increase from 6.29 MGD to 6.84 MGD.

The hydraulic capacities presented in Table 3 do not account for buffering of peak flows by the bioreactors. Actual allowable influent flows could be greater than those presented herein.

3.7.2 Key Performance Indicators

The CWP relies on several key performance indicators (KPIs) for the membranes. These include Flux Before Backpulse, Permeate Turbidity After Backpulse, Temperature-Corrected Permeability Before Backpulse, Trans-Membrane Pressure Before Backpulse, Trans-Membrane Pressure During Backpulse, and Total Permeate Flow. The manufacturer has accounted for cleanings in in sizing the membranes for the design capacity.

3.8 Permeate Pumps

The five permeate pumps are individually rated for 1,900 gpm. The permeate pumping capacity is reduced during the operation of the backpulse pumps, so an additional factor of 1.17 is used to calculate the required pumping capacity. Therefore, the permeate pumps have a firm capacity of 9.36 MGD during backpulse. With all five pumps in service the capacity is 11.7 MGD during backpulse.

3.9 Clean in Place/Backpulse Pumps

The two CIP/Backpulse pumps are individually rated for 3,022 gpm. Therefore, the CIP/Backpulse pumps have a firm capacity of 4.35 MGD. The CIP/Backpulse pumps are sized to accommodate the cleaning needs for up to nine membrane tanks (Phase II) according to the membrane manufacturer's Basis of Design. The average day influent flow for Phase II expansion is 12.0 MGD.

3.10 Disinfection

The Ten States Standards (Section 104.3) recommend a minimum of two UV lamp banks in series in open channel construction with level control to achieve the necessary disinfection. The hydraulic properties should simulate plug flow conditions without short circuiting under the full operating flow range.

The UV disinfection process at the CWP includes a single channel with two lamp banks and a self-adjusting flap gate for automatic level control. According to the 2006 Basis of Design, the UV system was designed to treat the Phase 1A maximum hourly flow rate of 12.34 MGD through the Machine Building. Due to buffering in the upstream processes, the Phase 1A maximum hourly influent flow is 16 MGD. According to the UV system manufacturer, the equipment itself can handle up to 13.5 MGD through the channel.

3.11 Return Activated Sludge Pumps

The Ten State Standards (Section 92.41) recommendations for the rate of sludge return are not applicable for the MBR configuration at the CWP. The recommendation for redundancy (Section 92.42) is accounted for in the hydraulic capacity. The RAS pump capacity is based on maintaining adequate velocities for flushing solids out of the membrane tanks.

Each of the three RAS pumps at the CWP is rated for 17,210 gpm. The firm capacity for the activated sludge pumps is 49.6 MGD, based on one pump out of service.

The 2006 Basis of Design states that the RAS pumps were sized to accommodate five times the design Phase 1A Maximum Month flow (MMF) rate of 9.91 MGD. The recirculation rate is proportional to the plant effluent rate. Over the study period, the RAS rate as a percentage of influent flow averaged 292%. Based on this ratio, the maximum average day flow could be as high as 17.0 MGD if only RAS is considered.

3.12 Waste Activated Sludge Pumps

Two WAS pumps are used to pump the mixed liquor from the WAS/Foam wet well to the biosolids holding tanks. The Ten State Standards (Section 92.44), recommendations for wasting rates are not applicable for the MBR configuration at the CWP. The recommendation for redundancy (Section 92.42) is accounted for in the hydraulic capacity.

Both of the WAS pumps at the CWP are rated for 325 gpm. The firm capacity for the WAS pumps is 325 gpm, based on one pump out of service.

Over the study period, the WAS rate averaged 102,000 gallons per day (gpd). Assuming the wasting rate is proportional to influent flow and the WAS concentration remains the same, the maximum average day flow could be as high as 17.0 MGD if only WAS is considered.

3.13 Sludge Handling

There are no Ten States Standards related to sludge pumping capacity, however, the Ten States Standards (Section 73.23) require a minimum velocity of 3 ft/s in sludge withdrawal pipelines.

For RAS piping, a minimum velocity of 2 ft/s is required if operating at normal return sludge rates (Section 92.43). The RAS pumps should deliver a minimum flow of 16.3 MGD in order to maintain 2 ft/s in the 48 inch diameter RAS piping. The average RAS flow rate over the study period was 10.8 MGD. Given that typical diurnal peak flows can be 2.5 times greater than average, the minimum velocity requirement is met daily.

The firm capacity of the WAS pumps is 325 gpm. With one WAS pump operating at full speed, the velocity in the 6 inch diameter WAS piping is 3.7 ft/s.

The ISP pumps used to pump sludge from the biosolids holding tanks to the ISPs located in the Machine Building have a firm capacity of 420 gpm. The individual pump capacity is 210 gpm. There are two 4 inch diameter supply lines for redundancy and to allow for a looped system, therefore, the velocity is 5.4 ft/s.

3.14 Biosolids Holding Tanks

The Ten States Standards (Section 88.31) recommend a minimum of 4 days production volume for storage for biosolids when mechanical dewatering is used.

The CWP has two biosolids holding tanks with a combined storage volume of 1.4 MG. Given a total storage volume of 1.4 MG and a minimum of 4 days solids storage, the average daily flow to the biosolids storage tanks could be 350,000 gpd.

The CWP meters the flow of biosolids from the WAS pumps to the storage tanks. During the study period, the CWP wasted an average of 102,000 gpd. Assuming the solids generation is proportional to influent flow and the current MLSS concentration in the bioreactors is maintained, the equivalent allowable influent flow could be as high as 12.68 MGD and the biosolids holding tanks would still meet the Ten States Standards.

3.15 Inclined Screw Presses

The Ten States Standards (Section 88.3) recommend that the number of mechanical dewatering units be sufficient to handle the sludge produced with the largest unit out of service. There are six ISPs at the CWP, each with an individual design capacity of 65 gpm. Over the study period, the thickened sludge from the biosolids holding tank averaged 1.3% solids and when dewatered by the ISPs averaged 12.4% solids. This system is operated 5 days per week at 9 hours per day, which represents an operational utilization of 27%. As needed, the CWP can increase the utilization of the ISPs.

The three polymer metering pumps are individually rated for 4.0 gph and therefore have a firm capacity of 8.0 gph. During the study period the average polymer use was 3.0 gph. Polymer is typically stored at the CWP in four totes. At the current usage rate of 3.0 gph, there is no concern related to polymer storage capacity.

The ISP pumps, which each have a capacity of 420 gpm, deliver an average of 94,400 gallons per day of biosolids to the ISPs. Based on an average solids concentration of 1.3% delivered from the biosolids holding tanks and the current ISP operational utilization rate of 27%, assuming biosolids production is proportional to influent flow and the current MLSS concentration in the bioreactors is maintained, the equivalent allowable influent flow could be as high as 13.8 MGD with full utilization of the ISPs.

3.16 Chemical Feed Systems

In accordance with the Ten States Standards (Section 111), the chemical feed equipment should be designed to meet the maximum dosage requirements for the design conditions. Chemical storage tanks are recommended to hold a minimum supply of 10 days' worth of chemical.

3.16.1 Sodium Aluminate

The CWP currently maintains an average sodium aluminate dosing rate of 67 gpd. The two sodium aluminate metering pumps are each rated for 31 gallons per hour. The two sodium aluminate storage tanks at the CWP can hold a total of 7,320 gallons, which is 109 days of storage based on the dosing rate. Both the feed pump capacity and the storage capacity exceed the needs of the CWP and meet the Ten States Standards.

3.16.2 Citric Acid

The usage of citric acid at the CWP is determined by the frequency of membrane cleaning. When a cleaning is performed, citric acid is added to the permeate upstream of the CIP pumps and this solution is pumped through the membranes into the membrane tanks. Maintenance cleaning is performed weekly and the chemical used is alternated between citric acid and sodium hypochlorite each week. Recovery cleaning is performed once every 9 – 12 months. The CWP currently uses approximately 15 gallons of citric acid for each maintenance cleaning cycle (single tank) and about 150 gallons for each recovery cleaning. The two citric acid feed pumps are each rated for 25 gpm. The citric acid storage tank at the CWP can hold 1,200 gallons, which exceeds the volume needed for recovery cleaning.

3.16.3 Sodium Hypochlorite

The CWP currently uses approximately 15 gallons of sodium hypochlorite for each maintenance cleaning cycle (single tank) and about 220 gallons for each recovery cleaning. The two sodium hypochlorite feed pumps are each rated for 45 gpm. The sodium hypochlorite storage tank at the CWP can hold 1,200 gallons, which exceeds the volume needed for recovery cleaning.

Total sodium hypochlorite usage averaged approximately 2,550 gallons each year during the study period. The volume not used for membrane cleaning was used for disinfection of the plant water system. The two plant water disinfection pumps are each rated for 0.082 gpm. Even with this additional use of sodium hypochlorite, there is plenty of storage and pump capacity available to meet the needs of the CWP.

3.17 Hydraulic Capacity Summary

A summary of the hydraulic capacities of each process described above is provided in Table 4. A comparison of the limiting allowable influent hydraulic capacity of each applicable process can be seen in Figure 17.

The volume of the bioreactor and membrane tanks is the hydraulically limiting process of the CWP if design HRT at average day flow is considered; however, the total MBR capacity is approximately 70% greater than the current average day flow. The MBR can accommodate higher maximum month flows.

4 TREATMENT CAPACITY ANALYSIS

The treatment capacities for the applicable CWP processes were analyzed using the recommendations and requirements of the Ten States Standards, as well as the limits set forth by the 2015 NPDES Permit. Unless noted otherwise, the CWP processes meet the Ten States Standards. Allowable Headworks Loadings (AHL) were also determined for processes where applicable. An AHL is defined by the EPA as the estimated maximum loading of a pollutant that can be received at a publicly owned treatment works' (POTW) headworks that should not cause a POTW to violate a particular treatment plant or environmental criterion.

4.1 Bioreactors

AHL values for BOD_5 were determined using three different loading constraints as described below. The AHL calculations for the bioreactors are based on the use of all three tanks. It is assumed that influent and recycle loadings also remain proportionally the same. The BOD_5 loading from supernatant recycle streams ranged from 0% to 3.5% of the bioreactor BOD_5 loading due to the fact that the biosolids storage tank decant was not returned daily. The actual values noted are based on the current operation of the CWP with two bioreactors online.

4.1.1 Organic Loading

The Ten States Standards (Section 92.31) establish permissible bioreactor capacities and loadings for various activated sludge systems; the allowable bioreactor organic loading is 40 lb BOD_5/day/1,000 ft^3 at design average BOD_5.

The total operating volume of the three bioreactors and five membrane tanks is 620,590 ft^3. Therefore, the allowable loading to the bioreactors is 24,840 lb BOD_5/day including recycle flows. However, the membrane manufacturer's Basis of Design states the allowable influent loading to be 21,175 lb BOD_5/day, which is more conservative.

The bioreactor loading values seen at the CWP during the study period averaged 24 lb BOD_5/day/1,000 ft^3. The loading from biosolids holding tank decant was as high as 0.85 lb BOD_5/day/1,000 ft^3. These values are approximations as the BOD_5 was not sampled and tested for every day that decant was returned.

The monthly average day bioreactor loading values seen at the CWP during the study period ranged between 20 and 34 lb BOD_5/day/1,000 ft^3 as shown in Figure 18. The NPDES Permit organic loading limits, which are based on $CBOD_5$, were not exceeded during the study period.

4.1.2 Aeration

In accordance with the Ten States Standards (Section 92.331), aeration equipment should be capable of maintaining a minimum of 2.0 mg/L dissolved oxygen in the mixed liquor at all times. The oxygen requirements for conventional aeration should be 1.1 lb O_2/lb design peak hourly BOD_5 and 4.6 lb O_2/lb design peak hourly TKN. The Ten States Standards (Section 92.332.f.) require that diffused air systems be capable of providing for 200 percent of the design average day oxygen demand, or the peak day oxygen demand.

One turbo blower and three centrifugal blowers are available to provide the air required to the bioreactors. The aeration of the bioreactors is limited by the capacity of the PABs. The maximum allowable airflow to the diffusers is 4.0 scfm/diffuser, or 32,590 scfm with all three tanks in service. The firm capacity of the centrifugal blowers is 13,200 scfm and the capacity of the turbo blower is 4,500 scfm. The centrifugal blowers and the turbo blower are intended to operate simultaneously. Based on the capacity of the PABs, the system can provide up to 38,590 lb O_2/day. This equates to an AHL of 35,080 lb BOD_5/day. The fine bubble disc diffusers installed in the bioreactors were designed such that the maximum air flow delivered by the PABs could be split between two of the three bioreactors to accommodate maintenance needs.

The CWP is designed to treat a significant ammonia load in addition to BOD_5. When membrane aeration and denitrification are factored in, there is sufficient process aeration capacity to treat the average day design loadings of 16,500 lb/day BOD_5 and 6,600 lb/day NH_3-N.

4.1.3 Food to Microorganism Ratio and Mixed Liquor Suspended Solids

The food to microorganism ratio (F:M) is the quantity of food available relative to the quantity of microorganisms. The maximum MLSS values are dependent upon the membrane flux, the rate of sludge return, and the aeration process. Based on an F:M of 0.10, an MLSS value of 8,000 mg/L, and the observed 81% volatile solids, the AHL is 25,100 lb BOD_5/day if only F:M is considered. As BOD_5 loading increases, the MLSS concentration can also increase to remain within the design range.

The F:M values during the study period were between 0.08-0.14 (Figure 19) and the average daily aeration tank MLSS values per month ranged between 4,510 and 6,330 mg/L (Figure 20). The average MLSS concentration in the aeration tanks was 5,390 mg/L and the average RAS flow rate was 292% of the influent flow rate.

4.2 Membranes

There are no capacity requirements for membranes provided in the Ten States Standards.

The membrane manufacturer's process design is provided in Appendix A. These design calculations are relied on for determination of allowable loading.

The membrane cassettes also utilize coarse bubble aeration for intermittent cleaning of the membranes to prevent fouling. The air is discharged at the bottom of each cassette for ten seconds and then is off for either ten or thirty seconds, depending on the operation scenario selected. Oxygen transfer does occur as a result of this aeration and, therefore, BOD_5 reduction is achieved in the membrane tanks. The reduction is about 5% relative to the reduction achieved in the bioreactors. This is accounted for in the bioreactor oxygen requirement calculations.

4.3 Odor Control

There are no capacity requirements for odor control provided in the Ten States Standards.

The odor control blower capacity is 13,800 cfm. Performance testing of the odor control biofilter was conducted at startup of the equipment. Hydrogen sulfide gas, ammonia, methyl mercaptan, and volatile organic compounds were measured. For hydrogen sulfide gas, the removal efficiency of the biofilter exceeded 99.7% throughout the 5-day test duration. Effluent concentrations of ammonia and methyl mercaptan were both below detection limits and therefore, a removal efficiency could not be calculated. The removal efficiency of VOCs was 60%.

Data from the study period was not available to determine current performance, but no noticeable odors are present on site or near the biofilter.

4.4 Overall CWP Treatment Capacity

The following AHL values are calculated based on the average flow rate and removal efficiency observed during the study period using the equation below:

$$AHL_{Overall} = \frac{8.34 * C_{NPDES} * Q_{WWTP}}{1 - R_{WWTP}}$$

where,

C = Concentration, mg/L

Q = average influent flow, MGD

R = Removal efficiency

A summary of the overall CWP AHL values is provided in the table below.

CWP Allowable Headworks Loadings Based on NPDES Permit Limits

Pollutant	NPDES Permit Limit (mg/L)	Removal Efficiency	AHL (lb/day)
$CBOD_5$			
May – November	4	99.4%	19,080
December – April	25	99.4%	125,310
TSS[1]			
May – November	20	99.4%	n/a
December – April	30	99.4%	n/a
Phosphorus	1.0	93.8%	500
Ammonia-N			
May – November	0.5	99.6%	3,730
December – April	--	99.5%	--

[1] Effluent TSS concentrations were reported as <2 mg/L on the Operator's Log, which is the method detection limit for the TSS analysis. For the purposes of calculating removal efficiency, a conservative approach was taken and values reported as <2 mg/L were calculated using a value of 2 mg/L. The actual TSS removal efficiencies are greater than 99.4%, due to the final effluent having passed through a 0.04 micron membrane filter.

4.5 Treatment Capacity Summary

A summary of the AHLs for each of the processes is provided in Table 5. Maximum Allowable Headworks Loading (MAHL) is defined by the EPA as the estimated maximum loading of a pollutant that can be received and treated at a CWP without causing pass through or interference with treatment processes. Therefore, the MAHL for each pollutant is the lowest (most protective) of the various AHLs calculated. The MAHL of each pollutant is summarized in the table below, and includes a safety factor of 10%. Figure 21 shows a comparison of the MAHL for each pollutant with the current average loadings.

CWP Maximum Allowable Headworks Loadings

Pollutant	MAHL, lb/day
BOD_5	19,060
TSS	25,090
Phosphorus	790
Ammonia-N	7,130

Some of the MAHL values are greater than the AHL values determined by the removal efficiency calculation in Section 4.4. While the AHL values based on the removal efficiency are a conservative representation based on the way the CWP operated during the study period, it was determined that they are not appropriate to override the Basis of Design loading values for several reasons. First, the original Basis of Design was conservative in its approach to establish allowable loading, and included a significant industrial load that is no longer in operation. Second, the CWP was not operated as designed during the study period. A lower MLSS concentration and RAS rate was maintained. Third, the calculated removal efficiencies for $CBOD_5$ and TSS are conservative due to the method detection limits. During the study period, the actual loading to the CWP did not approach the Basis of Design loading.

5 CONCLUSIONS

The average CWP influent flow over the study period was 46% of the design average flow. The trend line indicates that influent flows are slightly increasing. During the study period, the CWP had a single exceedance of the daily final effluent $CBOD_5$ permit limit, which was associated with the replacement of membrane modules. There were no other instances of the CWP operating outside permit limits.

The MBR volume is the hydraulically limiting process at the CWP based on HRT at average day flow. However, the total MBR capacity is approximately 70% greater than the current average day flow, and the MBR can accommodate higher maximum month flows.

The basis of design MAHLs for the pollutants provide guidelines that will help the CWP make informed decisions regarding accepting additional flow connections and/or additional loading. There is adequate treatment capacity for increased loading of all pollutants.

Influent and Effluent Data Comparison

	Basis of Design[1]		Actual: 2015-2017[2]	
Flow	**mgd**	**gpm**	**mgd**	**gpm**
Average Day[3]	8.0	5,556	3.70	2,567
Maximum Day	12.0	8,333	5.61	3,896
Monthly Average Day	**mg/L**	**lb/day**	**mg/L**	**lb/day**
$CBOD_5$				
Influent (BOD_5)	225	16,500	335	10,352
Effluent, 5/1 - 11/30	4	300[4]	2.1	64
Effluent, 12/1 - 4/30	25	1,700	2.1	65
TSS				
Influent	300	22,000	348	10,743
Effluent, 5/1 - 11/30	20	1,300	2.0	61
Effluent, 12/1 - 4/30	30	2,000	2.0	63
Total Phosphorus				
Influent	10	735	6.7	207
Effluent	1.0	67	0.4	13
Ammonia-Nitrogen				
Influent	90	6,600	26	802
Effluent, 5/1 - 11/30	0.5	30	0.1	3.0
Effluent, 12/1 - 4/30	--	--	0.1	4.5

Note:

[1] 2006 Operations & Maintenance Manual. Effluent design values based on maximum monthly limit set forth in current NPDES Permit.

[2] January 1, 2015 - December 31, 2017

[3] Membranes currently populated for 6.84 MGD. Refer to Table 3.

[4] January 2015 - October 2015 NPDES Permit limit was 270 mg/L.

Influent and Effluent Data Comparison

	NPDES Permit Limit[1]		Actual: 2015-2017[2]	
Fecal Coliform Bacteria	**ct/100 ml**		**ct/100 ml**	
Effluent	200		1.7	
pH	**S.U.**		**S.U.**	
Effluent	6.5 ≤ pH ≤ 9.0		7.1	
Dissolved Oxygen	**mg/l**		**mg/l**	
Effluent, 5/1 - 9/30	3.0 ≤ D.O.		6.6	
Total Mercury	**ng/l**	**lb/day**	**ng/l**	**lb/day**
Effluent	4.0	0.00027	0.5	0.00002

Note:
[1] Effluent values based on maximum monthly limit set forth in current NPDES Permit.
[2] January 1, 2015 - December 31, 2017

Treatment Efficiency Summary - $CBOD_5$

Process	May 1 - Nov 30		Dec 1 - Apr 30	
	mg/L	Removal	mg/L	Removal
Influent (BOD_5)	334.9	--	335.5	--
Effluent	2.1	99%	2.1	99%
Total Removal		**99%**		**99%**

Note:

Samples are taken of the raw influent and of the final effluent.

It is assumed that BOD_5 and ammonia removal occurs in the bioreactors and that TSS and phosphorus removal occurs in the membrane tanks.

Treatment Efficiency Summary - TSS

	May 1 - Nov 30		Dec 1 - Apr 30	
Process	**mg/L**	**Removal**	**mg/L**	**Removal**
Influent	345.5	--	350.3	--
Effluent	2.0	99%	2.0	99%
Total Removal		**99%**		**99%**

Note:
TSS analytical testing minimum detection limit is 2.0 mg/L. Actual effluent concentrations were consistently below detection limits.
Samples are taken of the raw influent and of the final effluent.
It is assumed that BOD_5 and ammonia removal occurs in the bioreactors and that TSS and phosphorus removal occurs in the membrane tanks.

Treatment Efficiency Summary - Phosphorus

Process	**mg/L**	**Removal**
Influent	6.7	--
Effluent	0.4	94%
Total Removal		**94%**

Note:
Samples are taken of the raw influent and of the final effluent.
It is assumed that BOD_5 and ammonia removal occurs in the bioreactors and that TSS and phosphorus removal occurs in the membrane tanks.

Treatment Efficiency Summary - Ammonia

Process	May 1 - Nov 30		Dec 1 - Apr 30	
	mg/L	Removal	mg/L	Removal
Influent	24.1	--	28.5	--
Effluent	0.1	99.6%	0.1	99.5%
Total Removal		**99.6%**		**99.5%**

Note:
Samples are taken of the raw influent and of the final effluent.
It is assumed that BOD_5 and ammonia removal occurs in the bioreactors and that TSS and phosphorus removal occurs in the membrane tanks.

CURRENT AND PROPOSED MEMBRANE CAPACITY

Flow Condition	Firm (N-1)								Available with Spare (N)							
	Trains Running	Cassettes/ Train	Modules/ Cassette	Area/ Module	Total Area	Net Flux*	Flow	Train Flow	Trains Running	Cassettes/ Train	Modules/ Cassette	Area/ Module	Total Area	Net Flux*	Flow	Train Flow
	#	#	#	sq. ft.	sq. ft.	gfd	MGD	MGD	#	#	#	sq. ft.	sq. ft.	gfd	MGD	MGD
Phase I (Original Operation) - 5 Trains																
ADF	4	10	48	340	652,800	9.63	6.29	1.57	5	10	48	340	816,000	9.63	7.86	1.57
MMF	4	10	48	340	652,800	11.47	7.49	1.87	5	10	48	340	816,000	11.47	9.36	1.87
MWF	4	10	48	340	652,800	12.39	8.09	2.02	5	10	48	340	816,000	12.39	10.11	2.02
MDF	4	10	48	340	652,800	14.23	9.29	2.32	5	10	48	340	816,000	14.23	11.61	2.32
PHF	4	10	48	340	652,800	14.23	9.29	2.32	5	10	48	340	816,000	14.23	11.61	2.32
Phase I-Mod (Current Transition) - 5 Trains																
ADF	4	10	48	370	710,400	9.63	6.84	1.71	5	10	48	370	888,000	9.63	8.55	1.71
MMF	4	10	48	370	710,400	11.47	8.15	2.04	5	10	48	370	888,000	11.47	10.19	2.04
MWF	4	10	48	370	710,400	12.39	8.80	2.20	5	10	48	370	888,000	12.39	11.00	2.20
MDF	4	10	48	370	710,400	14.23	10.11	2.53	5	10	48	370	888,000	14.23	12.64	2.53
PHF	4	10	48	370	710,400	14.23	10.11	2.53	5	10	48	370	888,000	14.23	12.64	2.53
Phase IA (Future) - 7 Trains																
ADF	6	10	48	370	1,065,600	9.37	9.98	1.66	7	10	48	370	1,243,200	9.37	11.65	1.66
MMF	6	10	48	370	1,065,600	11.25	11.99	2.00	7	10	48	370	1,243,200	11.25	13.99	2.00
MWF	6	10	48	370	1,065,600	12.19	12.99	2.16	7	10	48	370	1,243,200	12.19	15.15	2.16
MDF	6	10	48	370	1,065,600	14.00	14.92	2.49	7	10	48	370	1,243,200	14.00	17.40	2.49
PHF	6	10	48	370	1,065,600	14.00	14.92	2.49	7	10	48	370	1,243,200	14.00	17.40	2.49
Phase II (Future) - 9 Trains																
ADF	8	10	48	370	1,420,800	9.39	13.34	1.67	9	10	48	370	1,598,400	9.39	15.01	1.67
MMF	8	10	48	370	1,420,800	11.27	16.01	2.00	9	10	48	370	1,598,400	11.27	18.01	2.00
MWF	8	10	48	370	1,420,800	12.21	17.35	2.17	9	10	48	370	1,598,400	12.21	19.52	2.17
MDF	8	10	48	370	1,420,800	14.05	19.96	2.50	9	10	48	370	1,598,400	14.05	22.46	2.50
PHF	8	10	48	370	1,420,800	14.05	19.96	2.50	9	10	48	370	1,598,400	14.05	22.46	2.50

Notes:
*Flux values are based on the membrane manufacturer's basis of design, and assume a minimum temperature of 8 °C.
The membrane system was designed to handle all flow conditions with one train offline. "Firm" columns are with one train offline, "Available with Spare" columns represent all of the trains in operation.

ADF = Average Day Flow
MMF = Maximum Month Flow
MWF = Maxiumum Week Flow
MDF = Maximum Day Flow
PHF = Peak Hour Flow

Hydraulic Capacity Summary

Process	Capacity	Units	Capacity Notes	Allowable Influent Flow (MGD)	Allowable Influent Flow Notes
Influent	24.0	MGD		**24.0**	Rated capacity of Parshall flume
Comminutors	16.0	MGD		**16.0**	
Influent Screw Pumps	16.0	MGD	Firm capacity with 2 of 3 pumps in service.	**16.0**	
Grit Removal	16.0	MGD		**16.0**	
Screening	16.0	MGD		**16.0**	
Membrane & Bioreactor Tanks	4.6	MG	Combined Tank Volume (3 Bioreactors + 5 Membrane Trains)	**6.3**	ADF to maintain design HRT of 17.7 hours
Membranes	1.7	MGD	Flow per train	**12.6**	MDF Capacity - 5 trains (upon completion of membrane replacement in 2019)
				8.6	ADF Capacity - 5 trains (upon completion of membrane replacement in 2019)
				6.8	ADF Firm Capacity (upon completion of membrane replacement in 2019)
Plant Water	400	GPM	Firm Capacity	**n/a**	
Permeate	2.7	MGD	Individual Pump Capacity	**11.7**	Based on 4 out of 5 membrane trains in service
Disinfection	12.3	MGD		**16.0**	Phase 1A maximum hourly flow
RAS	24.8	MGD	Individual Pump Capacity	**17.0**	Based on average RAS rate over study period (2.92*Q)
WAS	325	GPM	Individual Pump Capacity	**17.0**	Based on average WAS rate over study period
Biosolids Holding Tanks	1.4	MG	Tank Volume	**12.7**	
Inclined Screw Pumps & Presses	65	GPM	Individual Press Capacity	**13.8**	Assumed solids loading proportional to increase in influent flow (1.3% solids)
	420	GPM	Individual Pump Capacity		
Sodium Aluminate Feed Pumps	31	GPH	Pump Capacity	**n/a**	Assumed proportional feed rate to current average day flow
Sodium Aluminate	7,320	gallons	Storage Volume	**n/a**	Assumed proportional feed rate to current average day flow, minimum 10 days of storage
Citric Acid Feed Pumps	25	GPM	Pump Capacity	**n/a**	Recovery Cleaning performed annually uses 150 gallons per membrane tank
Citric Acid Bulk Storage	1,200	gallons	Storage Volume	**n/a**	Assumed proportional feed rate to current average day flow, minimum 10 days of storage
Sodium Hypochlorite Feed Pumps	45	GPM	Pump Capacity	**n/a**	Recovery Cleaning performed annually uses 220 gallons per membrane tank
Plant Water Disinfection Pumps	0.082	GPM	Pump Capacity	**n/a**	
Sodium Hypochlorite Bulk	1,200	gallons	Storage Volume	**n/a**	Assumed proportional feed rate to current average day flow, minimum 10 days of storage
Polymer Feed Pumps	8.0	GPH	Firm Capacity	**9.9**	Assumed proportional feed rate to current average day flow

Note: Allowable influent flow is n/a where there is known to be adequate capacity or process capacity is not easily correlated to influent flow.

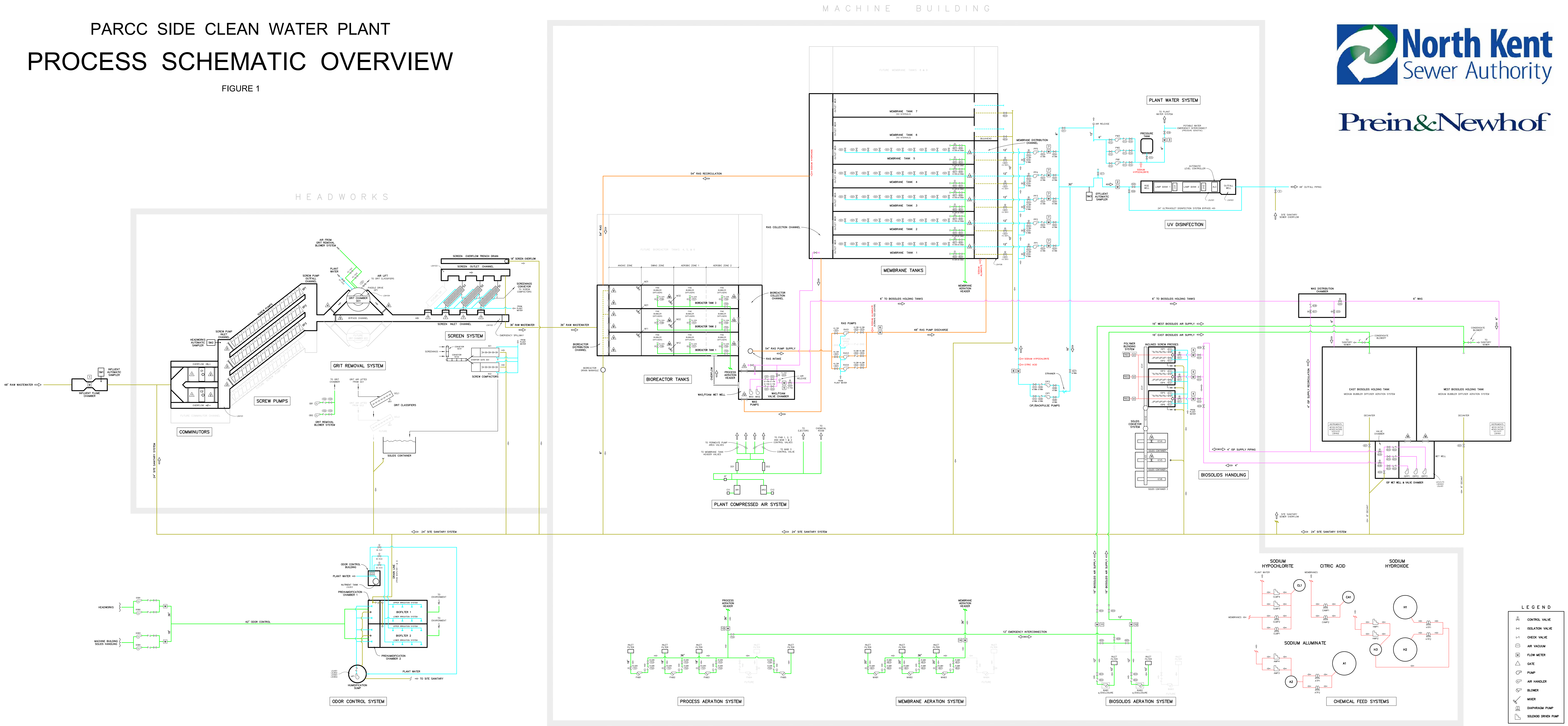
Allowable Headworks Loading Summary

Pollutant AHL Calculation Method	AHL (lb/day)	Current Loading (lb/day)
$CBOD_5$		
NPDES Permit, May - November	19,080	10,190
NPDES Permit, December - April	125,310	10,579
BOD_5		
Organic Loading (Basis of Design)	21,175	10,352
F:M Consideration	25,100	10,352
Aeration Capacity		
Summer	35,080	10,352
TSS		
Basis of Design	27,875	10,743
NPDES Permit, May - November	103,350	10,518
NPDES Permit, December - April	160,120	11,058
Phosphorus		
Basis of Design	882	207
NPDES Permit	500	207
Ammonia		
Basis of Design	7,920	802
NPDES Permit, May - November	3,730	733
NPDES Permit, December - April	NA	897

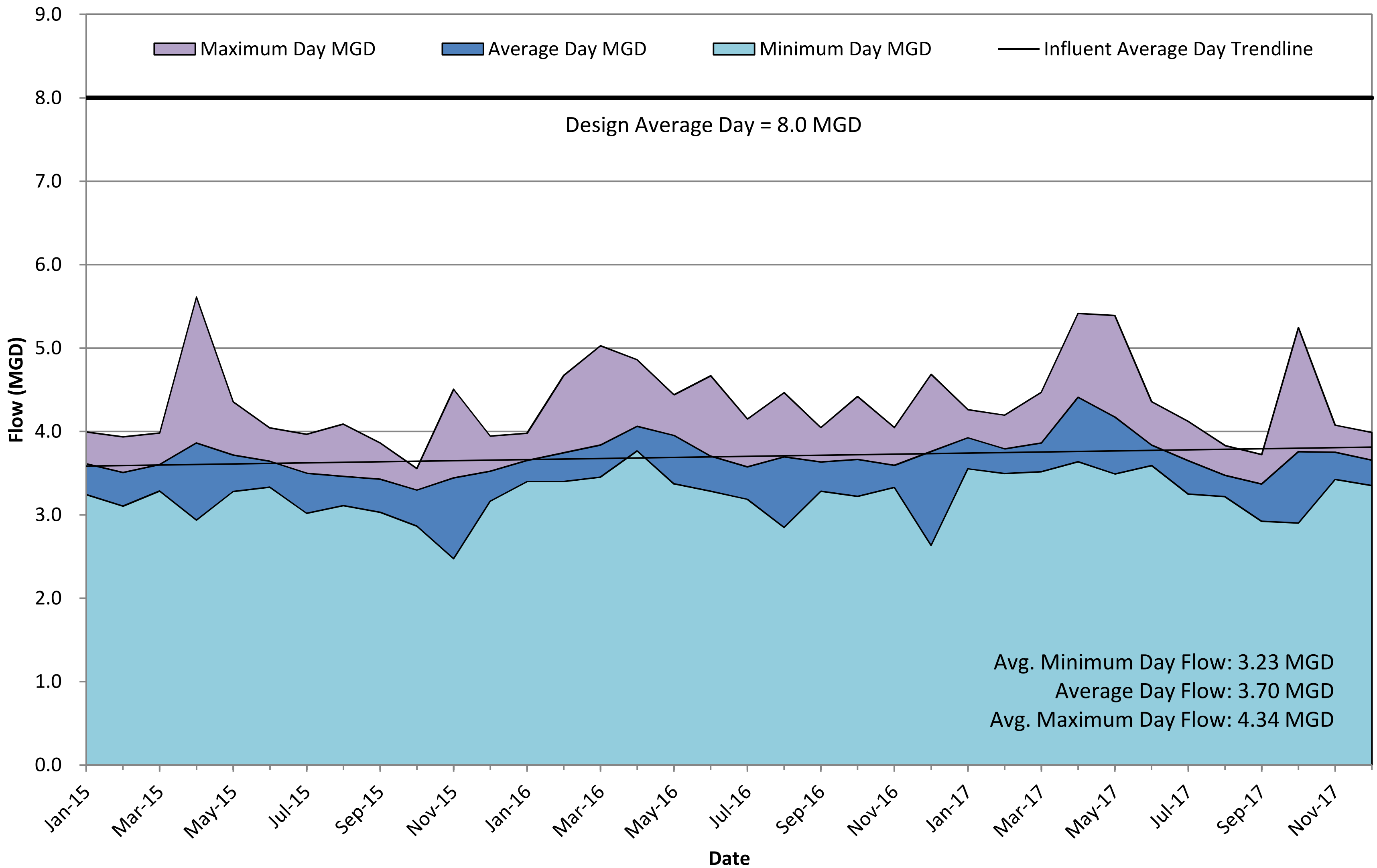
PARCC SIDE CLEAN WATER PLANT

PROCESS SCHEMATIC OVERVIEW

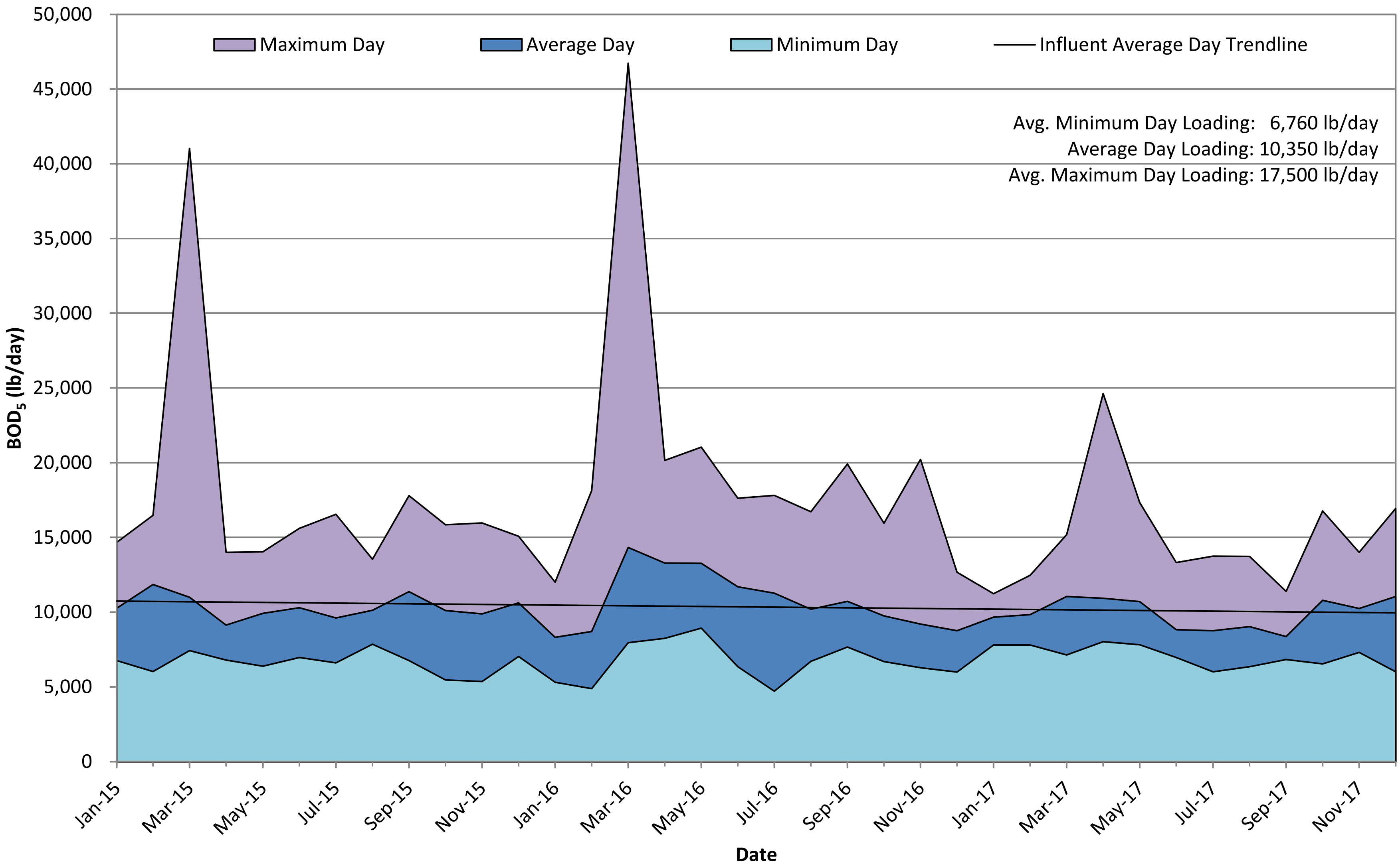
FIGURE 1



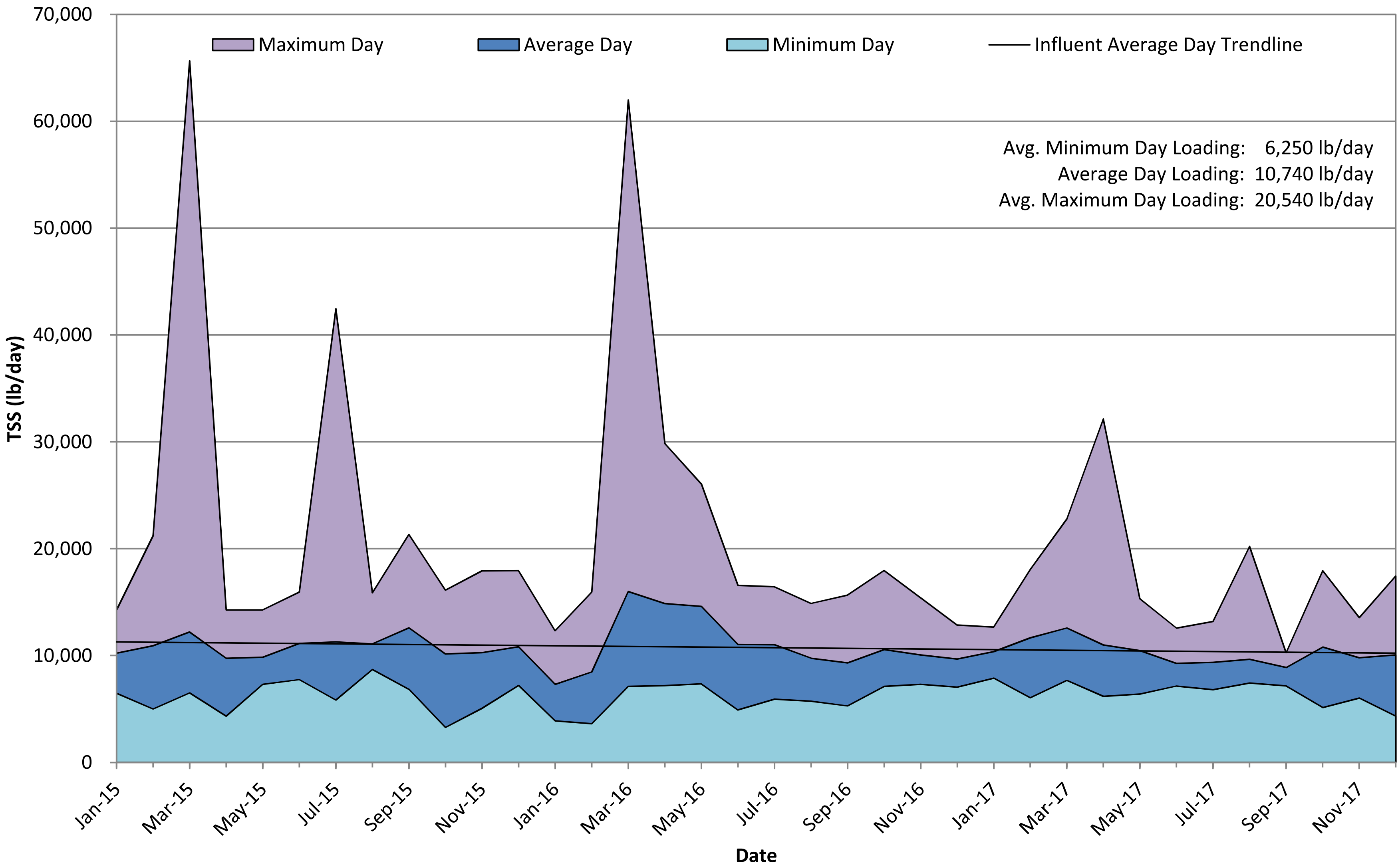
Influent Flows



Influent BOD_5 Loading



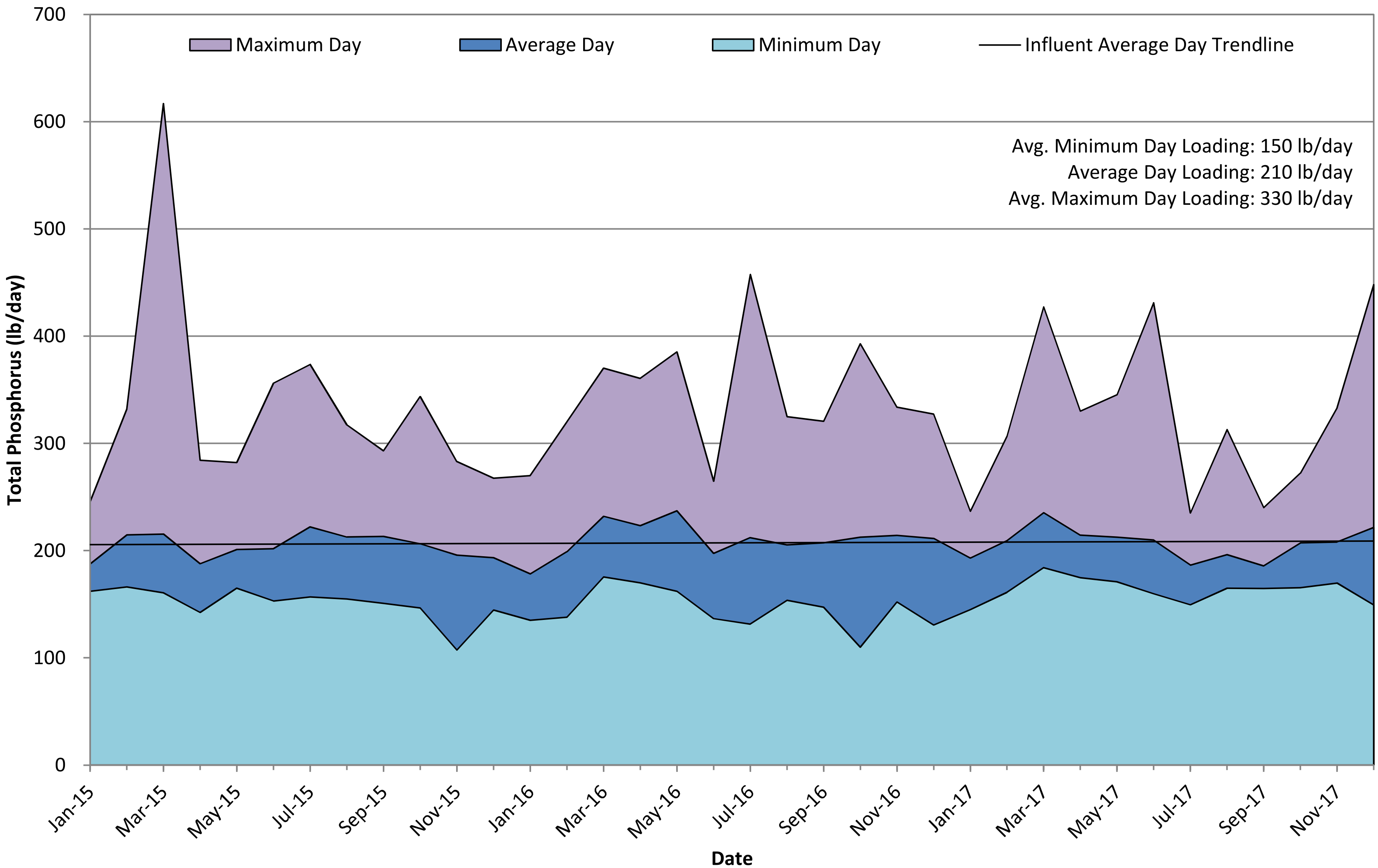
Influent TSS Loading



NORTH KENT SEWER AUTHORITY
PARCC SIDE CWP CAPACITY ANALYSIS

FIGURE 5

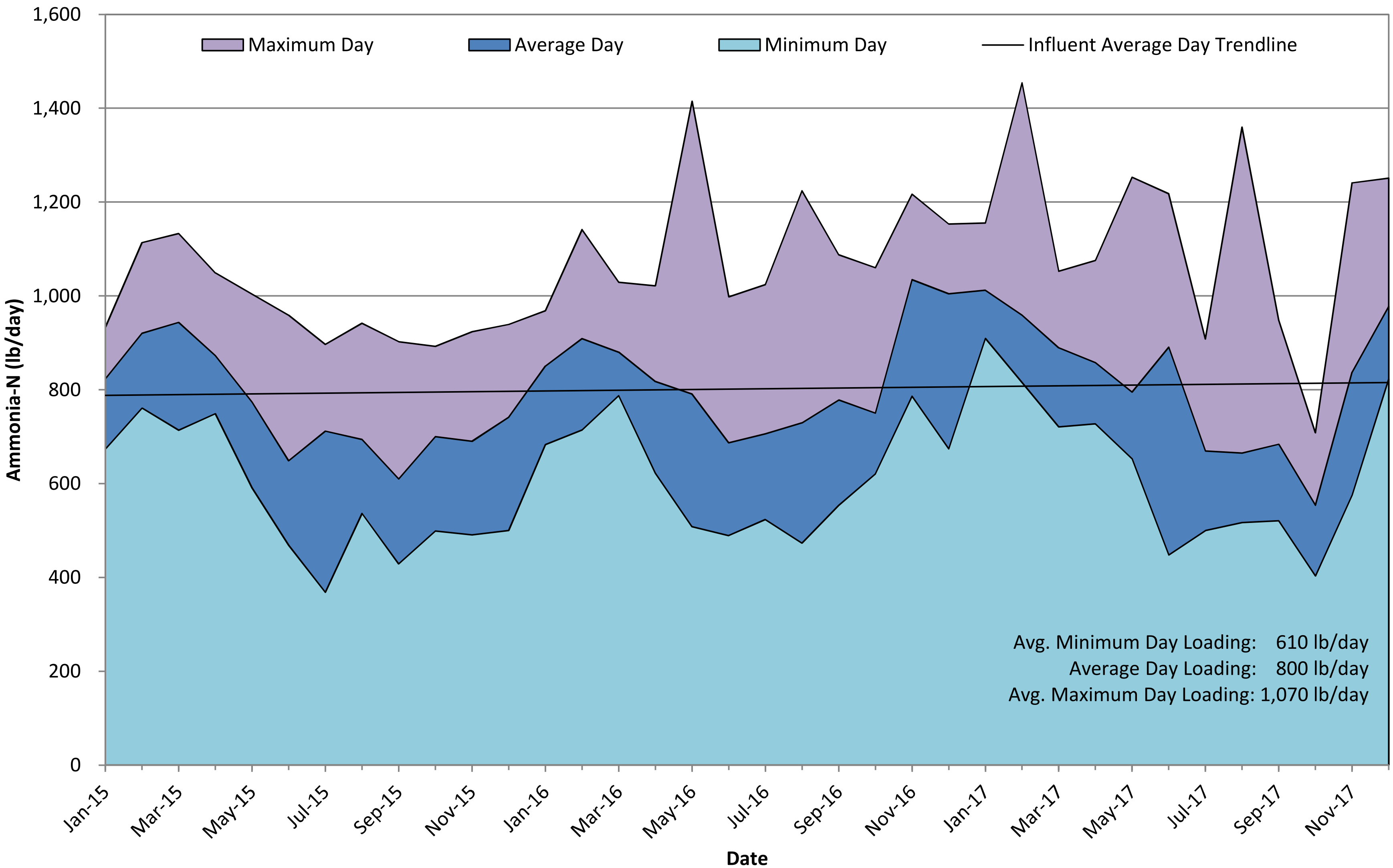
Influent Total Phosphorus Loading



NORTH KENT SEWER AUTHORITY
PARCC SIDE CWP CAPACITY ANALYSIS

FIGURE 6

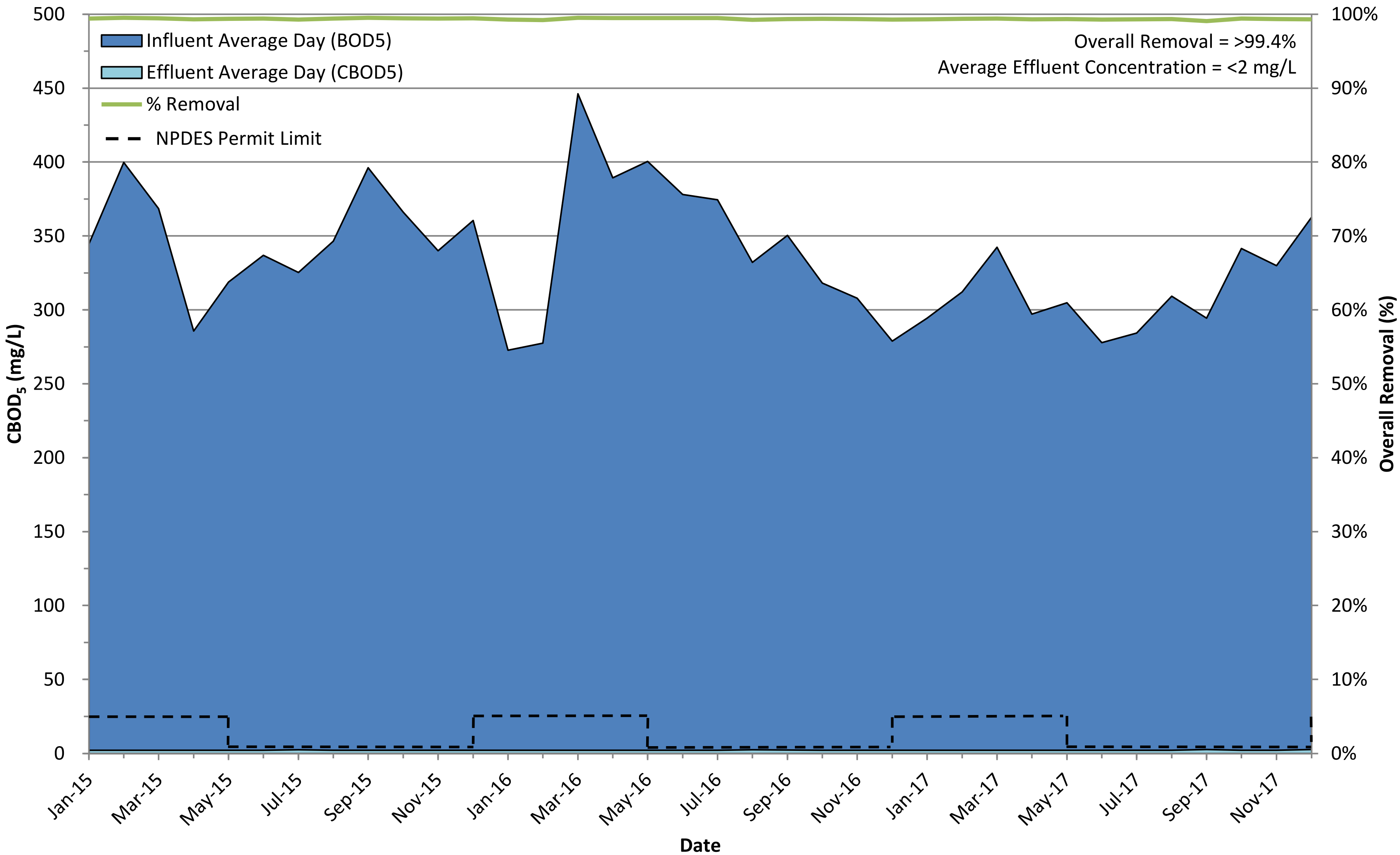
Influent Ammonia-N Loading



NORTH KENT SEWER AUTHORITY
PARCC SIDE CWP CAPACITY ANALYSIS

FIGURE 7

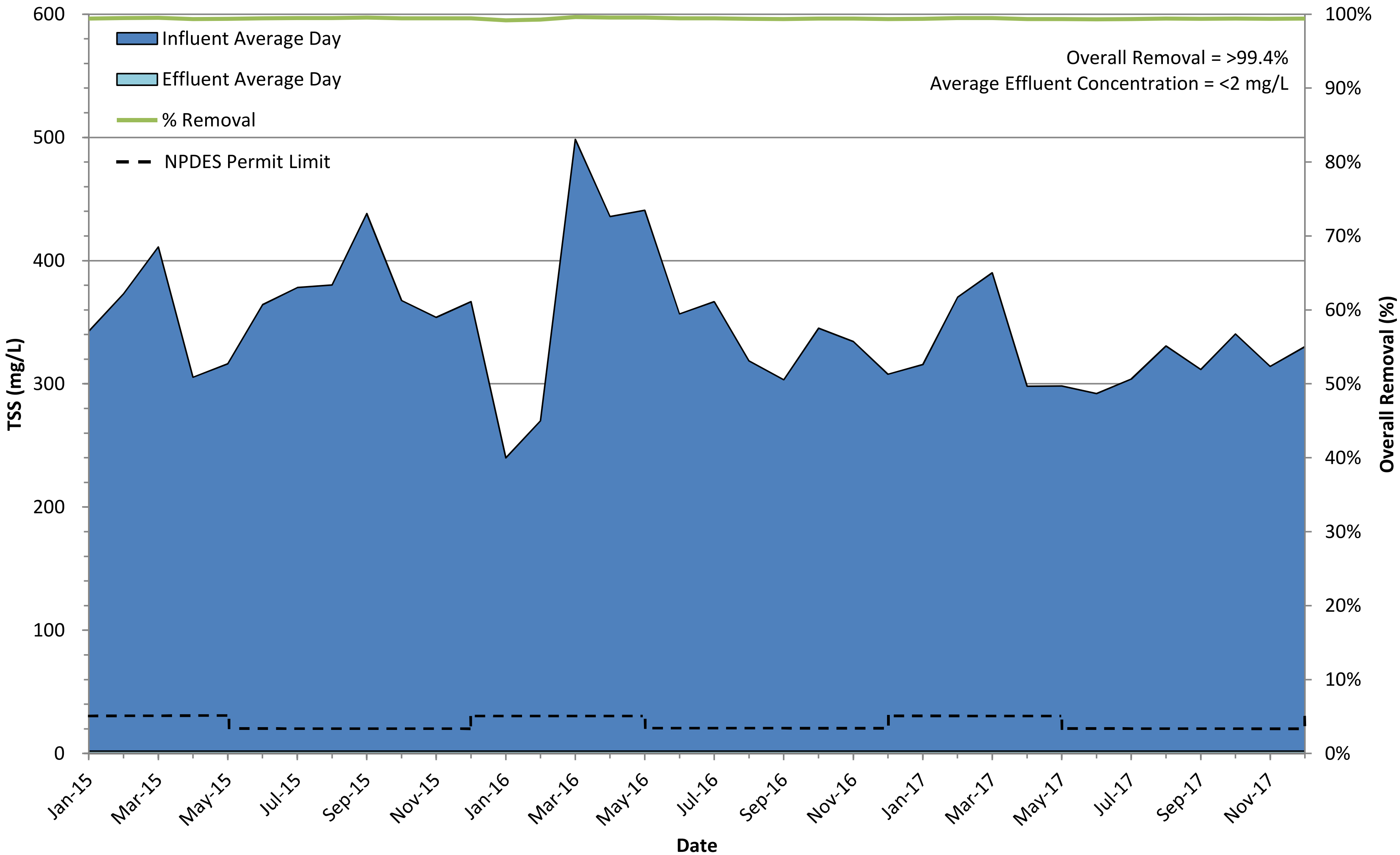
$CBOD_5$ Removal



NORTH KENT SEWER AUTHORITY
PARCC SIDE CWP CAPACITY ANALYSIS

FIGURE 8

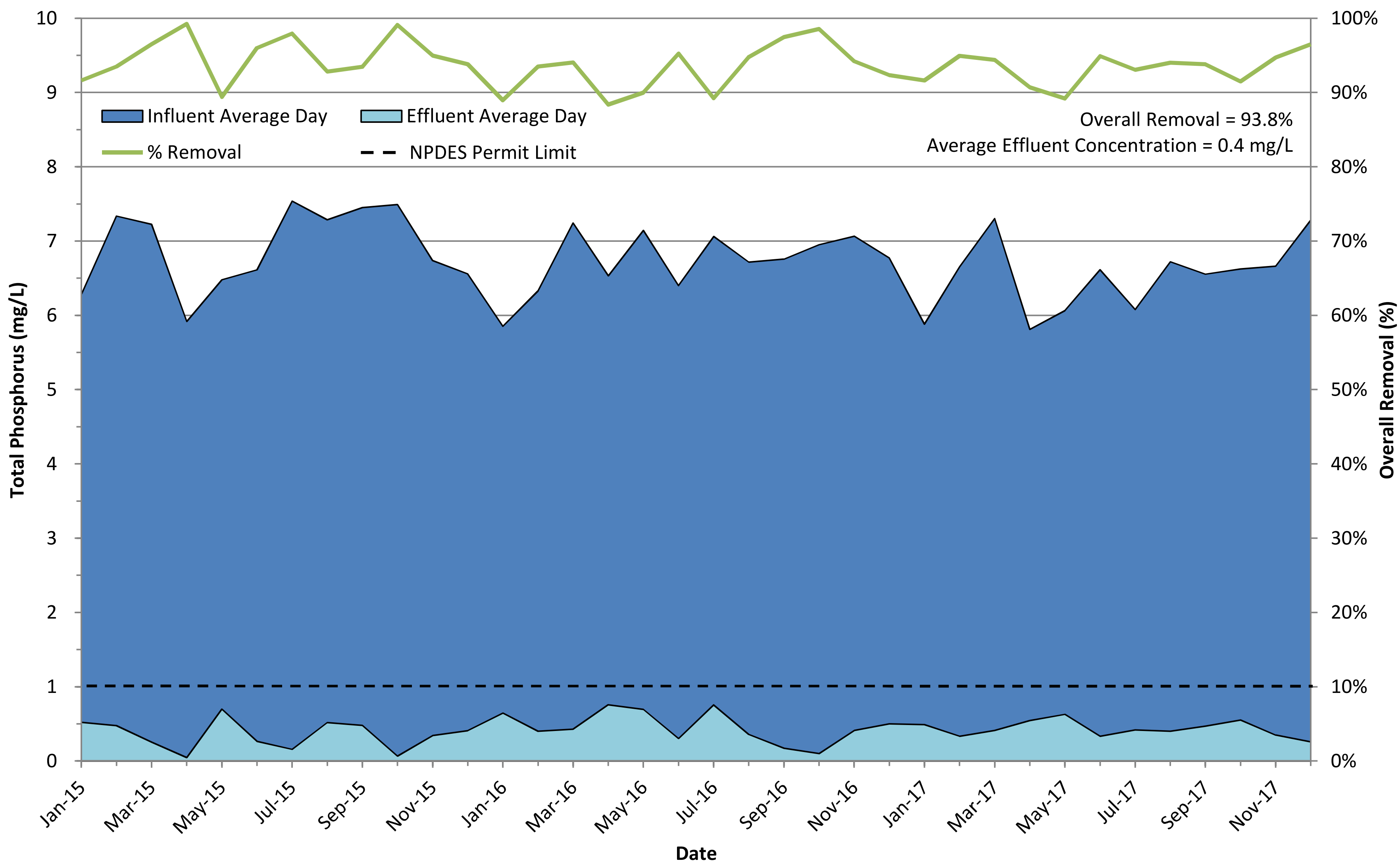
TSS Removal



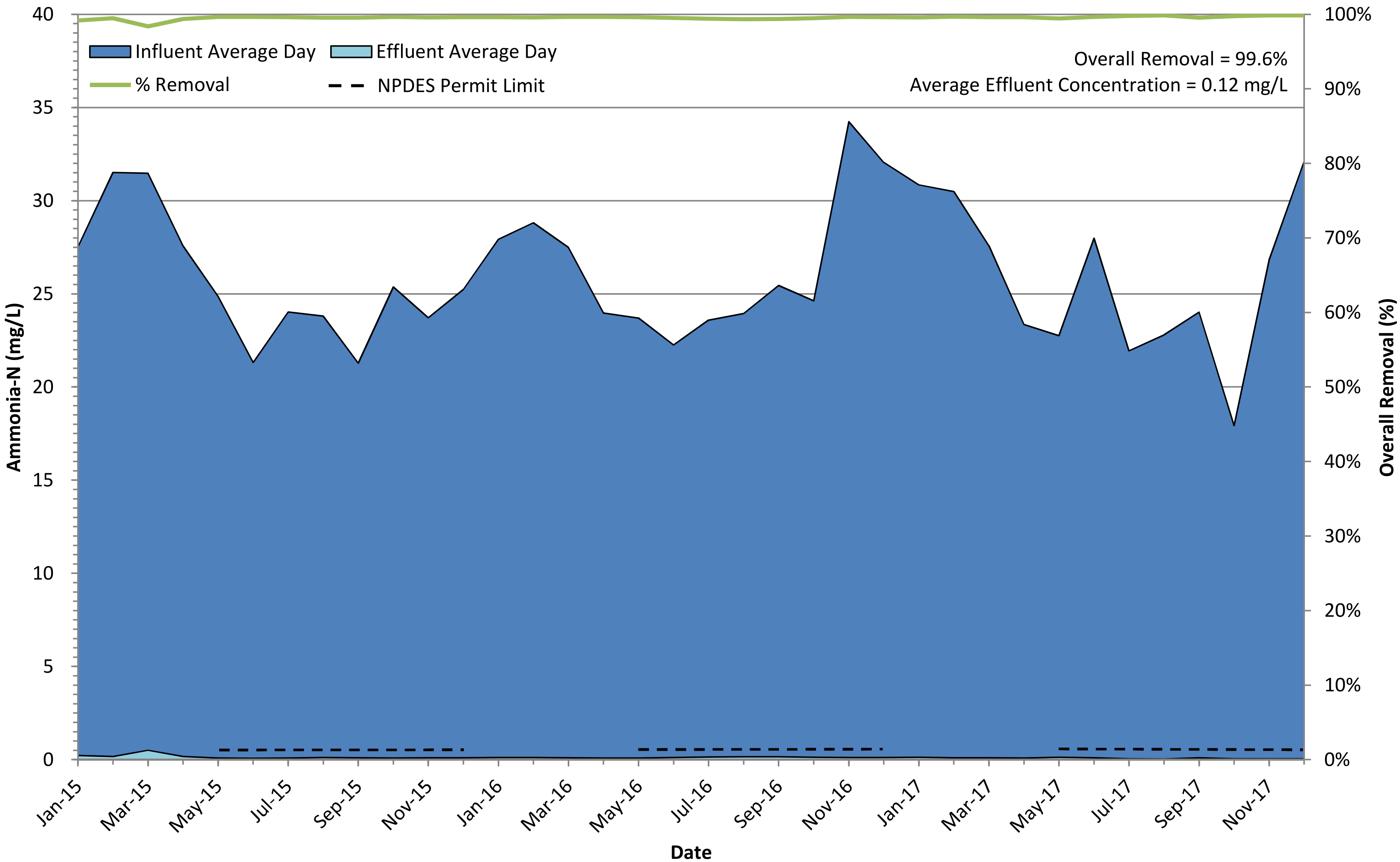
NORTH KENT SEWER AUTHORITY
PARCC SIDE CWP CAPACITY ANALYSIS

FIGURE 9

Total Phosphorus Removal



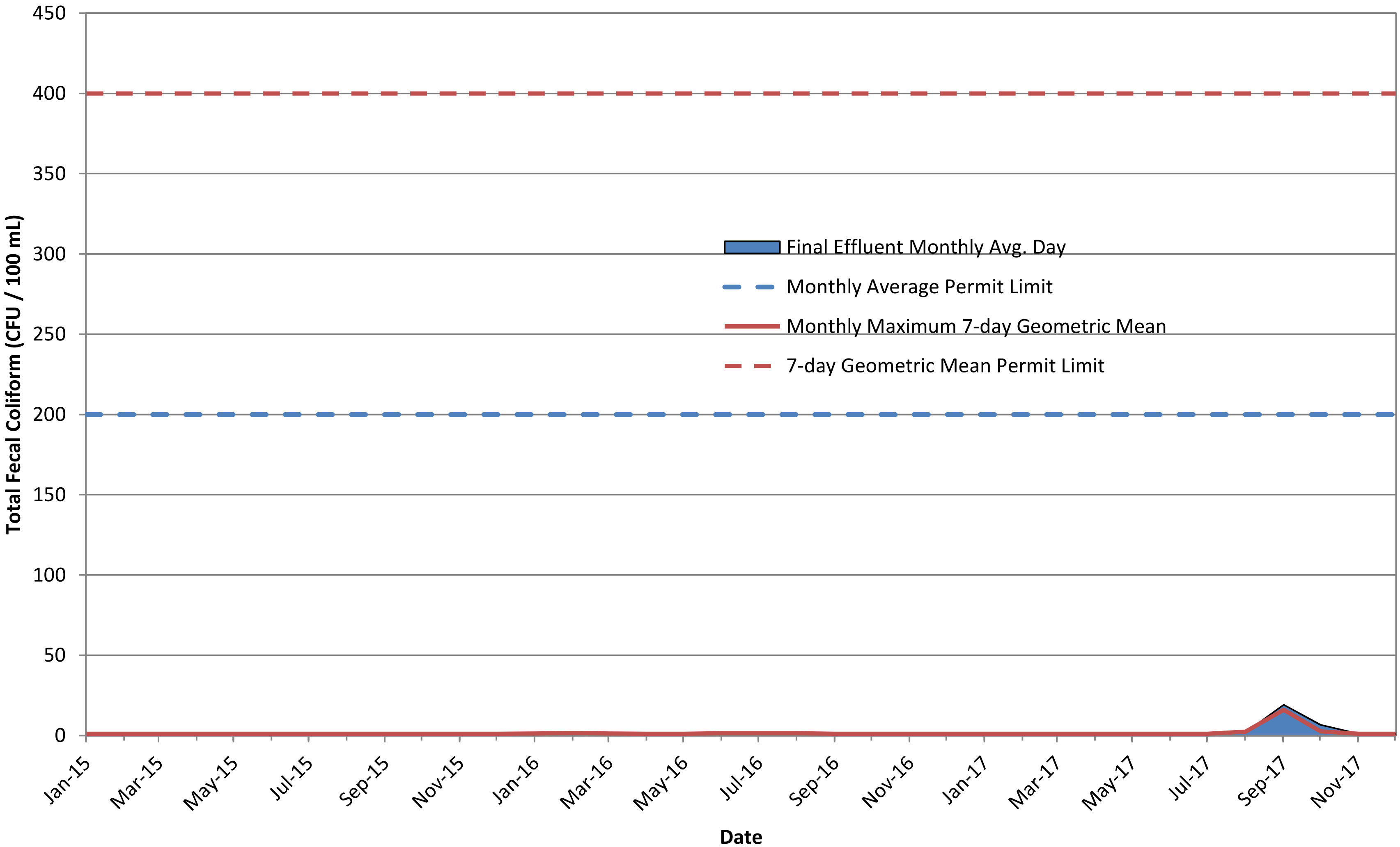
Ammonia-N Removal



NORTH KENT SEWER AUTHORITY
PARCC SIDE CWP CAPACITY ANALYSIS

FIGURE 11

Effluent Total Fecal Coliform

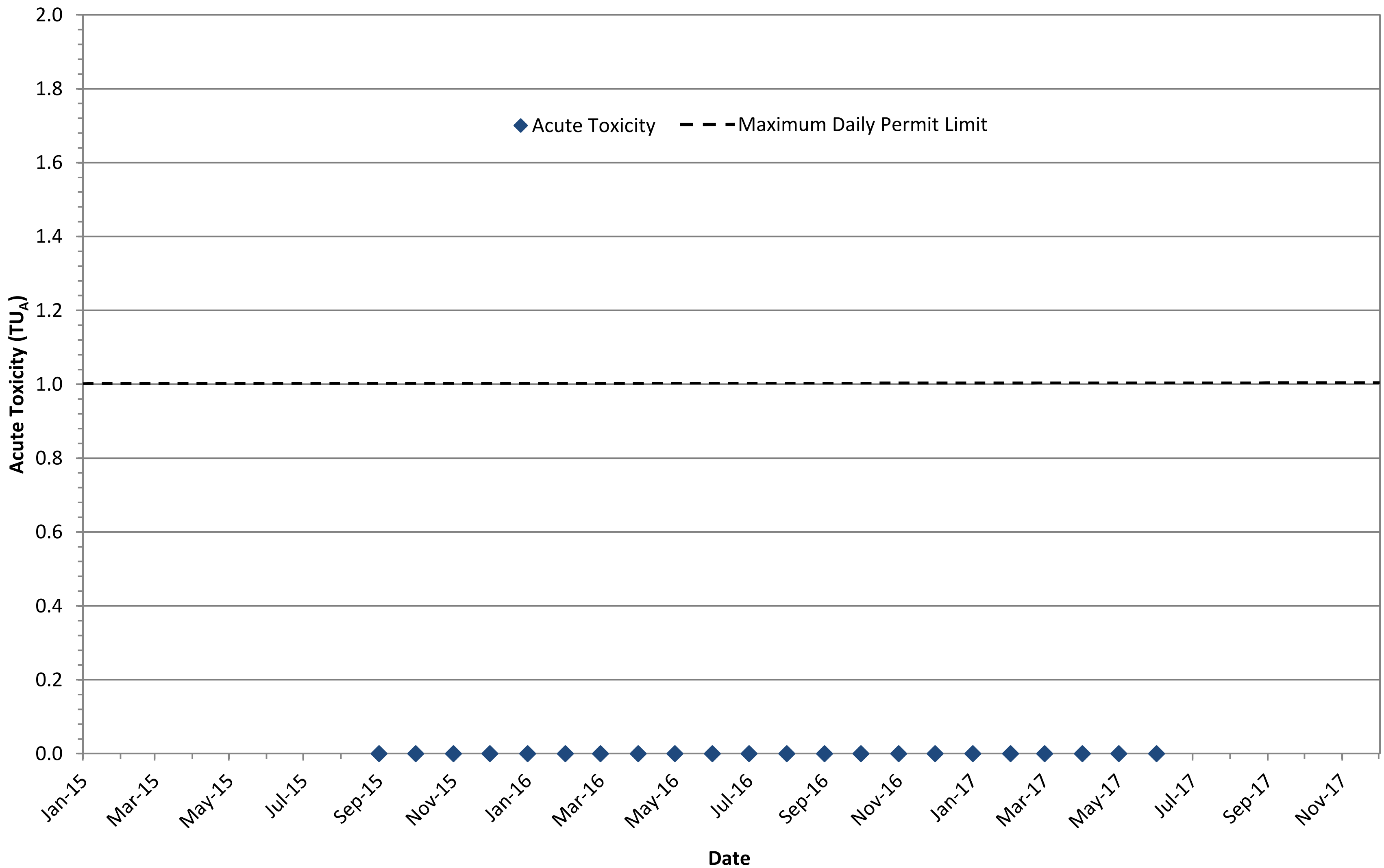


** The non-zero TFC results in the fall of 2017 were associated with the first phase of membrane module replacement. The procedures for performing this work were immediately addressed by the operators and effluent TFC has been zero ever since.*

NORTH KENT SEWER AUTHORITY
PARCC SIDE CWP CAPACITY ANALYSIS

FIGURE 12

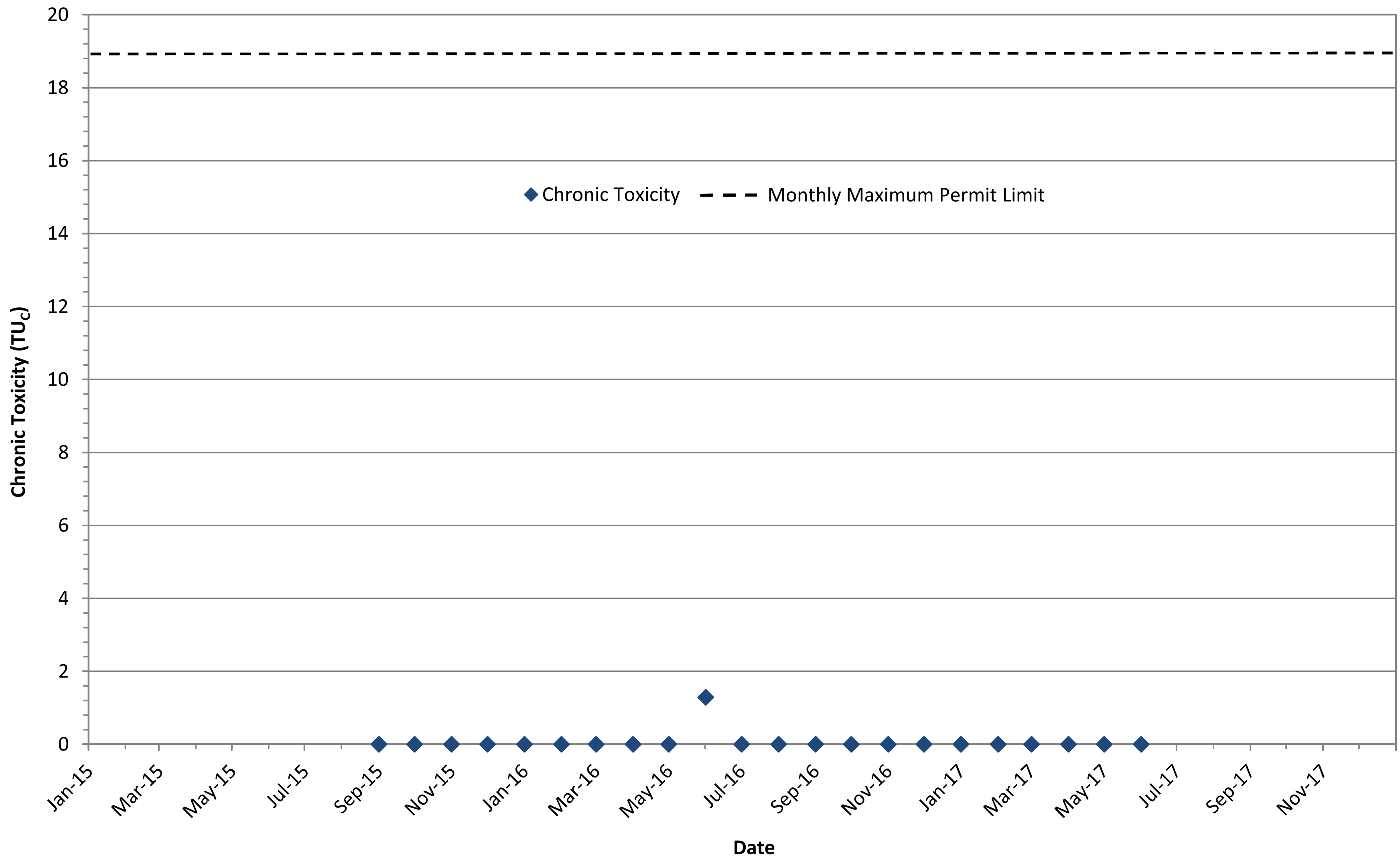
Effluent Acute Toxicity



NORTH KENT SEWER AUTHORITY
PARCC SIDE CWP CAPACITY ANALYSIS

FIGURE 13

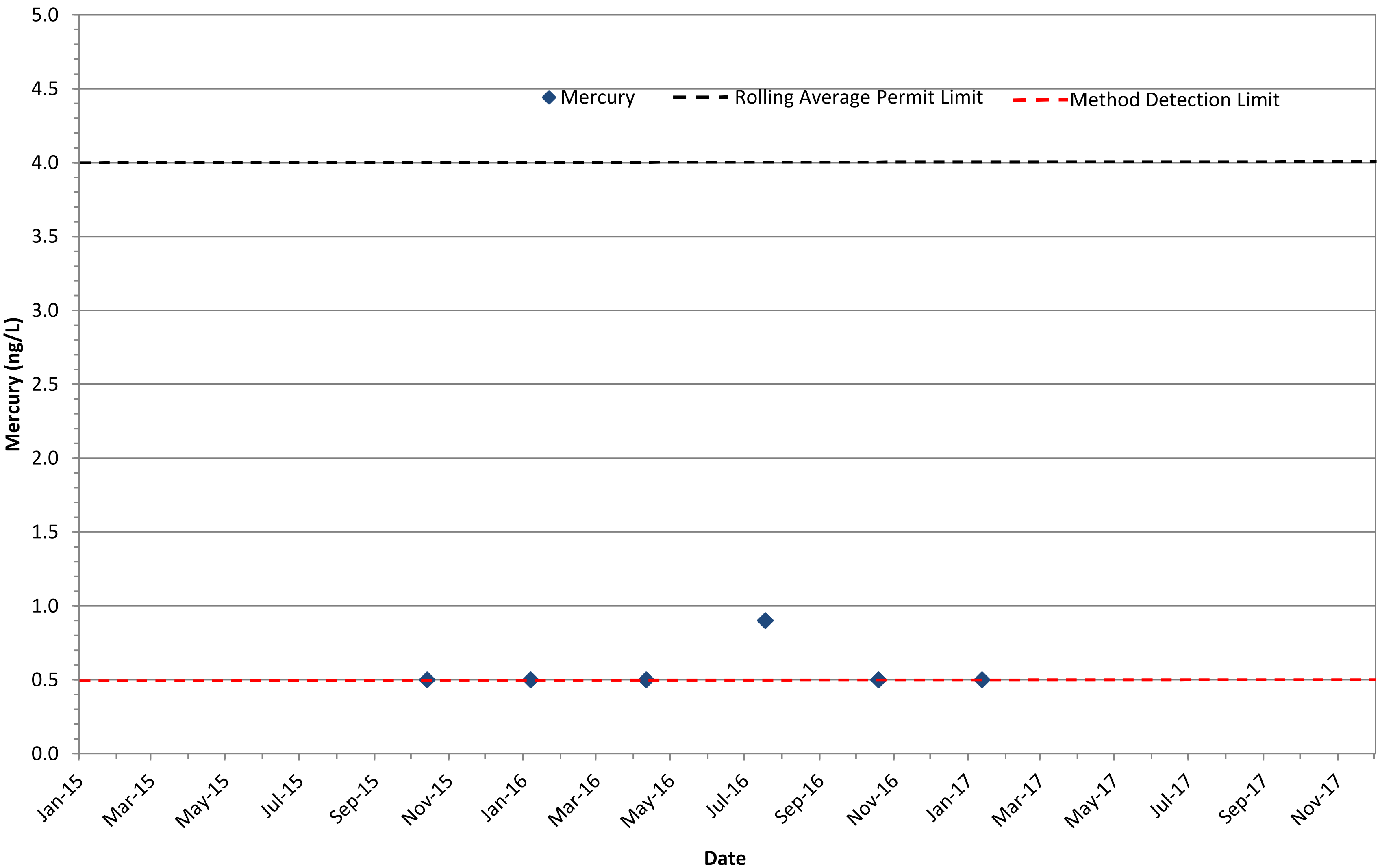
Effluent Chronic Toxicity



NORTH KENT SEWER AUTHORITY
PARCC SIDE CWP CAPACITY ANALYSIS

FIGURE 14

Effluent Mercury Concentration

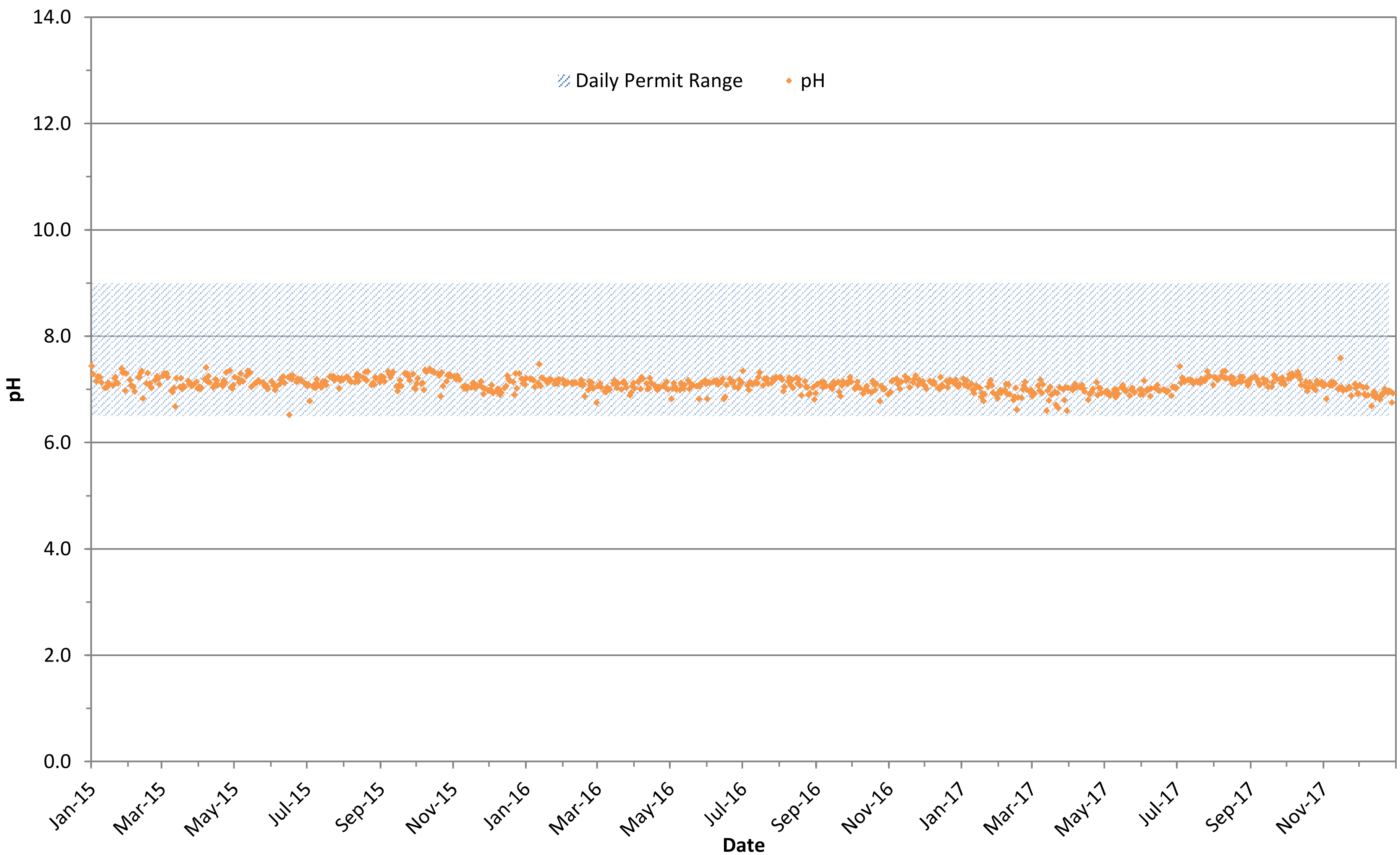


** Data shown as 0.5 ng/L on the graph above were reported as <0.5 ng/L, which is the method detection limit.*

NORTH KENT SEWER AUTHORITY
PARCC SIDE CWP CAPACITY ANALYSIS

FIGURE 15

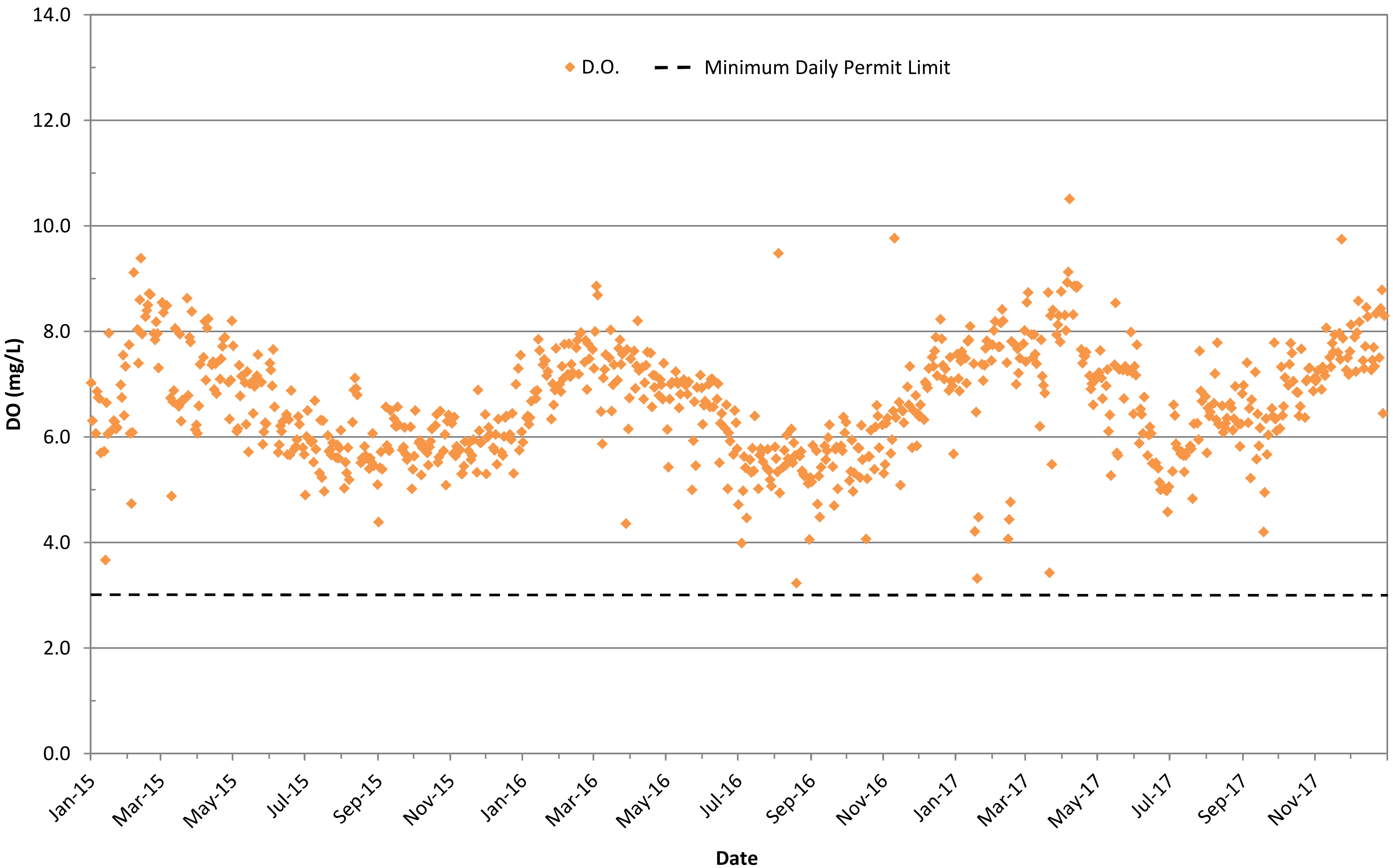
Effluent pH



NORTH KENT SEWER AUTHORITY
PARCC SIDE CWP CAPACITY ANALYSIS

FIGURE 16

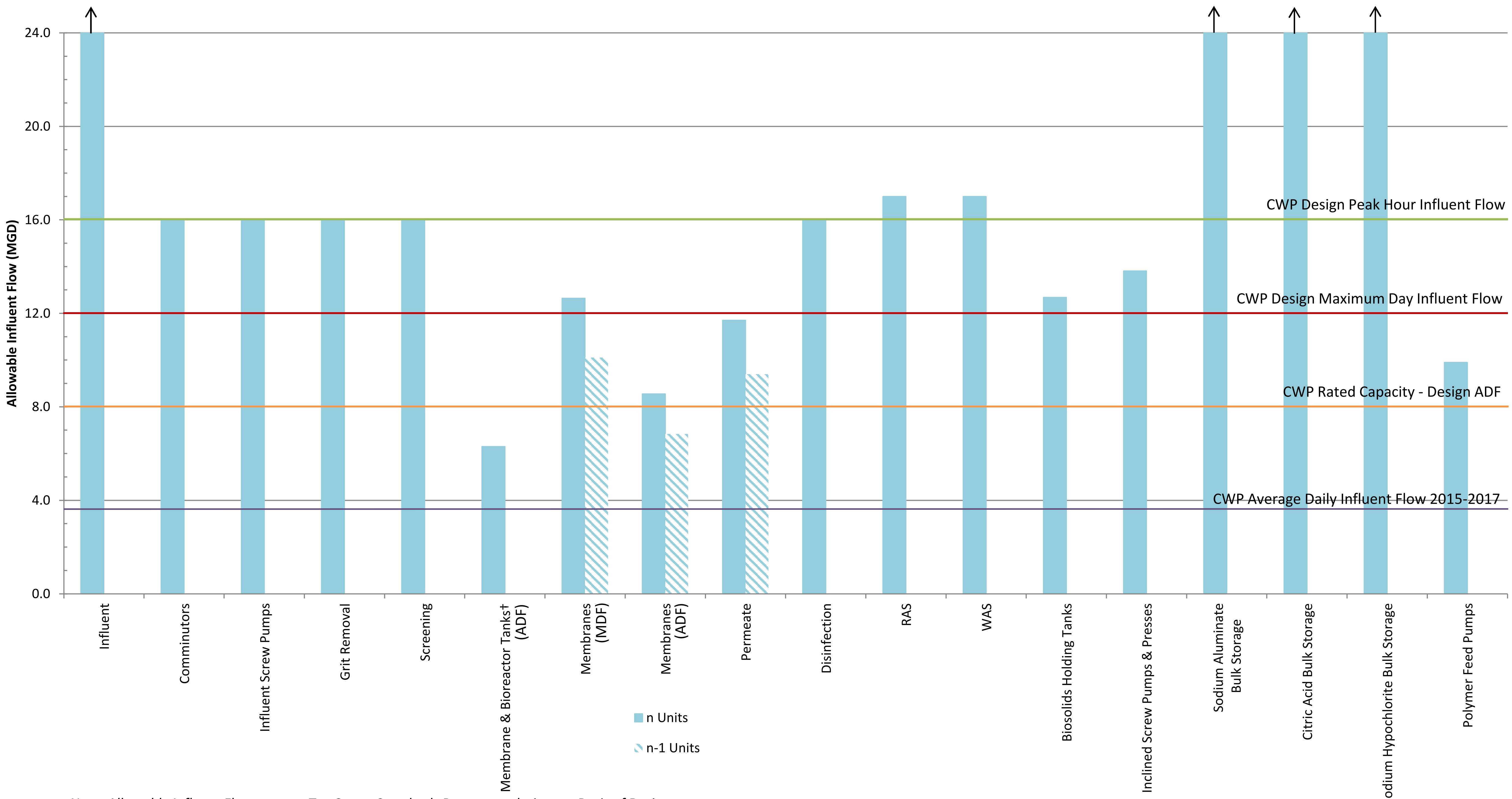
Effluent Dissolved Oxygen Concentration



NORTH KENT SEWER AUTHORITY
PARCC SIDE CWP CAPACITY ANALYSIS

FIGURE 17

Hydraulic Capacity Summary - Process Limitations

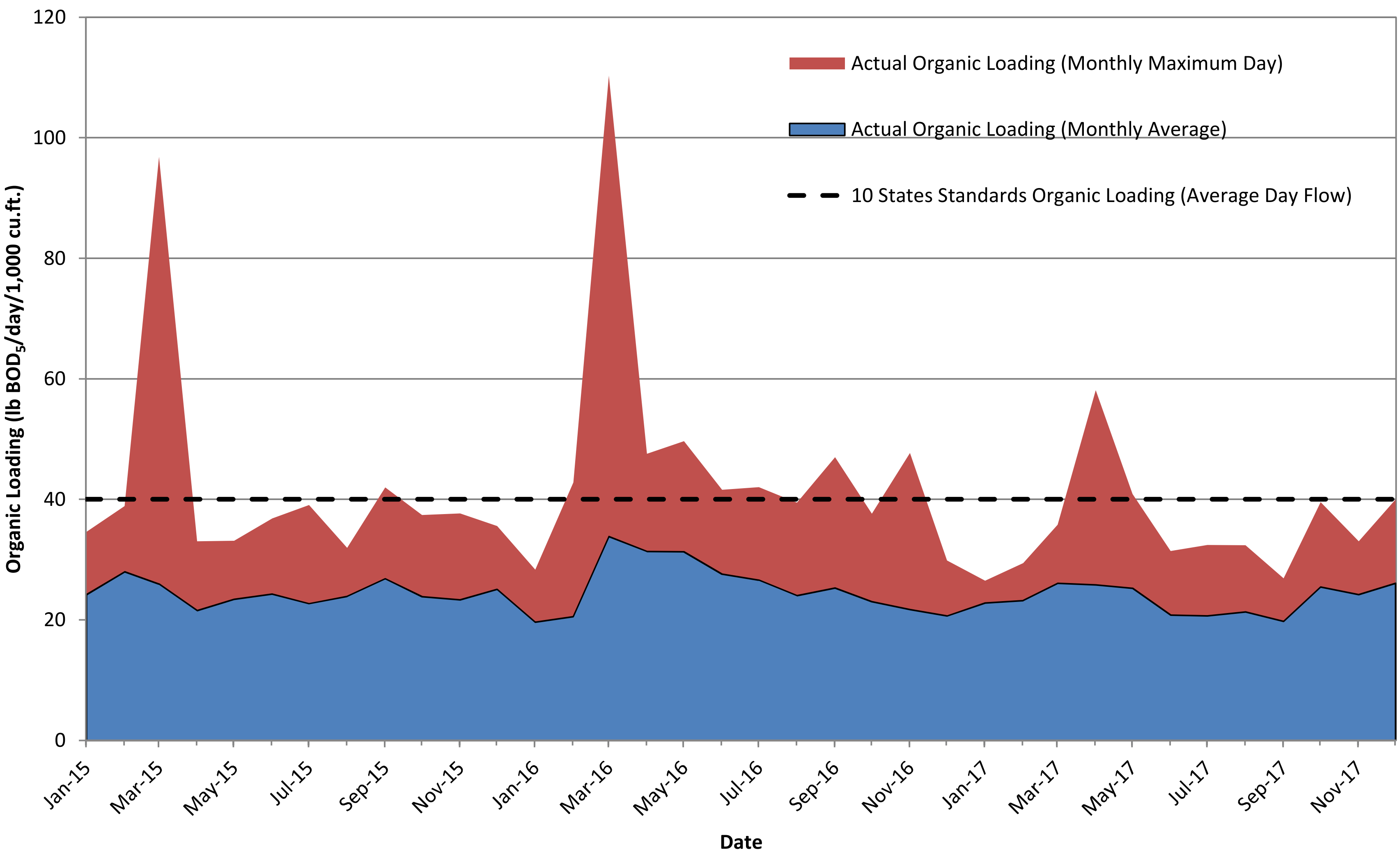


Note: Allowable Influent Flow to meet Ten States Standards Recommendations or Basis of Design parameters
†ADF to meet design HRT of 17.7 hours

NORTH KENT SEWER AUTHORITY
PARCC SIDE CWP CAPACITY ANALYSIS

FIGURE 18

Bioreactor Organic Loading



Bioreactor F:M Ratio

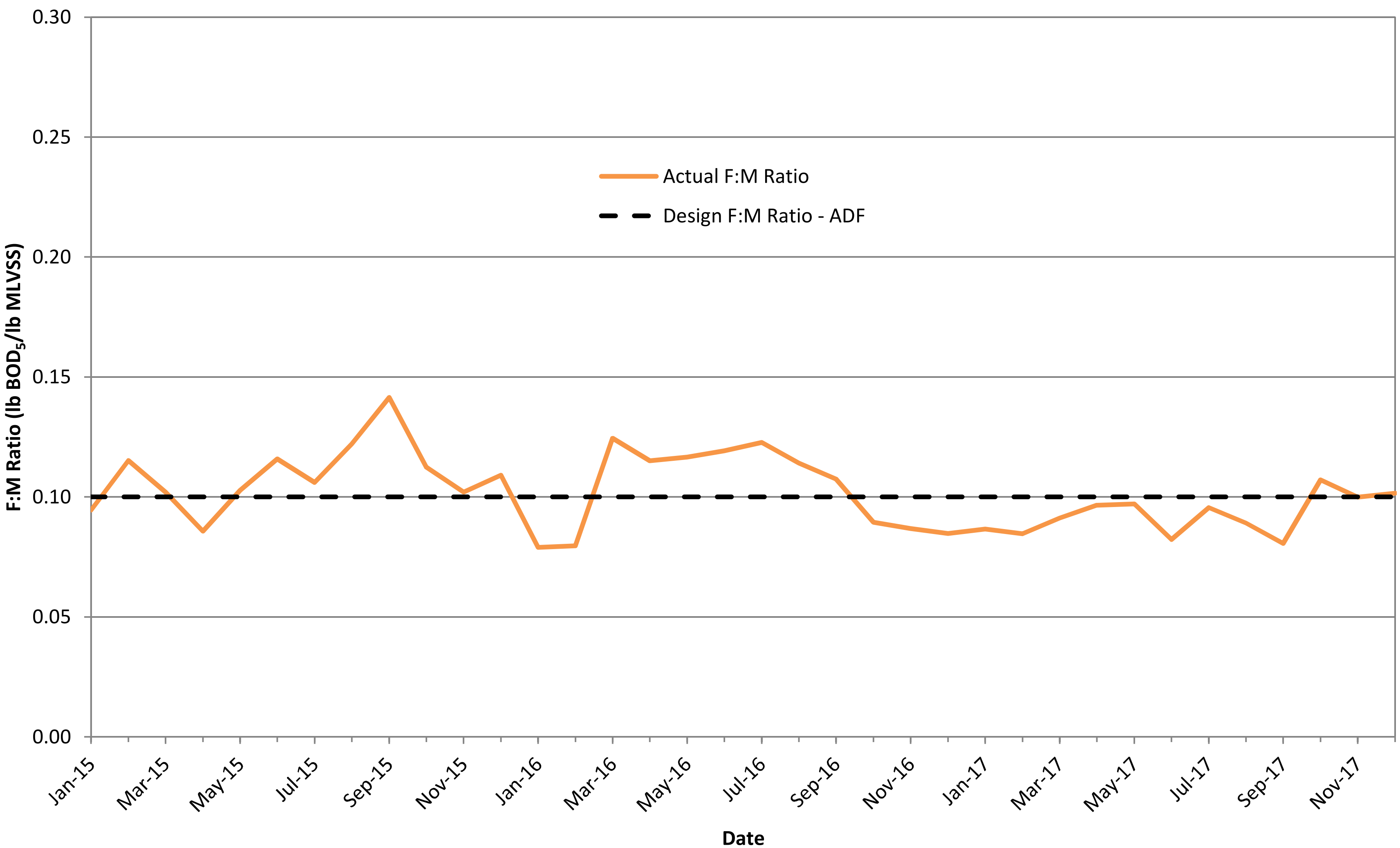
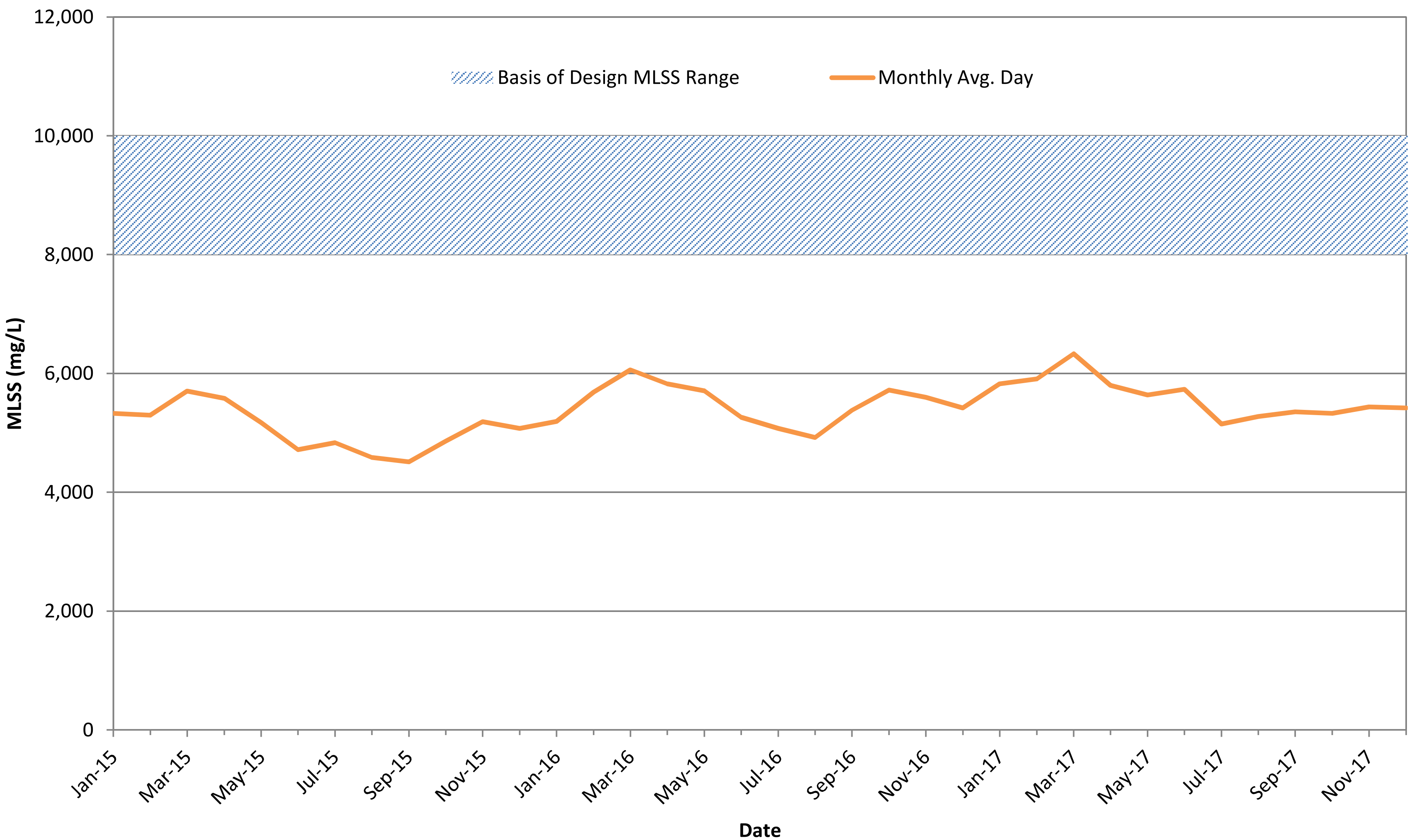
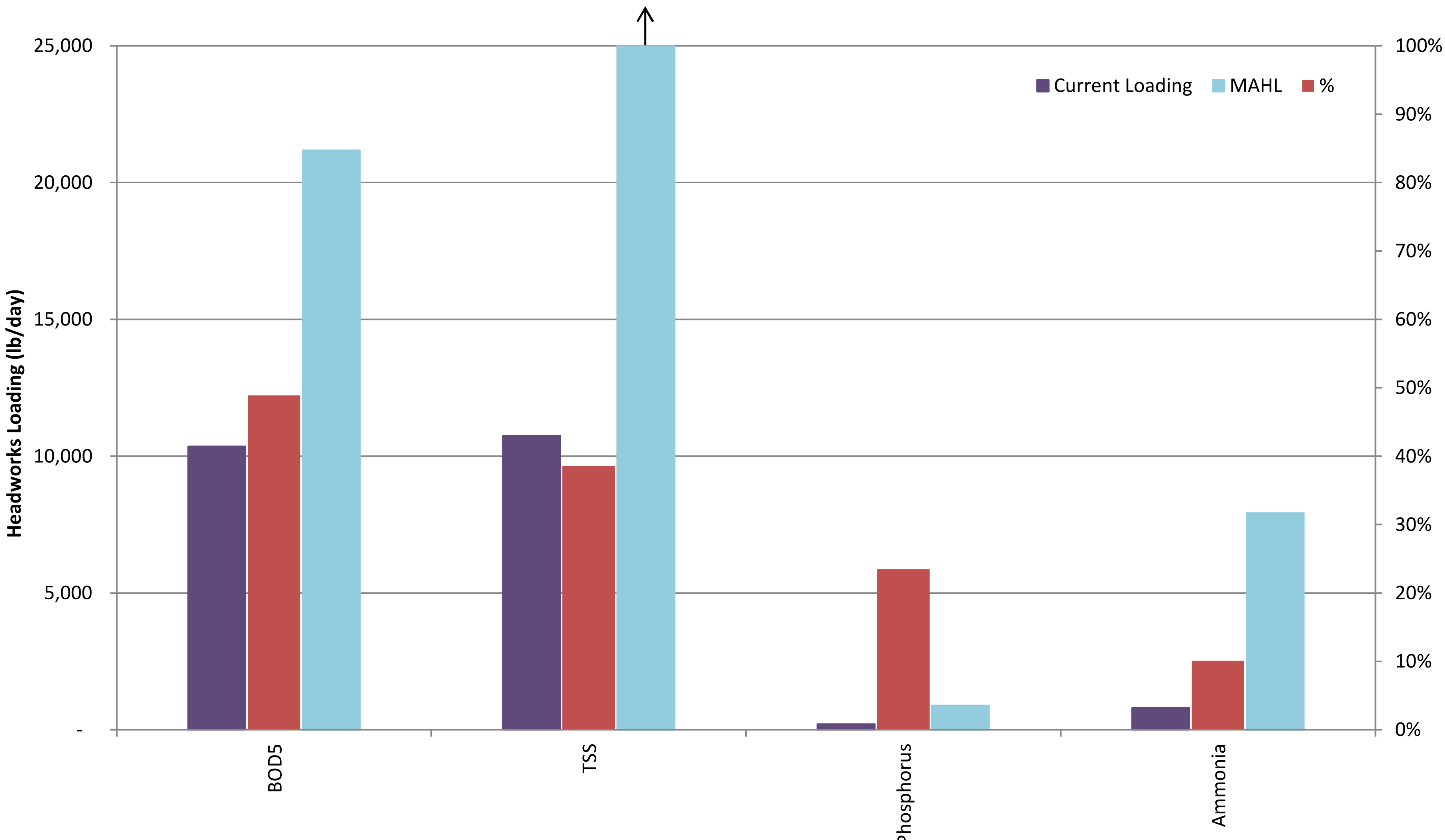


FIGURE 20

Bioreactor MLSS



MAHL Summary



Note: BOD$_5$ MAHL calculated based on all three Bioreactors in service.
During the study period, the CWP operated with two Bioreactors and five membrane trains in service.

Appendix A

Basis of Design

NORTH KENT SEWER AUTHORITY
PARCC SIDE CLEAN WATER PLANT
HEADWORKS BUILDING - CONTRACT No. 1.3
BASIS OF DESIGN

1. Wastewater Flows

The wastewater flows seen at the PARCC SIDE Clean Water Plant are as follows:

Current Average Day Flow Rate (ADF)	4.3 MGD
Current Peak Flow Rate	8 MGD
Phase 1/1A ADF	8 MGD
Phase 1/1A Max. Day Flow Rate (MDF)	12 MGD
Phase 1/1A Max. Hour Flow Rate (MHF)	16 MGD
Phase 1/1A Max. Instantaneous Flow Rate	16 MGD
Phase 1/1A Capacity	16 MGD
Headworks Future Capacity	24 MGD
Plant Future Peak Capacity	18 MGD (w/ EQ)

2. Comminutors

The comminutors will be the first stage of pre-treatment for the plant and will grind solids down to ¼ inch particles. The comminutor chamber will contain two comminutors and will have a firm capacity of 16 MGD. The chamber is located below grade outside the headworks building. Access to the comminutors and channels will be by hatches through the chamber cover. The comminutor motors will be located above the chamber cover.

Each comminutor will have the following characteristics:

Capacity	16 MGD
Coil Drum Screens	2
Dimensions	54" W x 44" H
Invert Elevation	610'-0"
Motor Size	5 HP, Immersible
Channel Width	4'-6"
Channel Depth	4'-9"
Rock Trap	6" x 24"
Means of Isolation	Upstream & Downstream Slide Gates

The elevations of the comminutors are set such that at 16 MGD flow the downstream screw pumps are not overloaded (see Section 3), and the upstream Parshall flume is not backed up. (The flume basis of design will be included with Contract No. 1.1

Site). The approximate water surface elevations and freeboard in the comminutor channel are as follows:

Flow	W.S. El.	Freeboard
Phase 1/1A ADF - 8 MGD	612'-4"	2'-8"
Phase 1/1A MHF - 16 MGD	613'-0"	2'-0"

The comminutors will be turned on and off manually. During normal operation one comminutor will be running continuously. Each comminutor will have an emergency stop button located adjacent to the motor.

There are two spillways that connect to overflow channels along side the comminutor channels in case of emergency. The comminutor and overflow channels connect to a common 4' wide channel downstream. Each spillway has the following characteristics:

Spillway Elevation	613'-0"
Spillway Width	5'-10"
Max. Flow before Topping Comminutors	6.34 MGD
Overflow Channel Width	3'-9"
Overflow Channel Depth	Varies

A third comminutor could be added in the future to provide a firm capacity of 32 MGD. The additional comminutor will require the construction of a separate channel and a means of upstream flow separation. The comminutor channel would be connected to the common discharge channel. The design has accounted for this future activity.

3. Screw Pumps

The common comminutor discharge channel is the inlet channel for the screw pumps. The screw pumps will pump the wastewater up to a point at which it can flow through the bioreactor tanks. There will be three screw pumps installed initially for a firm capacity of 16 MGD. Each screw pump will have the following characteristics:

Capacity	8 MGD
Lift Height	27'
Screw Diameter	60"
Torque Tube Diameter	36"
Number of Flights	2
Angle of Inclination	38 Degrees
Fill Depth	40"
Discharge	11"
Motor Size	60 HP
Lower Bearing Lubrication	Lube Pump
Upper Bearing Lubrication	Manual

Means of Isolation	Upstream Slide Gate

Each screw pump will be covered with Fiberglass Reinforced Plastic panels. Each screw pump trough will be capable of individual isolation. Access to the lower bearing will be by a hatch through the cover. The upper bearing pedestal will be located on the screw pump platform outside the headworks building.

All the screw pumps will discharge into a common 4' wide channel prior to entering the headworks building. The channel bottom will have a 1% slope toward the downstream grit chamber. The approximate channel water surface elevations and corresponding freeboard available will be as follows:

Flow	W.S. El.	Freeboard
Phase 1/1A ADF - 8 MGD	634'-3"	5'-5"
Phase 1/1A MHF - 16 MGD	635'-7"	4'-1"
Future MHF - 24 MGD	636'-0"	3'-8"

Normal operation will require one or two screw pumps to run continuously. A float will be placed in the screw pump inlet channel to send an alarm to the main control panel in the event that the third pump is required.

To provide a firm capacity of 24 MGD a fourth screw pump could be added in the future. The screw pump would be connected to the same inlet channel as the other three pumps.

4. Grit Chamber & Grit Classifier

The screw pump outlet channel enters the headworks building where the grit chamber is located. The grit chamber has the following characteristics:

Capacity	16 MGD
Operating Level	638'-0"
Grit Chamber Diameter	14'-0"
Collection Well Diameter	5'-0"
Number of Paddles	2
Paddle Drive Size	0.75 HP, XP
Torque Tube Diameter	10"
Water Scour Pipe Diameter	2"
Water Scour Delivery Rate	75 GPM
Water Scour Pressure	50-60 psi
Means of Isolation	Slide Gates

The grit chamber is designed to remove grit at the following efficiencies:

a) removal of 95% of grit greater than 50 mesh in size;
b) removal of 85% of grit greater than 70 mesh in size;
c) removal of 65% of grit greater than 100 mesh in size;

The grit chamber channels will have the following characteristics:

	Width	Slope
Inlet Channel	3'-0"	1.0%
Bypass Channel	4'-0"	1.0%
Outlet Channel	6'-0"	1.0%

The inlet and outlet channels of the grit chamber, as well as the grit chamber will have the following approximate water surface elevations and respective freeboard:

Flow	W.S. El.	Freeboard
Phase 1/1A ADF - 8 MGD	634'-3"	3'-9"
Phase 1/1A MHF - 16 MGD	635'-5"	2'-7"
Future MHF - 24 MGD	636'-0"	2'-0"

Accumulated grit will be removed from the grit collection well using an air lift system. The air lift system will have the following characteristics:

Air Lift Capacity	70 GPM
Air Lift Pipe Diameter	4"
Air Scour Pipe Diameter	1 ½"
Blower Size	7.5 HP; 1,800 RPM
Number of Blowers	2
Number of Air Separators	2

The air lift system will deliver the grit to a grit classifier with the following characteristics:

Grit Capacity	120 CFH
Water Capacity	240 GPM
Motor	2 HP, XP
Inlet Diameter	4"
Overflow Diameter	6"
Screw Diameter	14"
Drain Line Diameters	½", 2"
Discharge Size	14" x 16"

The classifier will discharge the solids into a dumpster located in a separate room.

A second grit chamber could be constructed in the future to provide additional capacity. The second chamber would use the same bypass channel as the first. An additional grit classifier would be required with the future grit chamber. The design has accounted for this future activity.

5. Fine Screens & Screw Compactors

The grit chamber outlet channel will be sloped at 1% until it reaches the screen inlet channel at which point it will be flat. Three drum screens will be installed initially for a firm capacity of 16 MGD. The screen inlet channel will feed the piped inlet of the screens. The screens will discharge into a channel below the operating platform. Each screen will have the following characteristics:

Capacity	8 MGD
Opening Size	1 mm
Inlet Diameter	24"
Operating Level	630'-0"
Outlet Diameter	30"
Motor	7.5 HP, XP
Means of Isolation	Slide Gate
Backwash	(2) 2" lines, 40-60 psi

The screen channels will have the following characteristics:

	Width	Elevation
Inlet Channel	4'-0"	633'-3"
Emergency Spillway	4'-0"	635'-9"
Outlet Channel	4'-0"	623'-1"

The screen inlet channel will have the following approximate water surface elevations and respective freeboard:

Flow	W.S. El.	Freeboard
Phase 1/1A ADF - 8 MGD	634'-2"	3'-10"
Phase 1/1A MHF - 16 MGD	635'-5"	2'-7"
Future MHF - 24 MGD	635'-8"	2'-6"

The screen outlet channel will have the following approximate water surface elevations and respective freeboard:

Flow	W.S. El.	Freeboard
Phase 1/1A ADF - 8 MGD	627'-6"	2'-4"
Phase 1/1A MHF - 16 MGD	628'-0"	1'-6"
Future MHF - 24 MGD	628'-6"	1'-3"

The screened solids will be discharged into a screw conveyor system appropriately sized by the screen supplier. The conveyor system connects to two screw compactors, each with the following characteristics:

Capacity	150 CFH
Inlet	12 ¾" x 25"
Outlet Diameter	12"
Screw Diameter	10"
Motor	5 HP, XP
Drain Diameter	2"
Backwash	Manual

The compacted solids are disposed of into the same dumpster as the grit classifier.

An additional drum screen can be added in the future to provide 24 MGD firm capacity. The design has accounted for this future activity.

6. Solids Disposal

The solids disposal room will be isolated from the rest of the headworks building. It will contain the dumpster for the solids discharged from the grit classifier and the screw compactors. The dumpster will be emptied approximately twice per week.

7. Odor Control & Ventilation

The headworks building will be ventilated. There will be approximately 6 complete air changes per hour. There will also be gas monitoring devices throughout the building to monitor hydrogen sulfide, oxygen, and combustibles (LEL).

8. Backup Power

The headworks building will be connected to a site-wide generator for power use in case of emergency.

9. Alarms

Appropriate alarms for the various components of the headworks building will be included in the site-wide SCADA system.

NORTH KENT SEWER AUTHORITY
PARCC SIDE CLEAN WATER PLANT
BIOREACTOR TANKS - CONTRACT No. 1.4
BASIS OF DESIGN

1. Objective

The Bioreactor Tanks are the activated sludge process tanks. Wastewater will be ground, screened, and degritted in the Headworks Building (Contract No. 1.3) prior to entering the bioreactor system. Flow from the headworks will enter the Bioreactor Distribution Channel. Flow will then be delivered and split between one of the three identical treatment trains/tanks. Each bioreactor tank will be comprised of an anoxic zone, a swing (anoxic or aerobic) zone and two aerobic zones. From the bioreactors, the flow will enter the Bioreactor Collection Channel from which it will be pumped to the membrane tanks by Return Activated Sludge (RAS) pumps in the Machine Building (Contract No. 1.5). A portion of the flow that has passed through the membrane tanks will then flow back to the RAS Collection Channel via weirs. The RAS Collection Channel will then recirculate the flow back to the Bioreactor Distribution Channel to be treated again.

A Waste Activated Sludge (WAS)/Foam wet well will remove mixed liquor from the process stream and send it to the Biosolids Holding Tanks (Contract No. 1.6). Foam and scum from the Bioreactor Collection Channel and the RAS Collection Channel will be fed into the WAS/Foam wet well and sent to the Biosolids Holding Tanks for treatment, thus removing it from the process stream.

Bioreactor tank isolation and flow control/balancing is accomplished by weir gates located on both the inlet and outlet of the treatment trains. The flow through the different zones of the treatment trains is controlled by stationary weirs.

The anoxic zones of the tanks will be mixed by anoxic mixers. The aerobic and swing zones will be aerated by a Fine Bubble Aeration System. Air supply to the aeration system will be provided by Process Aeration Blowers (PABs) located in the Machine Building.

The tank bottoms will have flap gates located in the intermediate walls between zones to facilitate draining the tanks. Slide gates at the end of the tanks will release the water into a pipe connected to the site sanitary sewer system.

2. Wastewater Flows

The wastewater flows seen at the PARCC SIDE Clean Water Plant are as follows:

Current Average Day Flow Rate (ADF)	4.3 MGD
Current Peak Flow Rate	8 MGD
Phase 1/1A ADF	8 MGD
Phase 1/1A Max. Day Flow Rate (MDF)	12 MGD
Phase 1/1A Max. Hour Flow Rate (MHF)	16 MGD
Phase 1/1A Max. Instantaneous Flow Rate	16 MGD
Phase 1/1A Capacity	16 MGD
Plant Future Peak Capacity	18 MGD (w/ EQ)

3. Biological Design

The biological design for the bioreactors is presented in the attached Zenon Biological Basis of Design.

4. Bioreactor Distribution Channel

The Bioreactor Distribution Channel has the following characteristics:

Width	6'-0"
Slope	Flat
Water Depth	7'-6"
Top of Channel Elevation	630'-0"
Freeboard	2'-6"

5. Bioreactor Tanks

The Bioreactor Tanks will have the following characteristics:

Number of Tanks	3
Overall Dimension	122'-0" x 287'-0"
Individual Tank Dimension	38'-0" x 287'-0"
Outer Wall Elevation	630'-0"
Anoxic Zone	38'-0" x 70'-0"
Water Depth	19'-0"
Freeboard	3'-0"
Operating Volume	0.378 MG
Swing Zone	38'-0" x 70'-0"
Water Depth	19'-0"
Freeboard	3'-0"
Operating Volume	0.378 MG

Aerobic Zone 1	38'-0" x 70'-0"
Water Depth	18'-0"
Freeboard	4'-0"
Operating Volume	0.358 MG

Aerobic Zone 2	38'-0" x 70'-0"
Water Depth	18'-0"
Freeboard	4'-0"
Operating Volume	0.358 MG

Tank Bottom "Sloped" Elevation	608'-0" to 607'-6"

6. Anoxic Mixers

The mixers will have the following characteristics:

Mixers per Anoxic Zone	1
Motor Size	12 HP
Mixer Speed	570 RPM

Each mixer will be equipped with a flow ring.

7. Fine Bubble Aeration System

The air supply requirements for the aerobic tanks are summarized in the Zenon Basis of Design. The Fine Bubble Aeration System has the following characteristics:

Maximum Air Requirement	12,940 SCFM
Submergence	17'-0"
Header Pipe Diameter	18"
Drop Pipe Diameter	10"
Lateral Pipe Diameter	6"
Aerobic Zone Diffuser Centerline	609'-0"
Swing Zone Diffuser Centerline	610'-0"

Number of Laterals per Aerated Zone	3
Diffuser Assemblies per Lateral	58
Diffuser Assemblies per Aerated Zone	174
Diffuser Tubes per Assembly	2
Diffuser Tubes per Aerated Zone	348
Diffuser Assembly Length	114.4"

Normal Airflow Range per Diffuser Assembly	6-40 SCFM
Peak Airflow Capacity per Diffuser Assembly	68 SCFM

Air supply to the aeration system will be provided by 3 Process Aeration Blowers (PABs), 2 duty + 1 standby, located in the Machine Building.

Dissolved oxygen probes will be located in the Swing and Aerobic zones to monitor and adjust the PAB operation.

8. Bioreactor Collection Channel

The Bioreactor Collection Channel has the following characteristics:

Width	6'-0"
Slope	Flat
Water Depth	6'-0" +/-
Top of Channel Elevation	630'-0"
Freeboard	4'-6"
RAS Pump Feed Pipe Diameter	54"

9. WAS/Foam Valve Chamber

The WAS/Foam Valve Chamber contains the appropriate isolation and check valves, air release valve, and mag meter for the pumping system. The chamber also contains an actuated valve which will allow the pumps to feed foam reduction/recombining spray nozzles located in front of the slide gates and in the wet well.

10. WAS/Foam Wet Well and Pumps

There are two submersible pumps located in the WAS/Foam Wet Well. The pumps will pump the mixed liquor to the Biosolids Holding Tanks (Contract No. 1.6). Each pump will have the following characteristics:

Capacity	325 gpm
TDH	13' to 31'
Discharge Pipe Size	4"
Motor Size	5 HP

Each pump will be capable of individual isolation.

The TDH will vary significantly depending on the water surface elevation in the Biosolids Holding Tanks. If the tanks are nearly empty, the WAS/Foam system could to act as a siphon. The air vacuum valve located in the valve chamber will eliminate this possibility. Additionally, the valve used for the sprayers will be electrically actuated and will close when the pumps are not running.

11. RAS Collection Channel

The RAS Collection Channel has the following characteristics:

Width	6'-0"
Slope	Flat
Water Depth	8'-0" +/-
Top of Channel Elevation	633'-0"
Freeboard	4'-0"
RAS Recirculation Pipe Diameter	54"

12. Backup Power

All equipment found in the Bioreactor Tanks will be connected to a site-wide generator for power use in case of emergency.

13. Alarms

Appropriate alarms for the various components of the Bioreactor Tanks will be included in the site-wide SCADA system.

NORTH KENT SEWER AUTHORITY
PARCC SIDE CLEAN WATER PLANT
MACHINE BUILDING - CONTRACT No. 1.5
BASIS OF DESIGN

1. Overview

The Machine Building is designed to accommodate essentially all process equipment related to the activated sludge and biosolids handling processes. The aeration equipment sizes are controlled by biological requirements for treating the wastewater. The balance of the equipment is sized according to hydraulic requirements. The process systems and associated equipment contained in the facility are as follows:

Return/Recirculation of Activated Sludge	3 Pumps
Waste Activated Sludge/Foam Removal	2 Pumps
Membrane Filtration	5 Trains
Permeate	5 Pumps
Clean-In-Place System for Membranes	2 Pumps
Disinfection	2 UV Lamp Banks
Chemical Feed	4 Systems
Process Aeration	3 Blowers
Membrane Aeration	3 Blowers
Biosolids Aeration	2 Blowers
Biosolids Disposal	3 Pumps
	6 Inclined Screw Presses

The process overview and biological design calculations for each system in the activated sludge process are provided in the Zenon Biological Basis of Design.

2. Wastewater Flows

The current wastewater flows that will be seen at the PARCC SIDE Clean Water Plant are as follows:

Current Average Day Flow Rate (ADF)	4.3 MGD
Current Peak Flow Rate	8.0 MGD

The design flows for the various phases of the Machine Building are as follows:

<u>Phase I</u>	
Average Daily Flow Rate (ADF)	6.0 MGD
Maximum Month Flow Rate (MMF)	7.51 MGD
Maximum Hourly Flow Rate (MHF)	9.34 MGD

<u>Phase IA</u>	
Average Daily Flow Rate (ADF)	8.0 MGD
Maximum Month Flow Rate (MMF)	9.91 MGD
Maximum Hourly Flow Rate (MHF)	12.34 MGD

<u>Phase II</u>	
Average Daily Flow Rate (ADF)	12.0 MGD
Maximum Month Flow Rate (MMF)	14.71 MGD
Maximum Hourly Flow Rate (MHF)	18.34 MGD

3. Return (Recirculation of) Activated Sludge (RAS) Pumps

The RAS pumps are can type pumps designed to pump mixed liquor from the bioreactor tank collection channel to the membrane tanks. This allows the wastewater to flow by gravity through the membrane tanks and back to the beginning of the bioreactor tanks as recycled mixed liquor. The RAS pump size is controlled by the hydraulic requirements of the plant. The RAS pumps are sized to accommodate five times the Phase 1A. Recycled mixed liquor is four times the Phase 1A MMF. The recirculation rate is proportional to the plant effluent rate.

The RAS pump system will have a firm capacity of 49.6 MGD with two of the three pumps running. The motors will have variable frequency drives to accommodate fluctuations in flow rate.

Individual RAS pumps will have the following characteristics:

Design Capacity	17,210 GPM
Design Total Dynamic Head	14.2 FT
Motor Size	75 HP
Maximum Speed	900 RPM
Suction Pipe Diameter	36 IN
Discharge Pipe Diameter	24 IN

The RAS pump suction header and discharge header are sized to accommodate 5 times the Phase II MMF (73.6 MGD) to allow for modular expansion in the future:

Suction Header Pipe Diameter	54 IN
Discharge Header Pipe Diameter	48 IN

See the Zenon Biological Basis of Design for additional information regarding the RAS pumps.

4. Membrane Filtration

The mixed liquor from the bioreactor tanks will be filtered by membranes arranged in five trains. The machine building will accommodate seven membrane tanks set up to filter the Phase IA ADF at buildout. Initially the membrane trains will be populated to filter the Phase I ADF. This will be achieved by using four membrane trains with one on standby. As flow increases, additional cassettes will be added to existing trains and new trains will be added as needed. The membranes have an approximate lifespan of ten years. The additional cassettes will likely be added at about the time that the original membranes are on their second replacement set.

The Phase I membranes will have the following characteristics based on 4 trains in operation:

Number of Cassettes per Train	8
Number of Modules per Cassette	60
Flow per Train	1.57 MGD
Total Membrane Area	652,800 FT^2
Net Flux	9.63 GFD

Number of Spare Cassettes per Train	2
Number of Spare Modules per Cassette	4
Available Area from Spares	217,600 FT^2

In order to accommodate Phase II flows two more membrane trains will be required for a total of nine trains.

The requirements and calculations for the membrane design are provided in the Zenon Biological Basis of Design.

5. Permeate Pumps

The permeate pumping system is based on one dedicated centrifugal end suction pump per membrane train. Seven membrane trains will be constructed, however only five will be populated for Phase I MHF initially. The Phase I ADF is achieved by using four membrane trains with one train offline. Therefore five permeate pumps are required. The permeate pumping capacity is reduced during the operation of the backpulse pumps, so an additional factor of 1.17 is used to calculate the required pump capacity. The motors will have variable frequency drives to accommodate fluctuations in flow rate. The permeate pumps will have the following individual characteristics:

Design Capacity	1,900 GPM
Maximum Total Dynamic Head	36 FT
Motor Size	30 HP
Maximum Speed	900 RPM
Suction Pipe Diameter	10 IN
Discharge Pipe Diameter	8 IN

The permeate pump discharge header will be used to store permeate to be utilized for backpulse and membrane chemical clean applications. The header will also accommodate the Phase II MHF to allow for modular expansion in the future:

Discharge Header Pipe Diameter	30 IN

See the Zenon Biological Basis of Design for additional information regarding the permeate pumps.

6. Clean in Place (CIP) Pumps

The CIP pumping system utilizes centrifugal end suction type pumps designed to backflush the membrane trains periodically with permeate to remove fouling and facilitate efficient operating conditions. There are three modes of cleaning the membranes, each of which utilize the CIP pumps; backpulse cleaning, maintenance cleaning, and recovery cleaning.

Backpulse cleaning is when the CIP pumps backflush the membranes in a train for 30 seconds, every 12 minutes. Maintenance cleaning involves backpulsing the membranes with chemically treated permeate. This process takes place approximately once a week during off-peak hours of the day. Recovery cleaning involves draining the membrane tanks and backpulsing the membranes with chemically treated permeate for an extended period of time. For additional information on the cleaning requirements for the membrane trains see the Zenon Biological Basis of Design.

The CIP pumping system will have two pumps, one duty and one standby. The pumps will be capable of meeting the cleaning needs for Phase I, Phase IA, and Phase II design conditions. Each pump will have the following characteristics:

Phase I Design Capacity	2,267 GPM
Phase I Maximum Total Dynamic Head	33 FT
Phase II Design Capacity	3,022 GPM
Phase II Maximum Total Dynamic Head	39 FT
Motor Size	40 HP
Maximum Speed	1,200 RPM
Suction Pipe Diameter	16 IN
Discharge Pipe Diameter	12 IN

The CIP pump discharge header is sized to accommodate the Phase II MHF to allow for modular expansion in the future:

Discharge Header Pipe Diameter	12 IN

See the Zenon Biological Basis of Design for additional information regarding the CIP pumps.

7. Ultraviolet Disinfection

The UV System is designed to treat the Phase 1A MHF using high-output, low pressure UV lamps. The UV System is designed to disinfect wastewater with the following characteristics:

Total Suspended Solids: 30 Day Avg.of grab samples	30 mg/L,
Effluent Temperature Range:	33 to 85 °F
Ultraviolet Transmittance @ 253.7 nm:	70 %, min.
Maximum Mean Particle Size:	30 microns

Effluent standards to be achieved:

200 fecal coliform/100 ml based on a 30 day Geometric Mean of daily samples for the effluent as detailed above. Effluent standards will be met regardless of influent count to UV system.

The UV system will have the following characteristics:

Number of Channels:	1
Number of Banks:	2
Number of UV Modules per Bank:	6 (fut. 8)
Number of Lamps per UV Module:	8
Total Number of Lamps in the UV System:	96 (fut. 128)
Number of System Control Centers:	1
Number of UV Detection Systems:	2
Number of Power Distribution Centers:	2
Number of Level Controllers:	1

Normal operation will use of one or both banks of UV lamps based on final effluent flow rate and quality. The system will be configured for dose pacing with either one or both banks in service.

The system has been sized to treat the peak flows with the "largest unit" out of service where the "largest unit" is defined as an individual module within the UV bank system (industry standard). The equipment will be capable of providing sufficient energy with one UV module out of service to theoretically treat the entire peak flow rate, regardless of void in the lamp array. Modules can be replaced without de-energizing the other lamps.

The UV system will be installed a single open channel having the following dimensions:

Length:	31 ft
Width:	32 in*
Depth:	57 in

* The channel width will initially be reduced to 24 inches by means of a reduction baffle to allow for uniform disinfection for current flow conditions. The baffle can be removed in the future to accommodate the treatment of additional flow.

The effluent depth in the channel will be 2.89 feet initially and 2.98 feet under future flow conditions.

The UV channel is capable of being isolated by means of an upstream butterfly valve. An additional butterfly valve is located upstream for bypassing the UV system in case of emergency.

To accommodate future Phase II MHF the reduction baffle in the UV channel will be removed and additional modules of lamps will be added to each bank.

8. Chemical Feed Systems

The plant requires four chemicals for biological treatment, membrane cleaning applications, and plant water disinfection. (Refer to the Zenon Biological Basis of Design for further information regarding the biological design of the chemical requirements.) The chemical storage room will be isolated from the rest of the machine building. Each type of chemical will have its own containment area capable of storing the volume of the largest tank in case of emergency. Each containment area will contain a sump to facilitate the removal of spilled chemical. All chemical storage and day tanks will be ventilated and will have a liquid level control system tied into the plant SCADA system. The chemical room will be adequately ventilated and will contain an emergency shower and eyewash station.

The individual chemical feed system characteristics are as follows:

A. Ferric Chloride

A 40% ferric chloride solution will be added to the common discharge header of the RAS pumps prior to the membrane tank distribution channel in order to enhance proper mixing for optimal phosphorous removal. Delivered ferric chloride will be stored in the storage tank and transferred to the day tank as needed by transfer pumps. The chemical will be pumped from the day tank to the point of application by metering pumps. The ferric chloride chemical feed system will have the following characteristics:

Storage Tank	
Volume	6,600 gal
Diameter	10'-0"
Overall Height	13'-7"
Days of Storage	11
Transfer Pumps	
Number of Pumps	2
Capacity	30 gpm
TDH	40'
Day Tank	
Volume	720 gal
Diameter	4'-0"
Overall Height	8'-7"
Daily Use	592 gal
Meter Pumps	
Number of Pumps	2
Capacity	5-30 gph
TDH	14.5'

B. Sodium Hydroxide

Sodium hydroxide will be added to RAS collection channel to restore alkalinity that has been depleted by nitrification and the addition of ferric chloride. Sodium hydroxide will be delivered to one of two storage tanks. The two storage tanks will be connected at the top and bottom for fluid transfer and overflow/venting protection, respectively. Sodium hydroxide will be transferred to the day tank as needed by transfer pumps. The chemical will be pumped from the day tank to the point of application by metering pumps. The sodium hydroxide chemical feed system will have the following characteristics:

Storage Tank (Typical of two)	
Volume	10,150 gal
Diameter	11'-11"
Overall Height	14'-5"
Days of Storage	7
Transfer Pumps	
Number of Pumps	2
Capacity	50 gpm
TDH	25'
Day Tank	
Volume	2,950 gal
Diameter	7'-6"
Overall Height	10'-8"
Daily Use	2,835 gal
Meter Pumps	
Number of Pumps	2
Capacity	22-120 gph
TDH	19.6'

C. Citric Acid

Citric acid is one of the chemicals used for cleaning the membranes. There is only one citric acid tank. The citric acid will be pumped from the tank to the point of application by metering pumps. The citric acid chemical feed system will have the following characteristics:

Tank	
Volume	1,200 gal
Diameter	5'-4"
Overall Height	8'-4"
Daily Use	46 gal

Meter Pumps

Number of Pumps	2
Capacity	9-25 gpm
TDH (Backpressure)	39 psi

D. Sodium Hypochlorite

Sodium hypochlorite is used for cleaning the membranes and disinfecting the plant water supply. There is only one sodium hypochlorite tank. The sodium hypochlorite will be pumped from the tank to the points of application by one of two sets of metering pumps. The sodium hypochlorite chemical feed system will have the following characteristics:

Tank	
Volume	1,200 gal
Diameter	5'-4"
Overall Height	8'-4"
Daily Use	48 gal
Meter Pumps	
Number of Pumps	2
Capacity	10-45 gpm
TDH (Backpressure)	36 psi
Plant Water Disinfection Pumps	
Number of Pumps	2
Capacity	0.05-0.082 gpm
TDH	8 psi

The chemical metering pumps are sized to service all membrane trains for chemical cleaning for both Phase I and Phase II.

9. Process Aeration Blowers (PABs)

Air supply to the aeration system in the bioreactor tanks will be provided by 3 centrifugal type PABs, 2 duty and 1 standby, located in the blower room. The maximum required air supply volume is 12,940 SCFM as calculated in the Zenon Biological Basis of Design. Air flow will be varied by an inlet throttling valve in response to a signal from the dissolved oxygen meter in the activated sludge tanks through the plant SCADA system. The intent is to maintain 1.0-2.0 mg/L of dissolved oxygen in the aerated zones of the bioreactor tanks. The blowers will have the following individual characteristics:

Design Capacity	6,600 SCFM
Design Pressure	8.7 PSI
Motor Size	400 HP
Maximum Speed	3,600 RPM

The PAB air header is sized to meet the Phase II MMF. The header size will be reduced outside the building. The outside header will be set up to accommodate a future loop of parallel headers for redundancy. Additional blowers will be required for Phase II airflow.

Discharge Header Pipe Diameter	36 IN
Loop Header Pipe Diameter	24 IN

10. Membrane Aeration Blowers (MABs)

Air supply to the membrane tanks will be provided by 3 centrifugal type MABs, 2 duty and 1 standby, located in the blower room. The maximum required air supply volume is 14,185 SCFM as calculated in the Zenon Biological Basis of Design. The required air flow will vary depending on the number of membrane trains in operation. The air flow will be adjusted by an inlet throttling valve. The intent is to maintain a mixing/scour rate at the membrane surface. The blowers will have the following individual characteristics:

Design Capacity	8,720 SCFM
Design Pressure	4.4 PSI
Motor Size	250 HP
Maximum Speed	3,600 RPM

The MAB header will meet the Phase II MMF airflow requirements to allow for modular expansion in the future. One additional blower will be required for Phase II airflow.

11. Biosolids Aeration Blowers (BABs)

The Biosolids Holding Tanks require medium bubble aeration to keep solids in suspension. For information regarding the medium bubble aeration system requirements refer to the Basis of Design for the Biosolids Holding Tanks (Contract No. 1.6). Two positive displacement type BABs, 1 duty and 1 standby, will be dedicated to providing the required aeration for the biosolids holding tanks. The blower speed will be varied by VFD in response to a signal from the dissolved oxygen meter in the tank and minimum mixing requirements through the plant SCADA system. The intent is to maintain 2.0 mg/L of dissolved oxygen and solid suspension in the tank. The biosolids aeration blowers will have the following characteristics:

Low Fluid Level Capacity	3,800 SCFM
Low Fluid Level Design Pressure	3.6 PSI
High Fluid Level Capacity	3,100 SCFM
High Fluid Level Design Pressure	9.5 PSI
Motor Size (VFD)	200 HP
Maximum Speed	3,600 RPM

The BABs will be connected to the PAB header in the blower room in case of emergency. There will be dedicated piping from the BABs to the holding tanks with the appropriate valves for air flow directing. An additional blower and piping will be required for Phase II.

12. Biosolids Disposal

Inclined Screw Press (ISP) Pumps

Conditioned biosolids from the biosolids holding tanks (Contract No. 1.6) will be pumped to the inclined screw presses (ISPs) in the biosolids handling room by submersible ISP pumps. The ISP pumps will be located in the ISP wet well adjacent to the biosolids holding tanks. As indicated in the Basis of Design for Contract No. 1.6, additional information regarding the ISP pumps is provided as part of the Machine Building Basis of Design. The three ISP pumps have a common header and two four inch supply lines going to the machine building. The ISP supply lines will be connected in a loop in the biosolids handling room for redundancy. The ISP Pumps will have the following characteristics depending on the number of ISP supply lines being used:

Single Line

Design Capacity	210 GPM
Total Dynamic Head (varies w/ tank level)	25-50 FT
Motor Size	7.5 HP

Looped System

Design Capacity	420 GPM
Total Dynamic Head (varies w/ tank level)	22-46 FT
Motor Size	7.5 HP

Incline Screw Presses (ISPs)

The ISPs will dewater the biosolids delivered from the holding tanks prior to disposal. The ISP design is based on the following assumptions for Phase IA MMF:

Thickened WAS (1.5% Solids)	133,725 GAL/DAY
WAS TSS	15,840 LBS/DAY
Dewatered Total Solids	15%
Processing days/week	5
Hours of processing/day	11

Based on the assumptions listed above, each ISP system will have the following characteristics:

Design Capacity	65 GPM
Operating Range	35-65 GPM
Design Solids Loading Capacity	2,440 LBS/HR
Motor Size	2 HP

Given the characteristics mentioned above 6 ISPs will be required for Phase IA, 5 duty and 1 standby. The ISPs will be arranged in pairs. Each pair will be connected to a common mixing manifold, flocculation tank reactor, and polymer feed system. The ISPs will be connected to a conveyor system which will deliver the dewatered biosolids to the solids disposal room. The solids disposal room will be isolated from the rest of the machine building. The solids room will contain space for three dumpsters to accommodate the solids discharged from the ISPs. Based on the loading provided above, approximately 4 dumpsters with 18 CY capacity will need to be emptied per day. The dumpster contents will then be hauled to a landfill for disposal. The water from the dewatering process will be sent to the site sanitary sewer and back to the beginning of the plant.

Phase II flow will require adjustment in the operation of the ISP equipment.

13. Odor Control & Ventilation

The machine building will be ventilated for typical facility design. There will be approximately 6 complete air changes per hour in the solids handling disposal area.

The heat from the blower room will be recovered during the winter months and used to heat the Machine Building.

14. Compressed Air System

Many of the systems in the machine building will use pneumatic valves for flow control. Two identical complete compressed air systems will be provided for redundancy to meet the needs of the valves. Each compressed air system will have a screw compressor, a dessicant dryer, and a receiver tank with the following characteristics:

<u>Screw Compressor</u>	
Design Capacity	78 CFM
Discharge Pressure	160 PSI
Motor Size	20 HP
<u>Dessicant Dryer</u>	
Design Capacity	40 CFM
Working Pressure	100 PSI
Pressure Dewpoint	-100°F
<u>Receiver Tank</u>	
Volume	240 GAL
Operating Pressure	165 PSI

The compressed air system will be complete with the necessary filters, regulators, and other ancillary equipment.

15. Backup Power

The machine building will be connected to a site-wide generator for power use in case of emergency.

The generator will be a 2.5 MW diesel generator with appropriate tankage, fill stations, transfer switch, alarms, and other ancillary equipment.

Based on Phase I and Phase IA power requirements, the generator will be able to support all current treatment power requirements. Staged system restarts will be included in the SCADA programming.

16. Alarms

Appropriate alarms for the various components of the machine building will be included in the site-wide SCADA system.

NORTH KENT SEWER AUTHORITY
PARCC SIDE CLEAN WATER PLANT
MACHINE BUILDING - CONTRACT No. 1.5
BASIS OF DESIGN - ADDENDUM

17. Plant Water System

Water used throughout the plant site for cleaning and other non-potable process purposes will be provided by the plant water system. The system will consist of three vertical multi-stage booster pumps and one hydro-pneumatic bladder tank. The system will utilize permeate filtered by the membranes as the water supply. Sodium hypochlorite for disinfection will be added to the plant water after pumping and before the hydro-pneumatic tank. The pumps will have the following characteristics:

Design Capacity	(GPM @ TDH)
Design Point One	150 GPM @ 220 FT
Design Point Two	200 GPM @ 200 FT
Design Point Three	250 GPM @ 170 FT
Firm Capacity (2 pumps)	400 GPM @ 200 FT

The hydro-pneumatic tank will have the following characteristics:

Capacity	2,000 GAL
Diameter	72 IN
Height	148 IN
System Pressure Point	85 psi
System Pressure Stop Point	90 psi

The plant water system will be controlled by a local control system and monitored with the plant SCADA system. The system will be complete with the appropriate alarms.

NORTH KENT SEWER AUTHORITY

PARCC SIDE CLEAN WATER PLANT
BIOSOLIDS HOLDING TANKS
CONTRACT 1.6

BASIS OF DESIGN

1.0 OBJECTIVE

Two Biosolids Holding Tanks capable of proper aeration, 7 to 10 days of biosolids storage, thickening, and decanting are proposed to provide temporary storage and conditioning of biosolids prior to dewatering and disposal.

2.0 INFLUENT CHARACTERISTICS

The current anticipated plant average day flow rate is 4.3 MGD. The plant design average day flow rate is 8.0 MGD. Under design average flow conditions the Biosolids Holding Tanks will receive 13,200 lbs of Total Suspended Solids (TSS)/day of which 8,200 lbs is Volatile Solids (VS)/day. The Waste Activated Sludge (WAS) is expected to be 1.0% solids. The average daily flow rate to the Biosolids Holding Tanks is anticipated to be approximately 158,500 gallons per day not including recycle.

3.0 BIOSOLIDS HOLDING TANKS

Size	72'x72'
Outer Wall Elevation	630'-0"
Dividing Wall Elevation	629'-0"
Design High Water Elevation	628'-0"
Design Low Water Elevation	615'-0"
Tank Bottom "Sloped" Elevation	610'-0" to 609'-0"
Tank Bottom – 3 Ft Wide Channel Elevation	608'-0"

Each Biosolids Holding Tank will hold 698,000 gal from 610'-0" to 628'-0". Each empty tank contains 4.4 days of storage during average flow. Through the use of decanting the plant storage has the capability to reach above 10 days.

Equipment per Tank

D.O. Meter	1 Each
ORP Meter	1 Each
Level Transmitter	1 Each
Decanter	1 Each
Medium Bubble Aeration System	1 Each
Slide Gate	1 Each

Float Level Indicators	2 per Tank
Elevation	628'-6"
Elevation	615'-0"

A minimum water depth of 2 feet will be maintained, one foot above the diffusers, to protect the membrane diffusers and the PVC piping from UV degradation and freezing during the winter months. The typical minimum tank liquid level will be 612'-0".

3.1 SLIDE GATES

One per Biosolids Holding Tank
Electrically Actuated
18"x18" Square
Wall Mounted inside each Biosolids Holding Tank to feed the ISP Wet Well.

3.2 DECANTER

One per Tank
650 gallons per minute
Lowers the Tank liquid level approximately 1 Ft. per Hour
8 inch Piping
8 inch Gate Valve

Each decanter has a support bracket to keep the decanter from reaching the tank bottom and to protect the membrane units. The top of the support bracket is at an elevation of 613'-0".

3.3 MEDIUM BUBBLE AERATION SYSTEM

Two different mixing scenarios were tested; 30 SCFM per 1000 cuft and 0.25 SCFM per sqft. Each scenario was calculated at both the minimum and maximum elevations of 615'-0" and 628'-0". At each elevation the calculation yielding the largest air requirement is the controlling air requirement for complete mixing. At a liquid elevation of 615'-0" the mixing requirement is 1,300 SCFM and at a liquid elevation of 628'-0" the air requirement for mixing is 2,800 SCFM.

In order to meet volatile solids destruction the following oxygen requirements must be met. With both tanks full (EL. 628'-0") the system has an Actual Oxygen Requirement (AOR) of 397.6 lb of oxygen per hour (O_2/Hr). At a liquid elevation of 615'-0" the AOR requirement is 55.25 lb of O_2/Hr per tank. A value of 1.5 pounds of oxygen per pound of BOD as well as 4.6 pounds of oxygen per pound of TKN, a liquid temperature of 30 deg. C, and a constant dissolved oxygen requirement level of 2 mg/L were used. At 4 feet of submergence (EL. 615'-0") the transfer efficiency is only 6.2% requiring 3,400 SCFM per tank. At 17 ft. submergence (EL. 628'-0") the transfer efficiency is 25%, resulting in a need of 2,950 SCFM per tank.

Oxygen demand controls the air requirements for the Biosolids Holding Tanks.

A 10% safety factor was used to assure the capability of providing adequate air in case of a heavy loading or a surge scenario. The following are the design values.

3,800 SCFM @ 3.6 PSI	4 ft Submergence
3,100 SCFM @ 9.5 PSI	17 ft Submergence

Diffuser Invert	611'-0" (+/- ¼ inch)
Drop Pipe	16 inch Dia.
Header Pipe	12 inch Dia.
Lateral Piping	8 inch reducing to 6 inch Dia.

Number of Laterals per Biosolids Holding Tank	4
Diffuser Units per Lateral	50
Diffuser Units per Biosolids Holding Tank	200 units
Diffuser Tubes per Unit	2
Diffuser Tubes per Biosolids Holding Tank	400 tubes
Tube Length	1 meter

Air per Diffuser Tube	9.5 SCFM
Max. Recommended Air per Diffuser Tube	24 SCFM
Max. Burst of Air per Diffuser Tube	44 SCFM

4.0 INCLINED SCREW PRESS WET WELL

Invert Elevation	608'-0"
Floor Elevation	604'-0"
One Level Transmitter	

3 Pumps (Lead, Lag, & Lag 2)

Each Pump Equipped with an Air Flush Mixer

Firm Capacity	420 gpm

Total Dynamic Head to be verified as part of the biosolids handling system and will be included with said system submittal.

5.0 INCLINED SCREW PRESS VALVE CHAMBER

The valve chamber controls the location the biosolids are pumped to. There are two actuated valves to control the flow to the ISP Biosolids Handling room where the biosolids will be dewatered and disposed. The third valve allows the biosolids to be recirculated back to the plant headworks. The third valve also allows the tanks to be drained and/or send poor dewatering solids to the site sanitary system and not the solids handling area.

5.0 WAS DISTRIBUTION CHAMBER

The WAS Distribution Chamber directs the biosolids to the appropriate Biosolids Holding Tank. Also in the chamber is a 4 inch actuated valve capable of recirculating the older biosolids in the ISP Feed lines back to either of the holding tanks.

NORTH KENT SEWER AUTHORITY
PARCC SIDE CLEAN WATER PLANT
ODOR CONTROL - CONTRACT NO. 1.7
BASIS OF DESIGN

1. Odor Control Air Flow Rates & Loading Rates

The PARCC SIDE Clean Water Plant Odor Control System is designed to use biofiltration to treat air from plant Headworks and the Machine Building. The air from the 48" influent pipe is pulled through the covered comminutor chamber and screw pump troughs of the Headworks at a flow rate of 1,800 cubic feet per minute (cfm). The volume of air from the Headworks is 9,400 cfm. The Headworks air flow rate is permitted under MI 1003922. The volume of air from the Machine Building Solids Disposal room is 2,600 cfm as permitted under MI 1004075. The system is designed to achieve 6 air changes per hour in each building. The biofilter is designed to treat a total air volume of 15,000 cfm, which includes 1,200 cfm for a safety factor.

The system is designed with a 30 second empty bed retention time and the following loading rates:

Hydrogen Sulfide (Average)	50 ppm
Hydrogen Sulfide (Peak)	100 ppm
VOCs (Average)	20 ppm
VOCs (Peak)	100 ppm
Mercaptan Loading	5 ppb
Ammonia Loading	20 ppm

Removal efficiencies will be as follows:

Hydrogen Sulfide	99%
Methyl Mercaptan	70%
Ammonia	90%

2. Blowers & Ducts

The Odor Control System will be a positive pressure system. The Headworks and Machine Building will have redundant blowers supplying the system. The Machine Building blowers will have a capacity of 2,600 cfm and Headworks blowers will have a capacity of 11,200 cfm.

The air lines for the Headworks and Machine Building will be 18" and 36" respectively. The two lines will combine into a 42" air header prior to splitting into (2) two 30" air ducts that enter the system. Air velocity through the ducts will be approximately 1,500 feet per minute. The yard air piping is permitted under MI 1003921.

The blowers will utilize variable frequency drives to control the air flow rate. 30" FRP dampers will be installed at the end of the 30" air ducts for air flow balancing through the system.

3. Humidification Chamber

A built-in-place humidification chamber is located at the front of the system. The humidification chamber will assure a minimum of 75% relative humidity in the incoming air.

The water for the humidification chamber will be supplied by a stainless steel submersible pump located in a sump outside of the chamber. Make-up water will be provided by the plant water system.

4. Media Bays

The system will have two completely separated built-in-place concrete media bays. Air will enter the media chamber from the humidification chamber, flow up through the biofilter media and exit the exhaust stacks located at the opposite end of the media chambers. Each chamber can be isolated for maintenance or media replacement via the 30" FRP valves located in the humidification chambers.

An internal irrigation system will be built into the media bays. The irrigation system will keep the biofilter media moist, as well wash away the acidic byproducts of the biofiltration process.

5. Odor Control Building

Controls for the irrigation system and the humidification pump will be contained in a 10'-8" x 13'-4" building built near the odor control system. The system will be connected to the plant SCADA system to monitor the odor control system alarms.

6. Drains

Drains from the media bays, the humidification sump overflow, and the Odor Control building will connect to the plant sanitary sewer. The drains from the humidification chamber will run back to the humidification sump to be recycled through the system.

7. Specifications

A copy of the Odor Control System specifications is attached for reference. All specifications for other project segments remain the same as previously approved.

NORTH KENT SEWER AUTHORITY
PARCC SIDE CLEAN WATER PLANT
SITE PIPING BASIS OF DESIGN

Description	Dia. (in)	Length (l.f.)	Capacity	Unit
Potable Water Service	8	495	N.A.	gpm
Potable Water Service	12	480	N.A.	gpm
Plant Water (Non-Potable)	6	1,025	400	gpm
Biosolids Decant	8	44	830	gpm
Biosolids ISP Pump Waste	4	29	210	gpm
Biosolids ISP Supply	4	250	200	gpm
Plant Discharge	48	96	25,000	gpm
Raw Wastewater	36	153	11,700	gpm
Return Activated Sludge (RAS)	54	318	21,300	gpm
Sanitary Sewer	10	97	560	gpm
Sanitary Sewer	12	47	800	gpm
Sanitary Sewer	24	885	3,100	gpm
Sanitary Sewer	48	247	25,100	gpm
Bioreactor Tank Drain	8	144	370	gpm
UV Bypass	24	136	13,400	gpm
Waste Activated Sludge (WAS)	6	507	325	gpm
Storm Sewer	12	189	1,100	gpm
Storm Sewer	15	249	1,800	gpm
Storm Sewer	18	85	2,550	gpm
Storm Sewer	24	225	3,900	gpm
Odor Control	18	220	2,600	cfm
Odor Control	30	40	6,900	cfm
Odor Control	36	335	11,200	cfm
Odor Control	42	138	13,800	cfm
Air	16	783	3,800	cfm

4.1 Process Design for Long Term Reliability

Reliability, flexibility and expandability of the PARCC SIDE Clean Water Plant are critical to the long-term growth and environmental sustainability of Kent County, MI. The ZeeWeed® Membrane Bioreactor (MBR) system being proposed for this facility incorporates all of our extensive experience and knowledge in MBR technology, and is designed to meet or exceed all the objectives while providing a system that is cost effective and easy to operate. The overall design of the ZeeWeed® MBR system is described in this section along with the features that address the design objectives outlined previously.

This section presents the revised process design based on chemical phosphorous removal with ferric chloride ($FeCl_3$).

The proposed ZeeWeed® MBR System in Phase I will consist of three (3) biological process trains and five (5) ZeeWeed® membrane filtration trains. The membranes are installed in separate membrane compartments adjacent to the biological process tanks. As opposed to immersing the membranes directly in the activated sludge process tankage, separate membrane tanks provide an inherently more reliable and flexible integrated treatment process. The biological process tanks and the membrane tanks are hydraulically connected via the membrane tank distribution channel. This design effectively decouples the main biological and membrane processes and allows for any number of biological process trains to be operated with any number of membrane trains. Each process can be optimized independently, while still operating as a fully an integrated process.

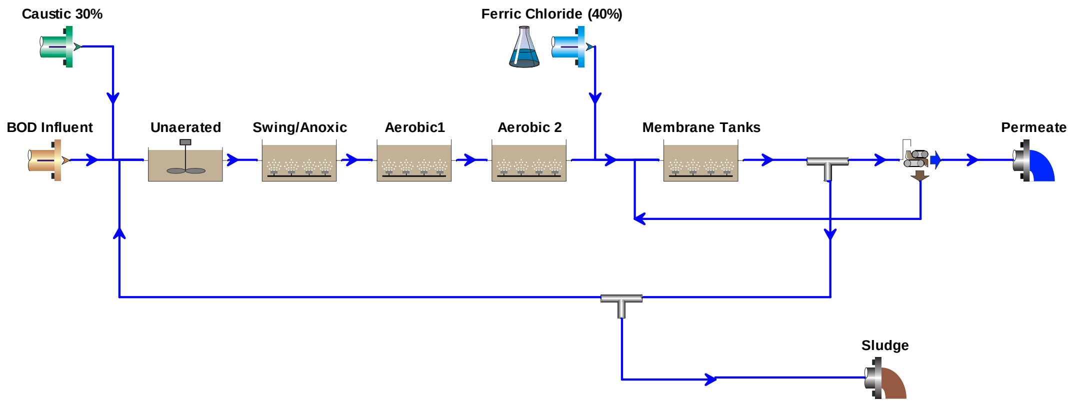
The ZeeWeed® MBR design for Phase 1, includes enough flexibility to accommodate Phase 1A and Phase 2 with minimum operational disruption.

Process Overview

Screened and degritted raw sewage is combined with the recycled mixed liquor from the membrane tanks in the bioreactor distribution channel and is distributed equally to each operating biological process train. Mixed liquor flows through the different zones of each biological process train (unaerated/anoxic, swing and aerobic zone) by gravity and into the mixed liquor collection channel. The mixed liquor is transferred to the membrane tank distribution channel via mixed liquor recirculation pumps. Ferric chloride is added into the common discharge header of the mixed liquor recirculation pumps prior to the membrane tank distribution channel in order to enhance proper mixing for optimal phosphorous removal.

The mixed liquor then flows by gravity to each membrane tank via downward opening valves, which are designed to ensure equal flow distribution to all the membrane tanks and the same water level in all tanks. The mixed liquor overflows from the membrane tanks into the mixed liquor recirculation channel and is recirculated, by gravity, to the head of the bioreactor, via a pipe. Clean water is withdrawn from the mixed liquor through the membrane using a dedicated permeate pump per train and is discharged after downstream disinfection (UV).

Since alkalinity is depleted by nitrification and the addition of ferric chloride, sodium hydroxide is added to the bioreactor distribution channel. The figure below, illustrates the design.



The swing/anoxic zone can be operated without aeration serving as an anoxic basin or aerated serving as an aerobic basin. This design approach maximizes operational flexibility.

Process Design

The design of ZeeWeed® MBR system is based on the design wastewater loadings specified by Prein & Newhof and the effluent quality requirements stated in the Request for Proposal. ZeeWeed® MBR system will meet or exceed all of the effluent quality requirements of the plant's discharge permit. The following tables summarize the influent quality and expected effluent quality for the proposed ZeeWeed® MBR system.

As per Prein & Newhof, the design loadings are based on maximum month loadings (1.2 of the Average Daily loads) and biosolids recycle loadings.

Influent Loadings and Concentrations

Parameters	ADF Loadings (lb/day)	MMF Loadings (lb/day)	Biosolids Recycle Loadings (lb/day)	Influent Design Loadings (lb/day)	Influent Design Concentrations (mg/L)
Biological Oxygen Demand (BOD_5)	16,500	19,800	1,375	21,175	339.02
Total Suspended Solids (TSS)	22,000	26,400	1,475	27,875	446.29
Ammonia, as N	6,600	7,920	-	7,920	126.80
Total Kjehldahl Nitrogen, as N	7,300	8,760	680	9,440	151.14
Phosphate, Total as P	735	882	-	882	14.12
Alkalinity	-	-	-	-	340

Anticipated Effluent Quality and Nutrient Removal

Parameters	Units	MBR Effluent
Biological Oxygen Demand (BOD_5)	mg/L	< 4
Total Suspended Solids (TSS)	mg/L	< 4
Ammonia, as N	mg/L	< 0.5 (May-Nov) < 1.0 (Dec-Apr)
Phosphate, Total as P	mg/L	< 1
Alkalinity	mg/L	n/a
Turbidity	NTU	<0.5

To balance between the capital cost of the biological process tankage and the operating cost associated with the fine bubble process aeration, we have selected a design MLSS in the bioreactor of 8 g/L. For the design mixed liquor recirculation rate (4Q at MMF), this will result in an operating MLSS concentration in the membrane tank of 10 g/L. The operating volume and footprint of the biological process trains and membrane trains under these design conditions are summarized in the table below.

Operating Volume and Footprint of the MBR system

Parameters	Units	Biological Process Tanks				Membrane Tanks
		Unaerated Zones	Swing Zone	Aerobic 1 Zone	Aerobic 2 Zone	
Number of trains	#	3	3	3	3	5
Number of tanks per train	#	1	1	1	1	1
Average Operating Water Level	Ft	19	19	18	18	8.75
Average Operating Volume per train	MG	0.378	0.378	0.3582	0.3582	0.045
Total operating volume per Zone	MG	1.1342	1.1342	1.0745	1.0745	0.2246
Total Operating Volume	MG	4.6420				

Mechanical Process Equipment

The three biological trains are identical and are sized for phase 1A. For phase 2, parallel biological trains will be added to the system. Each biological train is designed with one (1) unaerated/anoxic, one (1) swing and two (2) aerobic zones. Each unaerated zone has a dedicated submersible mixer to ensure homogeneous mixed liquor, maximizing alkalinity recovery.

The swing zones are equipped with a submersible mixer and a fine bubble diffuser grid with a motorized valve. Depending on the influent wastewater characteristics and temperature, the swing zones can operate as unaerated or aerated. These zones provide great flexibility to the operation of the PARCC SIDE Clean Water Plant as they can maximize nitrification or denitrifcation as required.

From the swing zone the mixed liquor flows into the aerobic tanks each equipped with one (1) independent fine bubble aeration grid that supply oxygen necessary for the biological process. The dropleg on each aeration grid is equipped with a motorized valve. Process aeration is provided by a common group of three (3) centrifugal blowers (2 duty + 1 standby) with inlet flow control valves on suction side for airflow control. The air flow rate can be regulated to control the DO level in the aerated zones for energy savings. Each of the swing and aerobic zones has a Dissolved Oxygen probe with one shared transmitter per train.

For phase 1A and phase 2, additional process blowers will be installed.

The mixed liquor flows by gravity from the aeration basins to the mixed liquor collection channel through partially submerged gate valves. The foam and scum are collected in the foam/WAS tank located at one end of the collection channel via downward opening weir gates. Foam, scum and waste activated sludge are removed from the system via two (2) submersible foam wasting pumps (1 duty + 1 standby).

The mixed liquor is transferred to the membrane tank distribution channel via three (3) recirculation pumps (2 duty + 1 standby) with common suction and discharge headers which are sized for Phase 2 MMF. As mentioned previously, ferric chloride is dosed on the common discharge. No additional mixed liquor recirculation pumps are required for Phase 1A, although an additional recirculation pump is required for Phase 2.

The following table summarizes the operating conditions for the ZeeWeed® MBR system based on chemical P removal at the average day flow (ADF) and the design flow – maximum month flow rate (MMF).

Operating Conditions at ADF and MMF

Parameters	Unit	ADF	MMF
Influent Flow Rate[1]	mgd	6.29	7.49
Minimum Water Temperature	°C	8	8
Maximum Water Temperature	°C	25	25
Average MLSS concentration in Aerobic Tanks	g/L	8	8
Average MLSS concentration in Membrane Tanks	g/L	10	10
Average Recirculation MLSS Concentration	g/L	10	10
Recirculation Flow Rate[2]	RQ	4	4
Biological Solids Retention Time	day	18	15
Hydraulic Retention Time	hr	17.7	14.9
Combined F:M Ratio	1/day	0.10	0.12
Coagulant Addition for P Removal (40 % w/w $FeCl_3$)	mg/L	59	59
Caustic Addition (30% w/w NaOH)	mg/L	200	200
WAS Generation	mgd	0.203	0.242
Supplemental Air Requirement[2]	scfm	9,670	11,760

[1] Flow rate includes recycle streams from sludge handling processes
[2] Mixed liquor recirculated from membranes to process tanks
[3]At design condition and 10 sec ON/10 sec OFF aeration

Membrane Design

Membrane Flux Selection

The membrane net flux is the most important parameter when designing a membrane filtration system. The selection of the appropriate membrane flux depends on a number of factors including the minimum operating temperature, flow rates, duration of peaking conditions, and assumed sludge characteristics. Our flux selection is based on design curves developed from years of experience from full scale operating MBR plants under different conditions.

According to the Request for Proposal, the design must be capable of handling all flow conditions with one train off line. Based on a combination of temperature, flow conditions and redundancy required, suitable flux rates were selected assuming a reasonably filterable sludge. This resulted in five (5) membrane trains with eight (8) cassettes per train with each cassette having 60 modules and each module having 340 ft^2 of external surface area. This corresponds to 163,200 ft^2 of membrane area installed per train and a total of 816,000 ft^2 of membrane area installed in the five (5) trains. Two (2) spare spaces per tank were added for a total of ten (10) cassettes spaces per train. This corresponds to 25% spare space, which is within the range of ZENON's typical design and above the 15% spare space required by the RFP. The cassettes in each train are installed in a single row, each completed with its own permeate header and air headers.

For phase 1A, two (2) more identical trains will be added. In order to accommodate Phase 2 flows, two (2) additional membrane trains are required, for a total of nine (9) trains. No upgrades are necessary to the existing trains.

The table below presents a summary of major design parameters and the membrane configuration for the design condition (N-1 trains in operation at all times) and for the condition with all spaces filled within the trains, and N-1 trains running.

Summary of Basic Design Parameters

Flow Condition	Flow	No of Trains	Trains Running	Train Flow	Min Temp	Installed/ Operating: Cass per Train	Installed/ Operating: Modules per Cass	Installed/ Operating: Total Area	Installed/ Operating: Net Flux	Available with Spare[1]: Cass per Train	Available with Spare[1]: Modules per Cass	Available with Spare[1]: Total Area	Available with Spare[1]: Net Flux	Spare Space Per Train
	mgd	#	#	mgd	°C	#	#	sq.ft	gfd	#	#	sq.ft	gfd	%
ADF	6.29	5	4	1.57	8	8	60	652,800	9.63	10	64	870,400	7.23	25
MMF	7.49	5	4	1.87	8	8	60	652,800	11.47	10	64	870,400	8.61	25
MWF	8.09	5	4	2.02	8	8	60	652,800	12.39	10	64	870,400	9.29	25
MDF	9.29	5	4	2.32	8	8	60	652,800	14.23	10	64	870,400	10.67	25
MHF	9.29	5	4	2.32	8	8	60	652,800	14.23	10	64	870,400	10.67	25

Design Flux

[1] With 4 trains operating

Mechanical Process Equipment

For Phase 1 a total of five (5) trains are required, for phase 1A, two (2) additional membrane trains will be required in order to treat the additional flow. For phase 2, two (2) additional trains will be incorporated into the design for a total of nine (9) trains.

The mixed liquor flows from the membrane distribution channel, into five (5) identical ZeeWeed® membrane trains from the biological basins. Each train is designed with a dedicated permeate pump and turbidity meter. The permeate pumps discharge the treated water into a common permeate collection header for downstream UV disinfection and discharge. The activated sludge flows by gravity, from the membrane tank, to the mixed liquor collection channel which terminates in a pipe that recirculates the combined mixed liquor to the head of the bioreactor.

A common pair of Backpulse/Clean-In-Place (CIP) pumps (1 duty + 1 standby) is used to service all membrane trains. The trains that will be added for Phase 1A and Phase 2 are identical to the membrane trains in Phase 1; therefore, this pump is sufficient for both expansions. The permeate collection header is oversized in order to store permeate, or effluent, utilized for backpulse and membrane chemical clean applications.

The membrane tanks are drained by gravity to the site sanitary headwork.

Membrane aeration is provided by a common group of three blowers (2 duty + 1 standby) which discharges to a common air supply header leading to membrane tanks. Additional membrane blowers will be required for Phase 2.

In order to prime the permeate system, an ejector system is provided which incorporates the use of compressed air from the high pressure instrument air compressor system.

A common group of chemical dosing pumps with dedicated installed standby units are used to service all membrane trains for chemical cleans (including additional trains in Phase 1A and Phase 2).

Major Equipment Sizing

The assumptions and key design parameters used for sizing the following major equipment are described below for:

- Permeate Pump
- Recirculation Pump
- Membrane Aeration Blower
- Process Aeration Blower

Permeate Pump

The pump selection is based on the flow range the pump has to cover and the total dynamic head (TDH) at minimum and maximum flow rates. The permeate system is based on one dedicated permeate pump per train, with all pumps discharging into a common permeate collection header. This header has already been sized for Phase 2 flows.

Capacity range of the permeate pump is based on the following.

Loss of production due to relaxation/backpulse, valve change time and cleaning is accounted for by using two instantaneous factors. A 1.08 factor is used when operating in relaxation mode and 1.17 is used when in backpulse mode.

- Minimum net production capacity per pump is 6.29 mgd / 4 trains = 1.57 mgd. The design minimum pump capacity based on minimum net production in relaxation mode is 1.57 mgd x 1.08 x 10^6 / 1440 = 1,180 gpm.
- Maximum net production capacity per pump is 9.29 mgd / 4 trains = 2.32 mgd. The design maximum pump capacity based on peak flow rate per train and the higher instantaneous factor (1.17) is 2.33 mgd x 1.17 x 106 / 1440 = 1891 gpm (1,900 gpm)

Minimum TDH of the permeate pump at the minimum flow and TMP is estimated based on the following:

- Average TMP at the pump suction is 3 psig or 6.93 ft.
- Pumps suction losses, including piping and obstruction losses at minimum flow with 4 trains in service is estimated to be 1.7 ft.
- Permeate pump discharge pressure is based on 7.5 ft of static lift (dictated by hydraulic profile) and 1.1 ft of losses occurred inside the discharge piping at this flow.
- Minimum TDH of the permeate pump under minimum flow condition is 6.93 + 1.1 + 1.7 + 7.5 = 17.23 ft.

Maximum TDH of the pump at the maximum flow and TMP is estimated based on the following:

- Maximum TMP at the pump suction is 8 psig or 18.45 ft.
- Pumps suction losses, including piping and obstruction losses at MDF with 4 trains operating, is estimated to be 3.9 ft.
- Permeate pump discharge pressure is based on 10.6 ft of static lift (dictated by hydraulic profile) and 2.9 ft of losses occurred inside the discharge piping at this flow.
- Maximum TDH of the permeate pump at maximum flow is 18.45 + 3.9 + 2.9 + 10.6 = 35.85 ft.

Recirculation Pump

The pump selection is based on the flow range it has to cover and the total dynamic head (TDH) at minimum and maximum flow rates. The mixed liquor recirculation system is based a group of three (3) pumps (2 duty + 1 standby), with all pumps discharging into a common header.

These pumps are sized for Phase 1A flows, for Phase 2 an additional pump will be required.

Capacity range of the recirculation pump is based on the following:

- Based on 4Q mixed liquor recirculation rate, the maximum transfer pump capacity is 5Q, where Q is the MMF flow condition for Phase 1: 5 x 7.49x 10^6 mgd / 2 pumps / 1440 = 13,000 gpm. It is estimated that the initial minimum flows through the plant will be approximately 1.75 mgd which corresponds to a pump capacity of 6,076 gpm.

- For Phase 1A the pump capacity is: 5 x 9.91 mgd / 2 pumps / 1440 = 17,205 gpm. Assuming that for Phase 2 a third pump will be incorporated, the pump capacity is: 5 x 14.71 mgd / 3 pumps / 1440 = 17, 030 gpm. Therefore the pump capacity will be dictated by Phase 1A design flow.
- At ADF the pump capacity will drop by the factor ADF/MMF, resulting in the pump capacity of 13,000 x 6.29/7.49 = 10,920 gpm.
- With the proposed pump and piping design, the static lift is very low (5 ft). At operating flow rate (13,000 gpm), the suction and discharge pipe losses are 1.24 and 2.6 ft respectively.
- At design flow rate (17,205 gpm) the suction and discharge pipe losses are 2.3 and 5.2 ft respectively). This results in pump **TDH of 8.8 – 12.5 ft**.

All operating pumps will run at the same speed determined based on full plant recirculation flow divided by number of operating pumps. Pump capacity will be changed within a range using the motor speed control. The plant recirculation flow is proportional to the plant effluent flow rate.

Membrane Aeration Blowers

The blower selection is based on the airflow range the blower has to cover and the discharge pressure at minimum and maximum airflow rates. The blower design is based on two (2) duty and one (1) standby blowers for all five (5) trains.

Capacity range of the membrane aeration blowers is based on the following.

- For a completely filled ZW500d cassette with 64 modules the required average airflow rate is 227.5 cfm delivered at the location (submergence) of membrane aerator. Based on project specific parameters (minimum liquid temperature and aerator relative elevation), the conversion factor for PARCC SIDE Clean Water Plant to convert from delivered cfm at the aerator to a standard cfm (scfm) is 1.247, resulting in average airflow rate per cassette of 283.7 scfm.
- Minimum airflow per train is based on minimum number of cassettes per train times airflow rate per cassette. This corresponds to 8 x 283.7 scfm = 2,269 scfm per train.
- Minimum total airflow per plant is based on minimum number of operating trains times minimum air flow per train. This corresponds to 4 x 2,269 = 9,078 scfm per plant.
- Maximum airflow per train is based on maximum number of cassette spaces per train times airflow rate per cassette. This corresponds to 10 x 283.7 scfm = 2,837 scfm per train.
- Maximum total airflow per plant is based on maximum number of operating trains times maximum airflow per train. This corresponds to 5 x 2,837 = 14,185 scfm per plant.
- Minimum blower capacity is the minimum plant airflow requirement divided by number of duty blowers, which corresponds to 9,078 scfm / 2 blowers = 4,539 scfm.
- Maximum blower capacity is the maximum plant airflow requirement divided by number of duty blowers, which corresponds to 14,185 scfm / 2 blowers = 7,092 scfm.

Minimum and maximum discharge pressures for the blowers are estimated based on the following:

- Minimum blower discharge pressure is based on the average membrane diffuser submergence of 8 ft or 3.47 psig and the overall blower suction losses and discharge piping headloss of 0.93 psig. The blower discharge pressure is 4.4 psig.

Process Aeration Blowers

The blower selection is based on the airflow range the blower has to cover and the discharge pressure range. The blower design is based on three blowers (2 +1) for all three (3) biological trains.

Capacity range of the process aeration blowers is based on the following:

- Minimum airflow per plant is based on the minimum oxygen requirement. This flow is calculated using our in-house kinetic model based on the influent BOD and TN loadings (please refer to the previous tables for design loadings).
- Minimum oxygen required for BOD = 26,492 lbO_2/day, for nitrification = 35,979 $lbsO_2$/day. Total oxygen required = 62,472 lbO2/day. The oxygen credit for denitrification = 20,771 lbO_2/day
- Therefore the net biological oxygen requirement = 41,701 lbO_2/day. The actual oxygen supplied by membrane = 4,174 lbO_2/day, so the net oxygen supplied by process blowers = 37,527 lbO_2/day.
- Considering a fine bubble Alpha factor based on the MLSS concentration in bioreactor of 0.54 and a Beta factor of 0.95, maximum liquid temperature of 25 °C, temperature correction factor of 1.13, site elevation of 625 ft ASL, tank SWD of 18 ft, and fine bubble diffusers submergence of 17 ft, DO concentration in aeration tank = 2 mg/L, SOTE = 2% per foot of SWD, we have calculated that the system air requirement is 11,760 scfm.
- Maximum air requirement is calculated based on a 10% safety factor: 11,760 x 1.1 = 12,940 scfm; this value is used as blowers design capacity
- Two (2) duty blowers, each with a capacity of 6,750 scfm will be supplied, exceeding the estimated requirement.

Minimum and maximum discharge pressures for the blowers are estimated based on the following conditions.

- Minimum blower discharge pressure is based on the average fine bubble diffuser submergence of 17 ft or 7.4 psig, the overall blower suction losses and discharge piping headloss of 0.6 psig, the operating discharge pressure will be 8 psig.
- Maximum blower discharge pressure has been estimated to be 9.97 psig.

Process Design Calculations

This section presents the design calculations and the model outputs for the biological treatment process for the ZeeWeed® MBR system for PARCC SIDE Clean Water Plant. The design is based on an in-house kinetic model which has been developed over the last seven years, and has been used for the design of most currently operating municipal ZeeWeed® MBR plants. The design parameters employed are based on experience gain from operating plants.

Another design tool utilized by ZENON, is an industry recognized biological wastewater simulation software called BioWin, which is based on the IAWQ model. For the design being presented a BioWin simulation was done to confirm the design.

Description of ZENON Kinetic Model

Our kinetic model was employed for modeling the system at design and operating conditions. A BioWin simulation was used to confirm the kinetic design.

A brief explanation of the kinetic model is summarized below. The kinetic design for the Phase I max month condition is included.

Sheet 1

The first sheet of the model output shows the project details, which includes the following information:

- Influent wastewater characteristics (including assumptions)
- Site conditions (temperature and elevations)
- Effluent requirements
- Design Flow Rates

Sheet 2

The second sheet of the model output shows the process rates that are used for the design, including:

- Target F:M ratios, along with the design aerobic, anoxic and combined F/M ratios.
- Effective nitrification rate is estimated from the aerobic MLVSS inventory and NH3-N oxidized. This is an output rather than an input.
- Denitrification rate is estimated based on the anoxic F/M and temperature using the following relationship:

  $$\text{Denitrification Rate} = (0.03 * \text{Anoxic F/M} + 0.029) * 1.03^{(T-20)}$$

These parameters, along with experience, are used to determine the bioreactor volume (or hydraulic retention time, HRT), the ratio between the anoxic and the aerobic volumes and solids retention time (SRT).

- Target F/M ratio and design MLSS concentration are used to estimate the total tank volume (and thus the HRT and SRT).
- Recommended fraction of the total volume that is unaerated is between 20-40%. In this case the fraction is 24.4%. Considering the swing zone, the fraction is 48.9% in order to maximize denitrification and minimize sodium hydroxide consumption.

The amount of waste activated sludge and SRT is calculated from:

- WAS = ISS loading + BOD loading * Biological Sludge Yield
- Biological sludge yield is typically between 0.35 and 0.6 kg VSS/ kg BOD, and it is lower at higher SRT. Based on experience, the biological sludge yield was set at 53% for PARCC SIDE Clean Water Plant.
- SRT is the ratio of MLSS inventory and waste activated sludge (WAS).

Sheet 3

The third sheet shows the calculations to estimate the biological air requirements. These include:

- Oxygen demand for BOD removal and complete nitrification
- Oxygen credit from denitrification
- Estimate of net biological oxygen requirement
- Oxygen transfer associated with membrane aeration (typically 1-2% OTE)
- Estimate of supplemental aeration required from fine bubble aeration system
- Estimate of alpha based on bioreactor MLSS concentration (g/l) using the following formula:
- Alpha = e(-0.0771* MLSS)
- Estimate of AOTE based on alpha, diffuser depth, atmospheric pressure, maximum temperature and SOTE (2%/ft)
- Oxygen uptake rate is calculated and the target is less than 100 mgO_2/l/h.

Sheet 4

Finally an alkalinity balance is performed to determine whether pH adjustment is required. The target effluent alkalinity is >50 mg/l as $CaCO_3$ in order to maintain a neutral pH required for optimal nitrification.

Seasonal Membrane Operating Conditions and Cleanings

The proposed ZeeWeed® membrane filtration system is designed to operate efficiently and reliably under all design conditions specified in the Request for Proposal. As with all membrane filtration systems, the performance is based on operating flux and transmembrane pressure (TMP). For any given flux rate or production capacity, the operating TMP will change to achieve the desired capacity. This is related to both intervals between cleanings, as well as temperature of the wastewater.

Over time the TMP will increase to maintain the required production capacity. As the TMP increases above a certain level, this is an indication that a membrane recovery clean should be scheduled. The recovery clean will reduce the TMP back to an acceptable operating range.

The effect of membrane performance change with change of wastewater temperature is well known (but not always well understood), mainly due to the changes in viscosity of the mixed liquor. As the wastewater temperature reduces during the winter, the viscosity of the mixed liquor increases which results in a higher operating TMP for a given production capacity or net flux.

The seasonal changes in wastewater temperature have been taken into consideration in designing the ZeeWeed® membrane filtration system for PARCC SIDE Clean Water Plant. Based on the minimum temperature of 8°C provided for winter condition, maintenance cleaning is scheduled to occur at least once a week, during off-peak hours of the day. During summer conditions, warmer wastewater temperatures and improved sludge filterability, may result in reduced cleanings depending on the operating TMP.

The system is design for recovery cleanings up to two times per year. Typically, the recovery cleanings are scheduled for the beginning of the winter season (November/December) and early spring (March/April). It is possible that during a very long or very cold winter season, additional maintenance/recovery clean may be required during the winter.

Flux Justification

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Selection of the design flux for a membrane bioreactor (MBR) is the single most important parameter that impacts both the capital and operating costs of the plant. It is also the key design variable that dictates the long-term reliability and ease of operation of the membrane filtration process. The selection of the design fluxes must be reasonable and responsible to balance these factors. Our experience has shown that design fluxes for membrane bioreactors should be based on long-term full scale operating plants rather than short-term pilot studies. However, well-executed pilot studies conducted over an extended timeframe (>6 months) do provide ideal maximum flux limits that are achievable under the best operating conditions. These limits serve as benchmarks rather than actual design values for full-scale plants.

Based on large-scale municipal applications, years of full-scale immersed membrane bioreactor experience, and numerous R&D and pilot studies, we has developed design flux rates for the different diurnal flows and operating conditions. The design flux rates for the PARCC SIDE Clean Water Plant were selected based on the specific peak flow rates and corresponding minimum wastewater temperature provided in the Request for Proposal. We are confident that the fluxes selected for PARCC SIDE Clean Water Plant are reasonable and responsible for the plant size and will provide a stable and reliable operation over the long term.

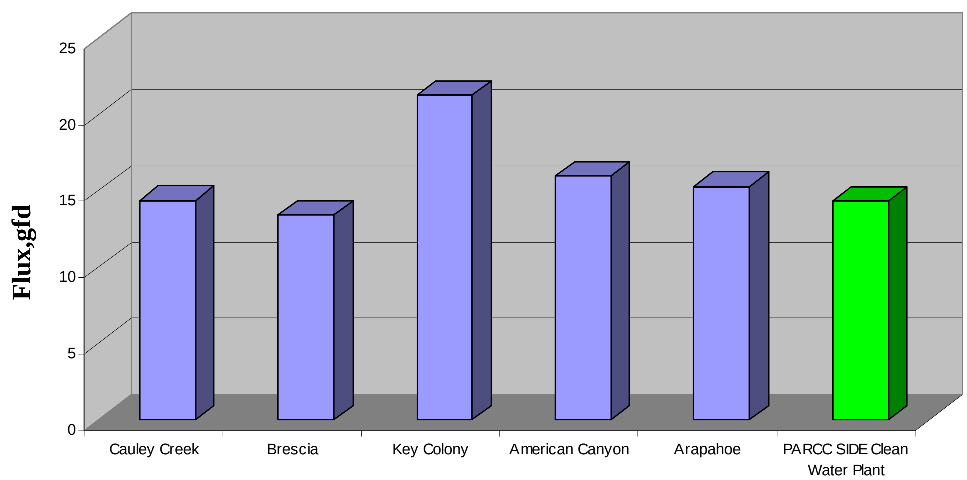
Design flux is selected based on the limiting flow conditions of the wastewater plant. These limiting conditions can be identified as the highest sustained flow at the lowest temperature; it is at these conditions where the transmembrane pressure (TMP) will reach its highest point.

For the PARCC SIDE Clean Water Plant the maximum day and peak hour flow conditions are the same; any flow exceeding the latter will be equalized.

As is typically the case for plants in colder weather, the highest flow and coldest temperature occur simultaneously. It is critical that flux is selected to ensure that all flow conditions can be treated within the operating TMP range of the membrane and the proposed cleaning intervals. It is important that the system is designed to ensure that the performance of the membrane is maintained over the life of the membrane, and not just the first couple years of operation.

In this section, design fluxes are justified by presenting operational fluxes from five (5) operating ZeeWeed® MBR plants of different sizes that have been in operation for a number of years. In addition, some pilot results from independent sources are presented to show the difference between full-scale and pilot fluxes.

The facilities were selected as reference sites due to their size and length of service. It should also be noted that a number of these plants, such as Cauley Creek and American Canyon are not operating at ultimate design capacity, and thus experience lower maximum day fluxes than design. The figure below shows that maximum day flux for the PARCC SIDE Clean Water Plant is comparable to the peak fluxes at referenced plants.



Operating Net Max Day Flux

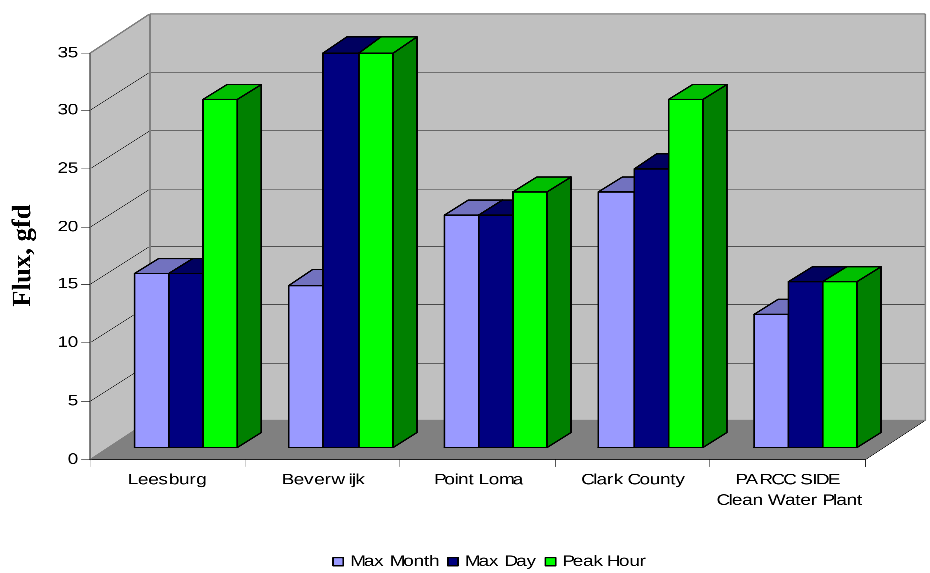
We invest considerably in ongoing development of our MBR technology. Since the design of the referenced plants, considerable advancements have been implemented in terms of the design and operation of the ZW500 series membrane filtration system in MBR applications. The latest development in membrane cassette configuration is the ZW500d generation – the fourth iteration of ZENON's proprietary reinforced hollow fibre membrane. The 64-module ZW500d cassette has been specifically designed for large scale MBRs. Yet, the design is flexible enough to be appropriate for smaller applications, where partially filled cassette can be used. Unique features include: reduced packing density, easy module access, increased module surface area, cyclic aeration within the cassette (when required), permeating from top and bottom, and increased cassette size.

In addition to the improved membrane product, a number of MBR plant design improvements have been made as well. Over the last several years, fine screening has become standard practice in every new MBR design, resulting in longer expected membrane life and increased membrane performance. In addition, all new ZeeWeed® MBR plants are designed with automatic in-situ cleaning of an entire membrane train which prevents "over-fluxing" of clean membrane when mixed with fouled membrane. This significantly increases the performance and long-term reliability of the system. Enhanced aeration allows for better membrane cleaning resulting in less frequent chemical cleans and power conservation.

The design of the PARCC SIDE Clean Water Plant will incorporate the most up-to-date and exciting advancements made by us and the wastewater industry in membrane wastewater treatment technology over the past decade. With the incorporation of our best design practices, such as a reasonable and responsible flux selection, the latest membrane and cassette design, fully automatic in-situ membrane cleaning, backpulse capable membrane, and the patented cyclic aeration, the PARCC SIDE Clean Water Plant will be ensured of reliable long term performance.

Pilot Scale Results for Reference

Full-scale and pilot-scale operations vary in terms of length of service and the range of operational parameters such as membrane airflow rates, mixed liquor suspended solids concentration, water temperature, and permeate flow rates. These fundamental differences between pilots and full-scale plants, along with controlled conditions of pilot studies, allow for higher flux rates achieved during short-term pilot study. To further illustrate the importance of using long-term full-scale data rather than pilot data to select design fluxes for ZeeWeed® MBRs, data from four (4) pilot studies are plotted along with the design fluxes for the PARCC SIDE Clean Water Plant in figure below.



Pilot Flux Comparison

The first ZeeWeed® MBR pilot study was conducted by CH2M Hill in Leesburg, Virginia1. The pilot was operated between October 18, 2000 and May 18, 2001. During the pilot study, the membranes were operated at an average net flux of 17.7 gfd. A diurnal peak test was

[1] Loudoun County Pilot - CH2M Hill; Broad Run Pilot Testing Program Final Report (2001).

conducted over a 7-day period. During the test, the permeate flux was increased rapidly from 16 gfd to 30.6 gfd and maintained at that peak flux for a 3-hour period on two occasions during each 24-hour period. An additional peak flux test was successfully completed at MLSS concentrations of up to 13 g/L for a period of 6 hours.

The second ZeeWeed® MBR pilot study was conducted by DHV Water BV at the Beverwijk site in the Netherlands as part of an extensive independent evaluation of membrane bioreactors from four different manufacturers[2].

The pilot was operated between March 14, 2000 and June 29, 2001. The system was operated at fluxes ranging from 14.7 to 35.3 gfd. The peak flux of 35.3 gfd was originally intended as a diurnal peak flux test, however due to the excellent performance of the membrane and no evidence of fouling, the system continued to operate at a net flux of 35.3 gfd continuously for a period of 9 days. DHV subsequently selected the ZeeWeed® MBR technology for the 2 MGD full-scale demonstration plant at Varsseveld.

The third ZeeWeed® MBR pilot study was conducted by MWH at the Point Loma Wastewater treatment plant in San Diego, CA[3]. This pilot study began in November 2002 and ended in August 2003. Our pilot unit was consistently operated at 22 gfd and at a very low HRT for a long period of time with a minimal increase in TMP.

The fourth ZeeWeed® MBR pilot study was also conducted by MWH in Clark County, Nevada between November 2002 and March 2003. During this pilot study, several peak hour flux rates were demonstrated above 31 gfd. The pilot was typically operated between 18 and 24 gfd with stable membrane performance. Sodium hypochlorite maintenance cleans were performed once per week. Flux data from the pilot study are presented in the figure below. It can be seen that even after several months of operation at high flux rates and without recovery cleaning, the membranes were still operating well below the maximum recommended TMP.

We have conducted dozens of other MBR pilot studies over the past decade and have found that pilot tests on municipal wastewater are useful to demonstrate the technology and excellent effluent quality to operators and clients, but not useful to determine long term design flux or membrane life. As evidenced from the pilot studies cited above, relatively high fluxes are achievable during short-term piloting. We believe that the design fluxes for municipal MBR plants must be based on long-term performance data from a number of operating facilities as presented above.

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2 Beverwijk Pilot, Van der Roest, H.F., Lawrence, D.P., & Van Bentem, A.G.N. (2002). Membrane Bioreactors for Municipal Wastewater Treatment. London: IWA Publishing.

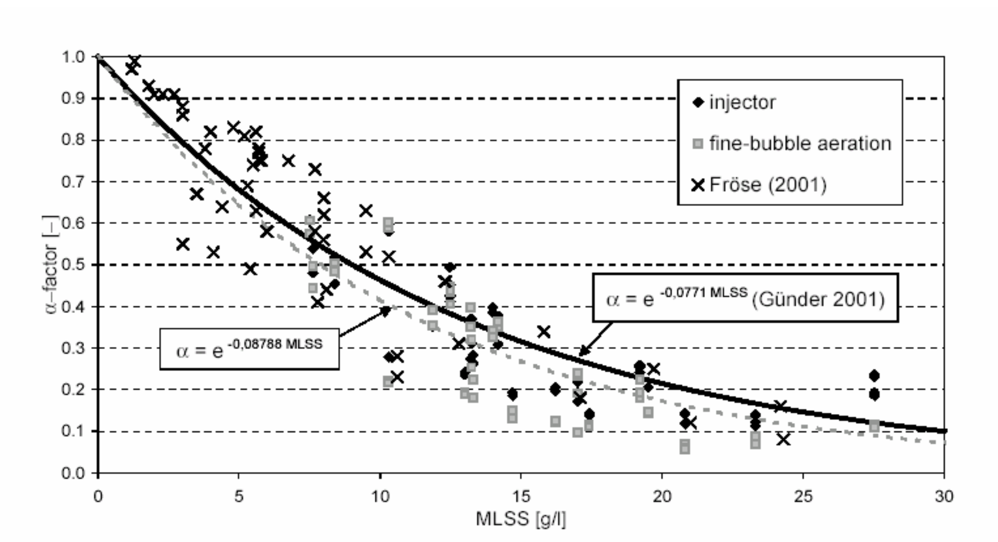
3 Point Loma Pilot. MWH (2004), Adham, S,. et al. Evaluation and Optimization of Membrane Bioreactors for Water Reclamation.

Selection of the MLSS Concentration

Most smaller scale commercial and industrial ZeeWeed® MBR plants are designed and operated with MLSS concentrations of 15 g/L or greater. Additionally, the ZeeWeed® membrane is capable of operating at elevated MLSS concentrations as high as 40– 50 g/L, as evidenced in ZeeWeed® sludge thickener applications currently operating at several municipal MBR plants (Cauley Creek, Creemore and Port McNicoll).

Operating at MLSS levels of up to 15 g/L enhances organic consumption, nitrification and reduces sludge production. Most MBRs operate effectively at short Hydraulic Retention Times (HRT), and are designed to provide long Solids Retention Times (SRT).

A higher inert fraction is present at higher MLSS concentrations, which affects the volumetric oxygen demand to the point that even fine bubble aeration systems may be incapable of satisfying the demand. Studies have also shown that the alpha factor decreases at higher MLSS as shown in the figure below. Therefore an optimization of the oxygen transfer efficiency has to be made.



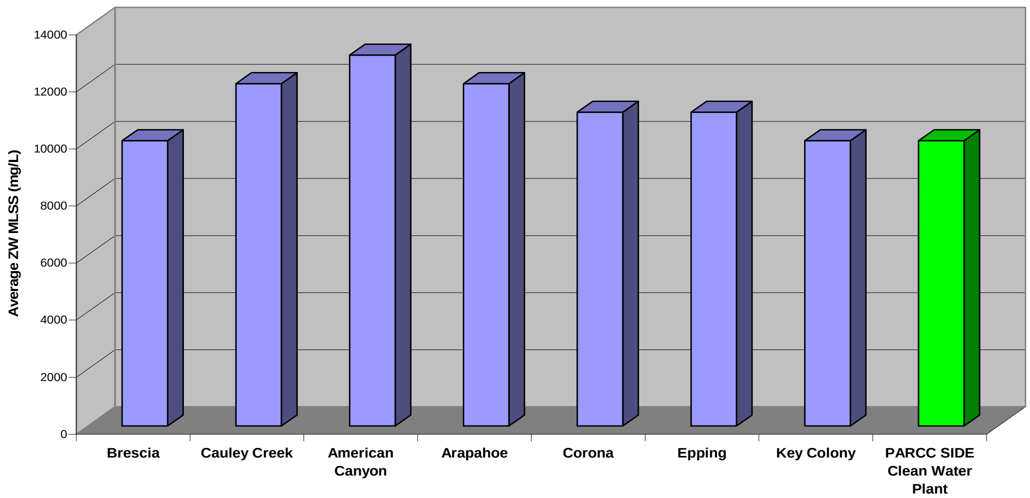
Krampe Jörg, et. Al., Oxygen Transfer into Activated Sludge with High MLSS concentrations, IWA, 2002

Effect of MLSS on alpha factor

Over the years, we have determined that an MLSS concentration of 10– 12 g/L in the membrane compartment is most efficient for maintaining stable, long-term membrane performance. Similarly, an MLSS concentration in the range of 8– 10 g/L in the bioreactor is most suitable for balancing the benefits of smaller bioreactor size at higher MLSS; and higher fine bubble aeration efficiency at lower MLSS concentrations.

Our membrane nominal pore size (0.04 micron) has no effect over the MLSS selection, because as described before, the concentration of the mixed liquor is first selected for the bioreactor and the resulting MLSS in the membrane tank is based on the recirculation rate.

The analysis of bioreactor cost versus aeration energy cost was conducted for PARCC SIDE Clean Water. Based on this analysis, we have determined an operational water level of bioreactor of 18 ft and an average MLSS concentration of 8 g/L in the biological process trains. The corresponding average MLSS concentration in the membrane tanks is 10 g/L for maximum month flow conditions. As illustrated in the figure below the maximum month MLSS concentration recommended for PARCC SIDE Clean Water is similar to the operating MLSS concentrations at referenced ZeeWeed® MBR installations.



Average MLSS Concentration in Membrane Tank

Project: **North Kent Sewer Authority - NKSA**
Design Capacity 6.29 **mgd**
Regional Manager: **US Central - Dan Higgins**
Retrofit or Greenfield? **New Tanks**
Designed by: **Malpica De La Torre, Jessica**
Status: **Budgetary Proposal**
Reviewed by: **...**
Design Date: **10-Nov-06** **Review Date: 11/11/2005**

1. Influent Quality		Units	Indicate if parameter is assumed
Feed Source	**Raw Sewage**		**WW charact by**
BOD	339	mg/L	**Prein & Newhof**
TSS	446	mg/L	
% Inert Solids	20%		
NH3-N	127	mg/L	
TKN	151	mg/L	
TP	14	mg/L	
Alkalinity	340	mg/L	
Min WW Temperature	8.0	ºC	
Max WW Temperature	25.0	ºC	
Min Ambient Air Temperature	(17.8)	ºC	
Max Ambient Air Temperature	37.8	ºC	
Site Elevation	190.5	m	
2. Effluent Requirements		**Units**	**Indicate if parameter is assumed**
BOD	4.0	mg/L	4-25 mg/L
TSS	4.0	mg/L	20-30 mg/L
NH3-N	0.5	mg/L	(May to Nov)
TN	17.0	mg/L	assumed
TP	1.0	mg/L	
Turbidity	0.5	NTU	
Fecal Coliforms	n/a	CFU/100 mL	After disinfection
SDI	n/a	-	
3. Flow Characteristics		**Units**	**Indicate if parameter is assumed**
Average Day	6.291	**mgd**	0.291 mgd added for pressate
Max Month	7.491	mgd	0.291 mgd added for pressate
Max Week	8.091	mgd	0.291 mgd added for pressate
Max Day	9.291	mgd	0.291 mgd added for pressate
Peak Hour	9.291	mgd	0.291 mgd added for pressate
4. Flow Equalization		**Units**	**Indicate if parameter is assumed**
Duration of Peak	24.0	hours	

Comments

Conservatism	
Rank: 1 is conservative, 10 is aggressive	

Signature (Process Manager) Date

Signature (Process Lead) Date

Wastewater Characteristics

	Total	Ratio:C/N
BOD5 (mg/L)	339	2.24
TSS (mg/L)	446	
ISS (mg/L)	89	
TKN (mg/L)	151	
TP (mg/L)	14	
Alkalinity (mg/L)	340	
Minimum Water Temp (ºC)	8	

Kinetic Design Based on: Max Month

	28,357	m^3/d	7.49	MGD

Flow Characteristics

Average Day	23,814	m^3/d	6.29	MGD
Max Month	28,357	m^3/d	7.49	MGD
Max Week	30,628	m^3/d	8.09	MGD
Max Day	35,170	m^3/d	9.29	MGD
Peak Hour	35,170	m^3/d	9.29	MGD

Process Rates

Target F:M ratio	0.08	kg BOD5/kg MLVSS*day
Aerobic F:M ratio	0.24	kg BOD5/kg MLVSS*day
Anoxic F:M ratio	0.25	kg BOD5/kg MLVSS*day
Combined F:M Ratio	0.12	kg BOD5/kg MLVSS*day
Effective Nitrification Rate	0.09	kg NH3 oxidized /(day * kg(mlvss))
Denitrification Rate Safety Factor	**1.15**	
Denitrification Rate	0.022	kg NO_3-n /(day * kg(mlvss))

Tank Volumes

Based on Biowing modelling

Calculated Minimum Anoxic Volume to achieve required [NO_3]	18,467	m^3	4,878,437	USgal
Total Anoxic	**8,587**	m^3	2,268,402	USgal
Total Supplemental Aerobic	**8,135**	m^3	2,149,013	USgal
Total Membranes	850	m^3	224,665	USgal
Total Overall Plant Volume	17,572	m^3	4,642,080	USgal
	48.9%	% Anoxic (typically 20-40%)		

Hydraulic Retention Time

Total Anoxic	7.3	hours
Total Aerobic (including membranes)	7.6	hours
Total Membranes	0.7	hours
Total System HRT	14.9	hours

Three biological trains
Total Unaerated Volume: 1,134201 gal
Each unaerated tank: 378,067 gal / train
Total Swing Volume: 1,134,201 gal
Each swing tank: 378,067 gal / train
Total Aerobic Volume: 2,149,013 gal
First aerobic zone: 358,169 gal / train
Second aerobic zone: 358,169 gal / train

Process Parameters

Design ZeeWeed MLSS	**10,000**	mg/L
Max Day ZeeWeed MLSS	10,000	
Design Bioreactor MLSS	8,000	mg/L
% volatile solids	56%	mlvss/mlss
Biological Sludge yield	**53%**	kg VSS produced/kg BOD treated/day
pH	**5.0<pH<9.0**	At membrane discharge

Loading Rates

Flow m^3/d	BOD5 kg/d	ISS kg/d	TSS kg/d	TN kg/d	TP kg/d
28,357	9,613	2,531	12,655	4,286	400
	21,175 lb/day		**27,875 lb/day**	**9,440 lb/day**	**882 lb/day**

Net Sludge Generation

Mass in bioreactor + membrane tank (vol tank x MLSS) (Kg)	Bio Sludge Wasted/day (BODxQxYield) (Kg/day)	Inert SS Sludge Wasted (kg/day)	Chem. Sludge Wasted (kg/day)	Total Sludge Wasted (kg/day)	Sludge Age (Bio+ISS) (days)	Total Sludge Age (Bio+ISS+Chem) (days)
142,278	5,095	2,531	1,550	9,176	19	15.5
				917.6	m^3/d	

Nutrient Removal

N Removed by Waste		P Biologically removed	
% Nitrogen (MLVSS)	**10%**	% Phosphorus	**1.5%**
Nitrogen (kg/d)	510	P (kg/day)	76
Nitrogen (mg/L)	18.0	P (mg/L)	2.7

Calculated NO3n in effluent

Process circulation Qt=Qr +Qi m3/d	# Recirc. From Membranes To Bioreactor	Minimum NO3-N Based on Recirc Rate mg/l	Assumed Non-Biodegradable TKN Fraction	Maximum NO3-N Required mg/l
141,783	**4.00**	26.63	**0.05**	8.94

Recirc Pump Options
◉ Pump TO Membranes ○ Pump FROM Membranes

Stoichiometric Chemical Dosage Requirements

Influent P	400.4	kg/day	
P removed Biologically	76.4	kg/day	
P removed Biologically	2.7	mg/L	
P Effluent Criteria (mg/L)	1.00	mg/L	If no chemical P removal required, set this number such that the stoichiometric requirements equal zero
P Effluent Criteria (kg/day)	28.4	kg/day	
P to be removed Chemically	295.6	kg/day	
P to be removed Chemically	10.4	mg/L	

Chemical		Stoich. Amount Req'd	Amount Added	Note: Using following rates	
Alum (mg/L)	○	100	0	Alum 0.87 kg Al / kg P	Alum=9.1% Aluminum
Ferric Chloride (mg/L)	◉	54	59	Ferric 1.8 kg Fe / kg P	Ferric Chloride = 35% Fe
Ferrous Chloride (mg/L)	○	45	0	Ferrous 1.8 kg Fe / kg P	Ferrous Chloride = 44% Fe
Sodium Aluminate (mg/L)	○	37	0	NaOAl: 0.87 kg Al/kg P	NaOAl = 24.7% Al

Air Requirements

BOD5 Treated in Aerobic Process	9,613	kg/d	21,194	lb/d
NH3-N Nitrified in Aerobic Process	3,548	kg/d	7,822	lb/d
Oxygen Required for BOD5	**1.25**	kg O_2 / kg BOD_5	**1.25**	lb O_2 / lb BOD_5
Oxygen Required for Nitrification	**4.6**	kg O_2 / kg NH_3	**4.6**	lb O_2 / lb NH_3
Oxygen Required for BOD5	12,017	kg/d	26,492	lb/d
Oxygen Required for Nitrification	16,320	kg/d	35,979	lb/d
Denitrification O2 Credit	9,422	kg/d	20,771	lb/d
Total System Actual Oxygen Requirement (AOR)	18,915	kg/d	41,701	lb/d
Net Membrane Aeration Rate (Initial Operating)	15,463	a.m^3/hr	9,101	dcfm
Net Membrane Aeration Rate (Initial Operating)	**19,284**	N.m^3/hr	**11,350**	scfm
	10/10 aeration			
SCFM/DCFM Ratio (calculated)			1.247	
Mass of Oxygen per Unit Volume of Air	**0.2796**	kg/m^3	**0.0175**	lb/ft^3
Total oxygen suppplied by membrane aeration	129,383	kg/d	285,238	lb/d
Coarse Bubble Alpha Factor	**0.70**			
Beta	**0.95**			
Temp	25	ºC	77	ºF
Temperature Correction Factor (1.024^(T-20))	1.12589991			
Site Elevation	191	m (assumed)	625	ft (assumed)
Pressure @ mean sea level (Pmsl)	101.30	kPa		
Pressure at actual elevation (P)	97.77	kPa		
Coarse bubble submergence	2.39	m	7.83	ft
Saturation Concentration @ design temperature (Csw)	8.0			
Saturation Concentration @ 20C @ standard conditions (Cs)	9.09			
DO in Membrane Zone	**4.5**	mg/L		
AOTE/SOTE = Alpha x ((Beta(Csw)-DO)/Cs) x Temp Correction	0.266			
Assumed SOTE per meter submergence for coarse bubble aeration	**2.30**	%		
Assumed Standard Oxygen Transfer Efficiency (SOTE)	5.49	%		
Actual Oxygen Transfer Efficiency (AOTE)	1.46	%		
Actual Oxygen Supplied by membrane aeration	1,893	kg/d	4,174	lb/d
Supplemental Aeration Required (Total System AOR - AOS by membrane aeration)	17,022	kg/d	37,527	lb/d
Fine Bubble Alpha Factor	0.54			
Beta	**0.95**			
Temp	25	ºC	77	ºF
Temperature Correction Factor (1.024^(T-20))	1.1259			
Site Elevation	191	m (assumed)	625	ft (assumed)
Pressure @ mean sea level (Pmsl)	101.30	kPa		
Pressure at actual elevation (P)	97.77	kPa		
Aerobic Tank Water Depth	**5.5**	m	18.0	ft
Fine Bubble Submergence	5.2	m	17	ft
Saturation Concentration @ design temperature (Csw)	8.0			
Saturation Concentration @ 20C @ standard conditions (Cs)	9.09			
DO in Aerobic Bioreactor Zone	**2**	mg/L		
AOTE/SOTE = Alpha x ((Beta(Csw)-DO)/Cs) x Temp Correction	0.373			
Assumed SOTE per metre submergence for fine bubble aeration	**6.56**	% / m	2.00	% / foot
Assumed Standard Oxygen Transfer Efficiency (SOTE)	34.08	%		
Actual Oxygen Transfer Efficiency (AOTE)	12.70	%		
Supplemental Aeration Safety Factor	**1.1**			
Supplemental Aeration Required	21,985	N.m^3/hr	12,940	scfm
Mixing Air Requirements:	7,321	N.m^3/hr	4,309	scfm
Supplemental Oxygen Uptake Rate	87	mg/L/hr		
Membrane Oxygen Uptake Rate	93	mg/L/hr		

Alkalinity Balance

Influent Alkalinity	340	mg/L $CaCO_3$
Alum added	0	mg/L
Al added	0.0	mg/L
Fe added	21	mg/L
Alkalinity depleted		
due to Alum added	0	mg/L $CaCO_3$
due to Fe added	56	mg/L $CaCO_3$
due to N oxidized	921	mg/L $CaCO_3$
Alkalinity recovered		
due to nitrate reduced	436	mg/L $CaCO_3$
due to Sodium Aluminate added	0	mg/L $CaCO_3$
Add other Chemicals for Alkalinity Adjustment?	NaOH	
Target Effluent Alkalinity	**50**	mg/L $CaCO_3$
Concentration of Chemicals to dose	200	mg/L
Effluent Alkalinity	**50**	mg/L $CaCO_3$

Wastewater Characteristics

	Total	Ratio:C/N
BOD5 (mg/L)	339	2.24
TSS (mg/L)	446	
ISS (mg/L)	89	
TKN (mg/L)	151	
TP (mg/L)	14	
Alkalinity (mg/L)	340	
Minimum Water Temp (ºC)	8	

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Biological Sludge yield	**53%**	kg VSS produced/kg BOD treated/day
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% Nitrogen (MLVSS)	**10%**	% Phosphorus	**1.5%**
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Nitrogen (mg/L)	18.0	P (mg/L)	2.7

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P to be removed Chemically	295.6	kg/day	
P to be removed Chemically	10.4	mg/L	

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Alum (mg/L)	○	100	0	Alum 0.87 kg Al / kg P	Alum=9.1% Aluminum
Ferric Chloride (mg/L)	◉	54	59	Ferric 1.8 kg Fe / kg P	Ferric Chloride = 35% Fe
Ferrous Chloride (mg/L)	○	45	0	Ferrous 1.8 kg Fe / kg P	Ferrous Chloride = 44% Fe
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Oxygen Required for Nitrification	16,320	kg/d	35,979	lb/d
Denitrification O2 Credit	9,422	kg/d	20,771	lb/d
Total System Actual Oxygen Requirement (AOR)	18,915	kg/d	41,701	lb/d
Net Membrane Aeration Rate (Initial Operating)	15,502	a.m^3/hr	9,124	dcfm
Net Membrane Aeration Rate (Initial Operating)	11,567	N.m^3/hr	6,808	scfm
	10/30 aeration			
SCFM/DCFM Ratio (calculated)			0.746	
Mass of Oxygen per Unit Volume of Air	**0.2796**	kg/m^3	**0.0175**	lb/ft^3
Total oxygen suppplied by membrane aeration	77,608	kg/d	171,095	lb/d
Coarse Bubble Alpha Factor	**0.70**			
Beta	**0.95**			
Temp	25	ºC	77	ºF
Temperature Correction Factor (1.024^(T-20))	1.12589991			
Site Elevation	191	m (assumed)	625	ft (assumed)
Pressure @ mean sea level (Pmsl)	101.30	kPa		
Pressure at actual elevation (P)	97.77	kPa		
Coarse bubble submergence	2.39	m	7.83	ft
Saturation Concentration @ design temperature (Csw)	8.0			
Saturation Concentration @ 20C @ standard conditions (Cs)	9.09			
DO in Membrane Zone	**3**	mg/L		
AOTE/SOTE = Alpha x ((Beta(Csw)-DO)/Cs) x Temp Correction	0.397			
Assumed SOTE per meter submergence for coarse bubble aeration	**2.30**	%		
Assumed Standard Oxygen Transfer Efficiency (SOTE)	5.49	%		
Actual Oxygen Transfer Efficiency (AOTE)	2.18	%		
Actual Oxygen Supplied by membrane aeration	1,690	kg/d	3,725	lb/d
Supplemental Aeration Required (Total System AOR - AOS by membrane aeration)	17,225	kg/d	37,976	lb/d
Fine Bubble Alpha Factor	0.54			
Beta	**0.95**			
Temp	25	ºC	77	ºF
Temperature Correction Factor (1.024^(T-20))	1.13			
Site Elevation	191	m (assumed)	625	ft (assumed)
Pressure @ mean sea level (Pmsl)	101.30	kPa		
Pressure at actual elevation (P)	97.77	kPa		
Aerobic Tank Water Depth	**5.5**	m	18.0	ft
Fine Bubble Submergence	5.2	m	17	ft
Saturation Concentration @ design temperature (Csw)	8.0			
Saturation Concentration @ 20C @ standard conditions (Cs)	9.09			
DO in Aerobic Bioreactor Zone	**2**	mg/L		
AOTE/SOTE = Alpha x ((Beta(Csw)-DO)/Cs) x Temp Correction	0.373			
Assumed SOTE per metre submergence for fine bubble aeration	**6.56**	% / m	2.00	% / foot
Assumed Standard Oxygen Transfer Efficiency (SOTE)	34.08	%		
Actual Oxygen Transfer Efficiency (AOTE)	12.70	%		
Supplemental Aeration Safety Factor	**1.087**			
Supplemental Aeration Required	21,985	N.m^3/hr	12,940	scfm
Mixing Air Requirements:	7,321	N.m^3/hr	4,309	scfm
Supplemental Oxygen Uptake Rate	88	mg/L/hr		
Membrane Oxygen Uptake Rate	83	mg/L/hr		

Alkalinity Balance

Influent Alkalinity	340	mg/L $CaCO_3$
Alum added	0	mg/L
Al added	0.0	mg/L
Fe added	21	mg/L
Alkalinity depleted		
due to Alum added	0	mg/L $CaCO_3$
due to Fe added	56	mg/L $CaCO_3$
due to N oxidized	921	mg/L $CaCO_3$
Alkalinity recovered		
due to nitrate reduced	436	mg/L $CaCO_3$
due to Sodium Aluminate added	0	mg/L $CaCO_3$
Add other Chemicals for Alkalinity Adjustment?	NaOH	
Target Effluent Alkalinity	**50**	mg/L $CaCO_3$
Concentration of Chemicals to dose	200	mg/L
Effluent Alkalinity	**50**	mg/L $CaCO_3$

PARCC Side WWTP, North Kent Sewer Authority

Process Design Summary - ZEEWEED® MBR System

Table 1: Influent Wastewater Flow to MBR*

Parameter	Phase 1 - Influent (MGD)
Annual Average Day Flow (ADF)	6.29
Max. Monthly Average Flow (MMF)	7.49
Max. Weekly Average Flow (MWF)	8.09
Max Day Flow (MDF)	9.29
Peak Hour Flow (PHF)	9.29

* Flow rate includes 0.291 MGD due to pressate

Table 2: Design Influent Loadings

Parameter	ADF(1) (lb/day)	MMF(2) (lb/day)	Biosolids Recycle (lb/day)	Design loadings (3) (lb/day)
COD	44,000	52,800		52,800
BOD_5	16,500	19,800	1,375	21,175
TSS	22,000	26,400	1,475	27,875
TKN	7,300	8,760	680	9,440
Ammonia-N	6,600	7,920		7,920
Total Phosphorus	735	882		882

(1) ADF loadings (as per P&N design table 5, May 18,2005)
(2) MMF is 1.2 ADF
(3) Design loadings based on maximum monthly flow loadings and biosolids recycle

Table 3: Influent Parameters to MBR and Effluent Characteristics

Parameter	Units	Influent Wastewater	Final Effluent (Monthly Median)
COD	mg/L	845.35	
BOD_5	mg/L	339.02	< 4
TSS	mg/L	446.29	< 4
TKN	mg/L	151.14	n/a
Ammonia-N	mg/L	126.80	<1.0(1)
Total Phosphorus	mg/L	14.12	< 1
Alkalinity (as $CaCO_3$)	mg/L	340	n/a
Minimum Wastewater Temperature	°C	8	n/a
Maximum Wastewater Temperature	°C	25	n/a

(1)Ammonia-Nitrogen of 0.50 mg/L from May to November

Table 4: Chemical Dosage

Chemical	Units	
Coagulant (Ferric Chloride) dosage	mg/L	59
Caustic (NaOH) dosage	mg/L	200

Table 5. Process Tank Configuration(1)

Process Tank	Units	Number of Tanks	Working Volume per Tank	Total Tank Volume
Unaerated Zone	US gal	3	378,067	1,134,201
Swing Zone	US gal	3	378,067	1,134,201
Aerobic Zone 1	US gal	3	358,169	1,074,507
Aerobic Zone 2		3	358,169	1,074,507
Membrane Zones	US gal	5	44,933	224,665
Membrane bioreactor (MBR)	US gal	n/a	n/a	4,642,081

(1) Based on three process trains

Table 6. Process Tank Dimensions

Process Tank	Units	Width	Length	Operating Water Level
Unaerated Zone	ft	38	70	19
Swing Zone	ft	38	70	19
Aerobic Zone 1	ft	38	70	18
Aerobic Zone 2	ft	38	70	18

Table 7. Biological Process Parameters

Biological Design Parameters	Units	ADF	MMF
Bioreactor MLSS Concentration	g/L	8	8
Membrane Zone MLSS Concentration	g/L	10	10
Target F/M ratio	kg BOD_5/kg MLVSS-day	0.08	
Nitrification Rate	kg NH_3 oxidized/kg MLSS-day	0.09	
Denitrification Rate	kg NO_3-N reduced/kg MLSS-day	0.02	
Overall Hydraulic Retention Time (HRT)	hours	17.7	14.9
Sludge Retention Time (SRT)	days	18	15
Recycle Ratio, R (Membrane Tanks to ML Collection Channel)	RQ	4	4
Biological Sludge Yield	kg VSS produced/kg BOD_5 treated-day	0.53	
MLVSS/MLSS ratio	Fraction	0.56	
Waste Sludge Generated	mgd	0.203	0.242

Table 8. Aeration System

Parameters	Units	Design Condition 1 (10/10 aeration)	Design Condition 2 (10/30 aeration)
Membrane Aeration			
OUR in Membrane Zone	mg O2/L/hour	< 100	
Coarse bubble submergence	ft	7.83	
Alpha for coarse bubble aeration	Units	0.70	
Beta	Units	0.95	
Temperature Correction Factor	Units	1.125	
Site Elevation	ft	625*	
Saturated DO at max design temperature (25oC	mg/L	8.00	
Saturated DO at 20oC & standard conditions	mg/L	9.09	
DO in Membrane Zone	mg/L	4.50	
Membrane Aeration	scfm	11,350	6,808
Biological Reactor Aeration			
OUR in Bioreactor	mg O2/L/hour	< 100	
Fine bubble submergence	ft	17	
Alpha for fine bubble aeration	Units	0.54	
Beta	Units	0.95	
Temperature Correction Factor	Units	1.125	
Site Elevation	ft	625*	
Saturated DO at max design temperature (25oC	mg/L	8.00	
Saturated DO at 20oC & standard conditions	mg/L	9.09	
DO in Bioreactor	mg/L	2.00	
Bioreactor Aeration	scfm	11,760	11,900

* Site elevation assumed

Table 9. Membrane Filtration Process Design Parameters and Membrane Configuration

						Installed/Operating				Available with Spare[1]			
Flow Condition	Flow	No. of Trains	Trains Running	Train Flow	Min Temp	Cass per Train	Modules per Cass	Total Area	Net Flux	Cass per Train	Modules per Cass	Total Area	Net Flux
	MGD	#	#	MGD	°C	#	#	ft^2	gfd	#	#	ft^2	gfd
ADF	6.29	5	4	1.57	8	8	60	652,800	9.63	10	64	870,400	7.23
MMF	7.49	5	4	1.87	8	8	60	652,800	11.47	10	64	870,400	8.61
MWF	8.09	5	4	2.02	8	8	60	652,800	12.39	10	64	870,400	9.29
MDF	9.29	5	4	2.32	8	8	60	652,800	14.23	10	64	870,400	10.67
PHF	9.29	5	4	2.32	8	8	60	652,800	14.23	10	64	870,400	10.67

(1) With 4 trains operating

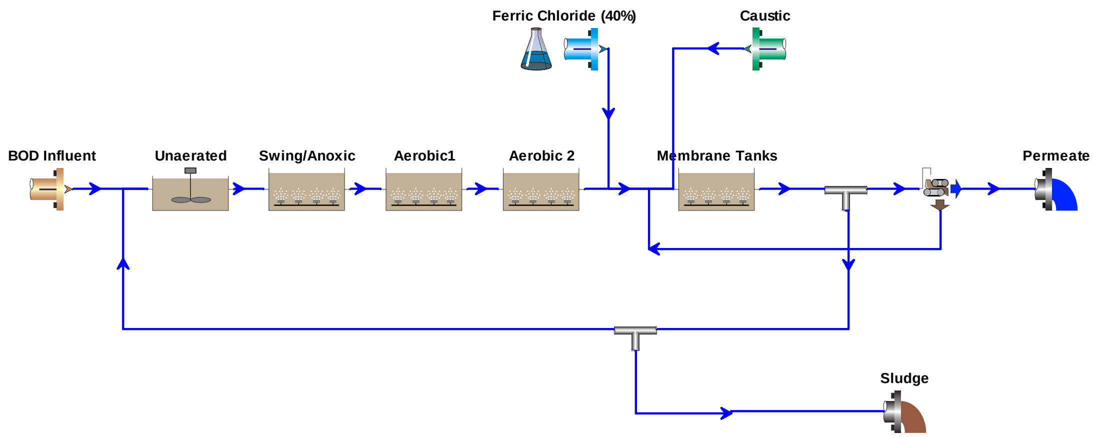
BioWin user and configuration data

Project details
Project name: North Kent Sewer Authority **Project ref.: 500354**
Plant name: NKSA **User name: JM**

Created: 1/8/2007 **Saved: 1/16/2007**

Steady state solution
SRT: 13.62
Temperature: 8.0

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Unaerated	1.1342	7980.0260	19.0
Membrane Tanks	0.2247	3533.8850	8.5
Aerobic1	1.0745	7979.9870	18.0
Aerobic 2	1.0745	7979.9870	18.0
Swing/Anoxic	1.1342	7980.0260	19.0

Configuration information for Splitter units

Operating data Average (flow/time weighted as required)

Element name	Split type	Average Split specification
Splitter	Flow paced	400.00 %
WAS Splitter	Flowrate [Side]	0.278

Configuration information for all Influent (SV) units – Sodium Hydroxide (30% w/w)

Operating data Average (flow/time weighted as required)

Element name	Caustic
Other Cations (strong bases) meq/L	9968.50
Total CO2 mmol/L	7.00
Flow	0.0048

Configuration information for all BOD Influent units

Operating data Average (flow/time weighted as required)

Element name	BOD Influent
Flow	7.491
Total Carbonaceous BOD mg/L	339.02
Volatile suspended solids mg/L	357.00
Total suspended solids mgTSS/L	446.29
Total Kjeldahl Nitrogen mgN/L	151.14
Total P mgP/L	14.12
Nitrate N mgN/L	0.00
pH	7.30
Alkalinity mmol/L	10.00
Calcium mg/L	160.00
Magnesium mg/L	51.00

Element name	BOD Influent
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.9028
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0650
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.2000
Fna - Ammonia [gNH3-N/gTKN]	0.6600
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0300
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0350
Fpo4 - Phosphate [gPO4-P/gTP]	0.5000
FupP - P:COD ratio for influent unbiodegradable part. COD [gP/gCOD]	0.0110

Configuration information for all Metal addition units – Ferric Chloride (40% w/w)

Operating data Average (flow/time weighted as required)

Element name	Ferric Chloride (40%)
Metal mg/L	195458.29
Other Anions (strong acids) meq/L	10499.67
Total CO2 mmol/L	7.00
Flow	0.0008

Configuration information for all Effluent units

BioWin Album

Album page - Summary Table

Elements	Flow [mgd]	Vol [Mil. Gal]	TSS [mg/L]	VSSs [mg/L]	CBODt [mg/L]	NH3-N [mg/L]	NO3-N [mg/L]	TP [mg/L]	DO [mg/L]	pH []
BOD Influent	7.49	0.00	446.34	357.00	339.02	99.75	0.00	14.12	0.00	7.30
Unaerated	37.18	1.13	8528.32	5087.93	1722.84	22.89	62.02	286.16	0.01	7.05
Swing /Anoxic	37.18	1.13	8518.29	5077.30	1711.57	14.73	70.57	286.16	0.58	6.75
Aerobic1	37.18	1.07	8508.78	5067.54	1701.44	6.91	78.74	286.16	0.75	6.55
Aerobic 2	37.18	1.07	8498.53	5057.84	1691.44	1.09	85.17	286.16	2.25	6.34
Membrane Tanks	181.55	0.22	10557.38	6272.15	2095.08	0.31	86.11	354.80	4.50	6.77
Permeate	7.22	0.00	0.06	0.00	0.93	0.31	86.11	0.99	4.50	6.77

Album page - Influent

BOD Influent		
Parameters	**Conc. (mg/L)**	**Mass rate (lb/d)**
Volatile suspended solids	357.00	22318.01
Total suspended solids	446.34	27903.01
Total P	14.12	882.72
Filtered TKN	124.91	7809.07
Particulate TKN	26.23	1639.51
Total Kjeldahl Nitrogen	151.14	9448.58
Filtered Carbonaceous BOD	121.08	7569.18
Total Carbonaceous BOD	339.02	21193.98
Total N	151.14	9448.58
Total inorganic N	99.75	6236.06
Alkalinity	10.00	283.57
pH	7.30	
Total inorganic suspended solids	89.34	5585.00
Ammonia N	99.75	6236.06
Nitrate N	0.00	0.00

Album page – Permeate (Effluent)

Permeate		
Parameters	**Conc. (mg/L)**	**Mass rate (lb/d)**
Volatile suspended solids	0.00	0.00
Total suspended solids	0.06	3.73
Total P	0.99	59.57
Filtered TKN	6.39	384.95
Particulate TKN	0.00	0.00
Total Kjeldahl Nitrogen	6.39	384.95
Filtered Carbonaceous BOD	0.93	56.13
Total Carbonaceous BOD	0.93	56.13
Total N	92.50	5572.46
Total inorganic N	86.42	5206.35
Alkalinity	2.28	62.43
pH	6.77	
Total inorganic suspended solids	0.06	3.73
Ammonia N	0.31	18.84
Nitrate N	86.11	5187.52

Album page – Unaerated Zone

Unaerated		
Parameters	**Conc. (mg/L)**	**Mass rate (lb/d)**
Volatile suspended solids	5087.93	1578567.10
Total suspended solids	8528.32	2645971.00
Total P	286.16	88782.38
Filtered TKN	29.51	9154.31
Particulate TKN	410.83	127462.95
Total Kjeldahl Nitrogen	440.34	136617.26
Filtered Carbonaceous BOD	1.44	446.73
Total Carbonaceous BOD	1722.84	534524.50
Total N	502.35	155858.38
Total inorganic N	84.91	26342.84
Alkalinity	13.74	1933.66
pH	7.05	
Total inorganic suspended solids	3440.39	1067403.90
Ammonia N	22.89	7101.72
Nitrate N	62.02	19241.12
Parameters	**Value**	**Units**
Flow	37.18	mgd
MLSS	8528.32	mg/L
Total oxygen uptake rate	4.90	mgO/L/hr
Carbonaceous OUR	3.33	mgO/L/hr
Nitrogenous OUR	1.57	mgO/L/hr
OTE	100.00	%
OTR	0.00	lb/hr
SOTE	100.00	%
SOTR	0.00	lb/hr
Air supply rate	0.00	ft3/min (20C, 1 atm)

Album page – Swing Zone

Swing/Anoxic		
Parameters	**Conc. (mg/L)**	**Mass rate (lb/d)**
Volatile suspended solids	5077.30	1575268.90
Total suspended solids	8518.29	2642859.80
Total P	286.16	88782.38
Filtered TKN	21.00	6515.90
Particulate TKN	410.27	127290.26
Total Kjeldahl Nitrogen	431.28	133806.16
Filtered Carbonaceous BOD	1.11	343.61
Total Carbonaceous BOD	1711.57	531026.15
Total N	501.84	155699.75
Total inorganic N	85.29	26462.41
Alkalinity	11.38	1601.08
pH	6.75	
Total inorganic suspended solids	3440.99	1067590.90
Ammonia N	14.73	4568.82
Nitrate N	70.57	21893.59
Parameters	**Value**	**Units**
Flow	37.18	mgd
MLSS	8518.29	mg/L
Total oxygen uptake rate	80.42	mgO/L/hr
Carbonaceous OUR	26.87	mgO/L/hr
Nitrogenous OUR	53.55	mgO/L/hr
OTE	16.74	%
OTR	768.61	lb/hr
SOTE	38.90	%
SOTR	1746.45	lb/hr
Air supply rate	4400.00	ft3/min (20C, 1 atm)

Album page – Aerobic 1

Aerobic1		
Parameters	**Conc. (mg/L)**	**Mass rate (lb/d)**
Volatile suspended solids	5067.54	1572240.60
Total suspended solids	8508.78	2639909.90
Total P	286.16	88782.38
Filtered TKN	13.05	4049.24
Particulate TKN	409.69	127109.08
Total Kjeldahl Nitrogen	422.74	131158.32
Filtered Carbonaceous BOD	1.02	316.81
Total Carbonaceous BOD	1701.44	527884.46
Total N	501.48	155589.07
Total inorganic N	85.65	26573.10
Alkalinity	8.44	1187.86
pH	6.55	
Total inorganic suspended solids	3441.24	1067669.30
Ammonia N	6.91	2142.35
Nitrate N	78.74	24430.75
Parameters	**Value**	**Units**
Flow	37.18	mgd
MLSS	8508.78	mg/L
Total oxygen uptake rate	79.05	mgO/L/hr
Carbonaceous OUR	25.77	mgO/L/hr
Nitrogenous OUR	53.27	mgO/L/hr
OTE	15.48	%
OTR	711.02	lb/hr
SOTE	36.55	%
SOTR	1640.87	lb/hr
Air supply rate	4400.00	ft3/min (20C, 1 atm)

Album page – Aerobic 2

Aerobic 2		
Parameters	**Conc. (mg/L)**	**Mass rate (lb/d)**
Volatile suspended solids	5057.84	1569232.10
Total suspended solids	8498.53	2636728.80
Total P	286.16	88782.38
Filtered TKN	7.18	2226.23
Particulate TKN	409.03	126903.03
Total Kjeldahl Nitrogen	416.20	129129.26
Filtered Carbonaceous BOD	0.95	294.99
Total Carbonaceous BOD	1691.44	524781.47
Total N	501.37	155553.01
Total inorganic N	86.25	26760.44
Alkalinity	6.07	854.53
pH	6.34	
Total inorganic suspended solids	3440.68	1067496.60
Ammonia N	1.09	336.69
Nitrate N	85.17	26423.75
Parameters	**Value**	**Units**
Flow	37.18	mgd
MLSS	8498.53	mg/L
Total oxygen uptake rate	66.33	mgO/L/hr
Carbonaceous OUR	25.44	mgO/L/hr
Nitrogenous OUR	40.89	mgO/L/hr
OTE	13.37	%
OTR	614.29	lb/hr
SOTE	36.55	%
SOTR	1640.87	lb/hr
Air supply rate	4400.00	ft3/min (20C, 1 atm)

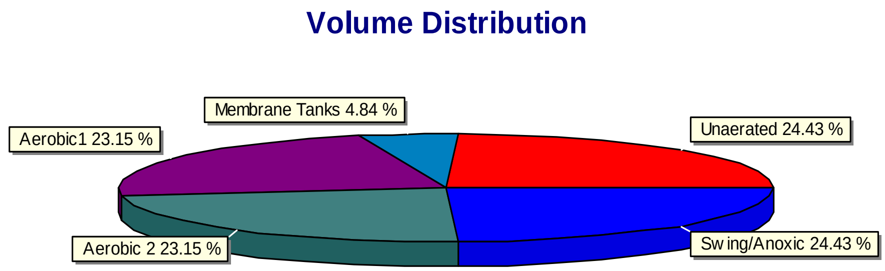
Album page – Membrane Tanks

Membrane Tanks		
Parameters	**Conc. (mg/L)**	**Mass rate (lb/d)**
Volatile suspended solids	6272.15	9503221.20
Total suspended solids	10557.38	15995985.00
Total P	354.80	537579.58
Filtered TKN	6.39	9681.83
Particulate TKN	507.25	768564.73
Total Kjeldahl Nitrogen	513.64	778246.55
Filtered Carbonaceous BOD	0.93	1411.79
Total Carbonaceous BOD	2095.08	3174353.50
Total N	599.76	908717.47
Total inorganic N	86.42	130944.71
Alkalinity	7.74	5316.54
pH	6.77	
Total inorganic suspended solids	4285.24	6492763.70
Ammonia N	0.31	473.79
Nitrate N	86.11	130470.92
Parameters	**Value**	**Units**
Flow	181.55	mgd
MLSS	10557.38	mg/L
Total oxygen uptake rate	60.69	mgO/L/hr
Carbonaceous OUR	31.39	mgO/L/hr
Nitrogenous OUR	29.31	mgO/L/hr

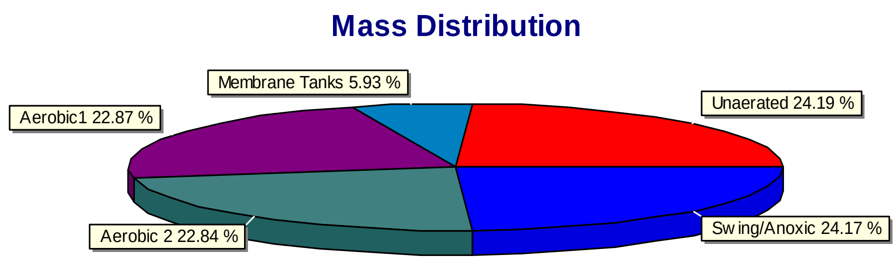
Album page – Sludge (WAS)

Sludge		
Parameters	**Conc. (mg/L)**	**Mass rate (lb/d)**
Volatile suspended solids	6272.15	14551.52
Total suspended solids	10557.38	24493.37
Total P	354.80	823.15
Filtered TKN	6.39	14.83
Particulate TKN	507.25	1176.84
Total Kjeldahl Nitrogen	513.64	1191.67
Filtered Carbonaceous BOD	0.93	2.16
Total Carbonaceous BOD	2095.08	4860.63
Total N	599.76	1391.45
Total inorganic N	86.42	200.51
Alkalinity	7.74	8.14
pH	6.77	
Total inorganic suspended solids	4285.24	9941.85
Ammonia N	0.31	0.73
Nitrate N	86.11	199.78

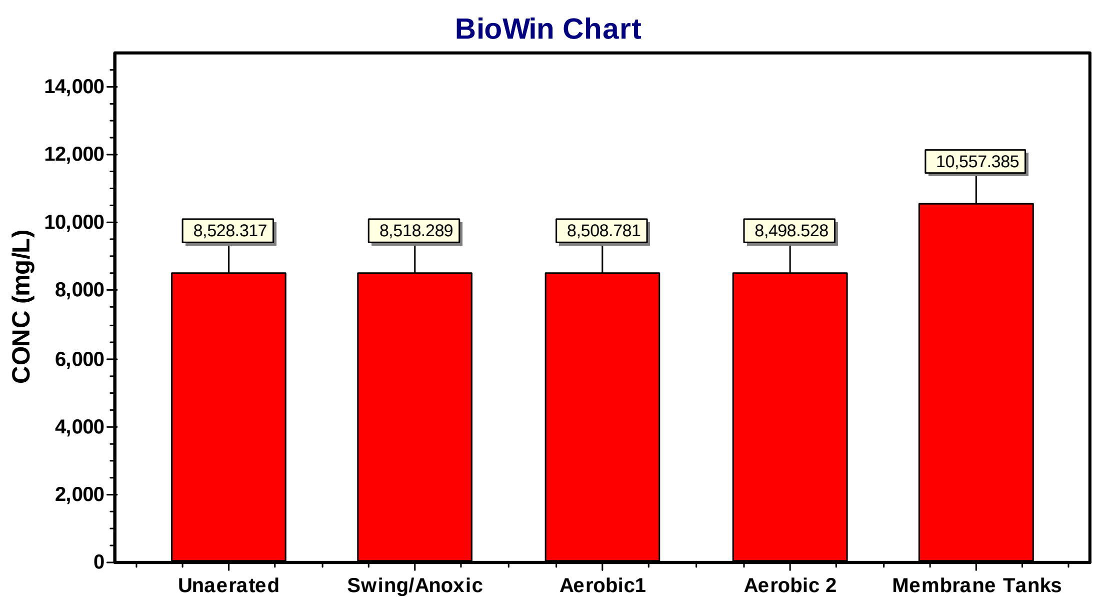
Album page - Fractions



Album page - Fractions



Album page – TSS Profile



Global Parameters

Autotroph Kinetic

Name	Default	Value
Max. spec. growth rate [1/d]	0.90000	0.90000
Substrate (NH4) half sat. [mgN/L]	0.70000	0.70000
Aerobic decay rate [1/d]	0.17000	0.17000
Anoxic/anaerobic decay rate [1/d]	0.08000	0.08000
CO2 half sat. for autotrophs [mmol/L]	0.01000	0.01000

Heterotroph Kinetic

Name	Default	Value
Max. spec. growth rate [1/d]	3.20000	3.20000
Substrate half sat. [mgCOD/L]	5.00000	5.00000
Anoxic growth factor [-]	0.50000	0.50000
Aerobic decay [1/d]	0.62000	0.62000
Anoxic/anaerobic decay [1/d]	0.30000	0.30000
Hydrolysis rate (AS) [1/d]	2.10000	2.10000
Hydrolysis half sat. (AS) [-]	0.06000	0.06000
Anoxic hydrolysis factor [-]	0.28000	0.28000
Anaerobic hydrolysis factor [-]	0.50000	0.50000
Adsorption rate of colloids [L/(mgCOD d)]	0.80000	0.80000
Ammonification rate [L/(mgN d)]	0.04000	0.04000
Fermentation rate [1/d]	3.20000	3.20000
Fermentation half sat. [mgCOD/L]	5.00000	5.00000
Anaerobic growth factor (AS) [-]	0.12500	0.12500
Hydrolysis rate (AD) [1/d]	0.10000	0.10000
Hydrolysis half sat. (AD) [mgCOD/L]	0.15000	0.15000

Methanol utilizers

Name	Default	Value
Max. spec. growth rate of methanol utilizers [1/d]	6.40000	6.40000
Methanol half sat. [mgCOD/L]	0.50000	0.50000
Aerobic decay rate of methanol utilizers [1/d]	0.24000	0.24000
Anoxic/anaerobic decay rate of methanol utilizers [1/d]	0.12000	0.12000

PolyP Kinetic

Name	Default	Value
Max. spec. growth rate [1/d]	0.95000	0.95000
Max. spec. growth rate, P-limited [1/d]	0.42000	0.42000
Substrate half sat. [mgCOD/L]	0.10000	0.10000
Substrate half sat., P-limited [mgCOD/L]	0.05000	0.05000
Magnesium half sat. [mgMg/L]	0.10000	0.10000
Cation half sat. [mmol/L]	0.10000	0.10000
Calcium half sat. [mgCa/L]	0.10000	0.10000
Aerobic decay rate [1/d]	0.10000	0.10000
Anaerobic decay rate [1/d]	0.04000	0.04000
Sequestration rate [1/d]	6.00000	6.00000
Anoxic growth factor [-]	0.33000	0.33000

Propionic Acetogen Kinetic

Name	Default	Value
Max. spec. growth rate [1/d]	0.25000	0.25000
Substrate half sat. [mgCOD/L]	10.00000	10.00000
Acetate inhibition [mgCOD/L]	10000.00000	10000.00000
Decay rate [1/d]	0.05000	0.05000
Aerobic decay rate [1/d]	0.52000	0.52000

Methanogen Kinetic

Name	Default	Value
Acetoclastic Mu Max [1/d]	0.30000	0.30000
H2-utilizing Mu Max [1/d]	1.40000	1.40000
Acetoclastic Ks [mgCOD/L]	100.00000	100.00000
H2-utilizing CO2 half sat. [mmol/L]	0.10000	0.10000
H2-utilizing Ks [mgCOD/L]	0.10000	0.10000
Acetoclastic propionic inhibition [mgCOD/L]	10000.00000	10000.00000
Acetoclastic decay rate [1/d]	0.13000	0.13000
Acetoclastic aerobic decay rate [1/d]	0.60000	0.60000
H2-utilizing decay rate [1/d]	0.13000	0.13000
H2-utilizing aerobic decay rate [1/d]	0.60000	0.60000

pH Inhibition

Name	Default	Value
Heterotrophs low pH limit [-]	4.00000	4.00000
Heterotrophs high pH limit [-]	10.00000	10.00000
Methanol utilizers low pH limit [-]	4.00000	4.00000
Methanol utilizers high pH limit [-]	10.00000	10.00000
Autotrophs low pH limit [-]	5.50000	5.50000
Autotrophs high pH limit [-]	9.50000	9.50000
PolyP heterotrophs low pH limit [-]	4.00000	4.00000
Poly P heterotrophs high pH limit [-]	10.00000	10.00000
Heterotrophs low pH limit (anaerobic) [-]	5.50000	5.50000
Heterotrophs high pH limit (anaerobic) [-]	8.50000	8.50000
Propionic acetogens low pH limit [-]	4.00000	4.00000
Propionic acetogens high pH limit [-]	10.00000	10.00000
Acetoclastic methanogens low pH limit [-]	5.50000	5.50000
Acetoclastic methanogens high pH limit [-]	8.50000	8.50000
H2-utilizing methanogens low pH limit [-]	5.50000	5.50000
H2-utilizing methanogens high pH limit [-]	8.50000	8.50000

Switching Functions

Name	Default	Value
Heterotrophic DO limit [mgO2/L]	0.05000	0.05000
Aerobic denit. DO limit [mgO2/L]	0.05000	0.05000
Autotrophic DO limit [mgO2/L]	0.25000	0.25000
Anoxic NO3 limit [mgN/L]	0.10000	0.10000
NH3 nutrient limit [mgN/L]	0.00500	0.00500
NO3 nutrient limit [mgN/L]	0.00500	0.00500
PolyP limit [mgP/L]	0.01000	0.01000
VFA sequestration limit [mgCOD/L]	5.00000	5.00000
P uptake limit [mgP/L]	0.15000	0.15000
P nutrient limit [mgP/L]	0.00500	0.00500
Heterotrophic Hydrogen limit [mgCOD/L]	1.00000	1.00000
Propionic acetogens Hydrogen limit [mgCOD/L]	5.00000	5.00000

Autotroph Stoich

Name	Default	Value
Yield [mgCOD/mgN]	0.24000	0.24000
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
P in inert [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

Heterotroph Stoich

Name	Default	Value
Yield (aerobic) [-]	0.66600	0.66600
Yield (fermentation, low H2) [-]	0.10000	0.10000
Yield (fermentation, high H2) [-]	0.10000	0.10000
Yield (fermentation of methanol) [-]	0.10000	0.10000
H2 yield (fermentation low H2) [-]	0.35000	0.35000
H2 yield (fermentation high H2) [-]	0.0	0.0
H2 yield (methanol fermentation) [-]	0.35000	0.35000
Propionate yield (fermentation, low H2) [-]	0.0	0.0
Propionate yield (fermentation, high H2) [-]	0.70000	0.70000
CO2 yield (fermentation, low H2) [-]	0.50000	0.50000
CO2 yield (fermentation, high H2) [-]	0.0	0.0
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
P in inert [mgP/mgCOD]	0.02200	0.02200
Endogenous Residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield (anoxic) [-]	0.54000	0.54000
Yield propionic (aerobic) [-]	0.50000	0.50000
Yield propionic (anoxic) [-]	0.41000	0.41000
Yield acetic (aerobic) [-]	0.40000	0.40000
Yield acetic (anoxic) [-]	0.32000	0.32000
Yield methanol (aerobic) [-]	0.50000	0.50000
Adsorp. max. [-]	1.00000	1.00000

Methanol utilizer

Name	Default	Value
Yield (anoxic) [-]	0.40000	0.40000
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
P in inert [mgP/mgCOD]	0.02200	0.02200
Endogenous Residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

PolyP Stoich

Name	Default	Value
Yield (aerobic) [-]	0.63900	0.63900
Yield (anoxic) [-]	0.52000	0.52000
Aerobic P/PHA uptake [mgP/mgCOD]	0.95000	0.95000
Anoxic P/PHA uptake [mgP/mgCOD]	0.35000	0.35000
Yield of PHA on sequestration [-]	0.88900	0.88900
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in part. inert [mgN/mgCOD]	0.07000	0.07000
N in sol. inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
P in part. inert [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous part. [-]	0.25000	0.25000
Inert fraction of endogenous sol. [-]	0.20000	0.20000
P/Ac release ratio [mgP/mgCOD]	0.49000	0.49000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield of low PP [-]	0.94000	0.94000

Propionic Acetogen Stoich

Name	Default	Value
Yield [-]	0.10000	0.10000
H2 yield [-]	0.40000	0.40000
CO2 yield [-]	1.00000	1.00000
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in endogenous residue [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
P in endogenous residue [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

Methanogen Stoich

Name	Default	Value
Acetoclastic yield [-]	0.10000	0.10000
H2-utilizing yield [-]	0.10000	0.10000
N in acetoclastic biomass [mgN/mgCOD]	0.07000	0.07000
N in H2-utilizing biomass [mgN/mgCOD]	0.07000	0.07000
N in acetoclastic endog. residue [mgN/mgCOD]	0.07000	0.07000
N in H2-utilizing endog. residue [mgN/mgCOD]	0.07000	0.07000
P in acetoclastic biomass [mgP/mgCOD]	0.02200	0.02200
P in H2-utilizing biomass [mgP/mgCOD]	0.02200	0.02200
P in acetoclastic endog. residue [mgP/mgCOD]	0.02200	0.02200
P in H2-utilizing endog. residue [mgP/mgCOD]	0.02200	0.02200
Acetoclastic fraction to endog. residue [-]	0.08000	0.08000
H2-utilizing fraction to endog. residue [-]	0.08000	0.08000
Acetoclastic COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
H2-utilizing COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

General Parameters

Name	Default	Value
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000
Ash content of biomass (synthesis ISS) [%]	8.00000	8.00000
Molecular weight of other anions [mg/mmol]	35.50000	35.50000
Molecular weight of other cations [mg/mmol]	39.10000	39.10000
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	0.30000	0.30000
Cation to P mole ratio in polyphosphate [meq/mmolP]	0.30000	0.30000
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	0.05000	0.05000
Cation to P mole ratio in organic phosphate [meq/mmolP]	0.01000	0.01000
Bubble rise velocity (anaerobic digester) [cm/s]	23.90000	23.90000
Bubble Sauter mean diameter (anaerobic digester) [cm]	0.35000	0.35000

Physico-chemical rates

Name	Default	Value
Struvite precipitation rate [1/d]	3.0000E+10	3.0000E+10
Struvite redissolution rate [1/d]	3.0000E+11	3.0000E+11
Struvite half sat. [mgTSS/L]	1.00000	1.00000
HDP precipitation rate [L/(molP d)]	1.0000E+8	1.0000E+8
HDP redissolution rate [L/(mol P d)]	1.0000E+8	1.0000E+8
HAP precipitation rate [molHDP/(L d)]	5.0000E-4	5.0000E-4

Physico-chemical constants

Name	Default	Value
Struvite solubility constant [mol/L]	6.9180E-14	6.9180E-14
HDP solubility product [mol/L]	2.7500E-22	2.7500E-22
HDP half sat. [mgTSS/L]	1.00000	1.00000
Equilibrium soluble PO4 with Al dosing at pH 7 [mgP/L]	0.01000	0.01000
Al to P ratio [molAl/molP]	0.80000	0.80000
Al(OH)3 solubility product [mol/L]	1.2590E+9	1.2590E+9
AlHPO4+ dissociation constant [mol/L]	7.9430E-13	7.9430E-13
Equilibrium soluble PO4 with Fe dosing at pH 7 [mgP/L]	0.01000	0.01000
Fe to P ratio [molFe/molP]	1.60000	1.60000
Fe(OH)3 solubility product [mol/L]	0.05000	0.05000
FeH2PO4++ dissociation constant [mol/L]	5.0120E-22	5.0120E-22

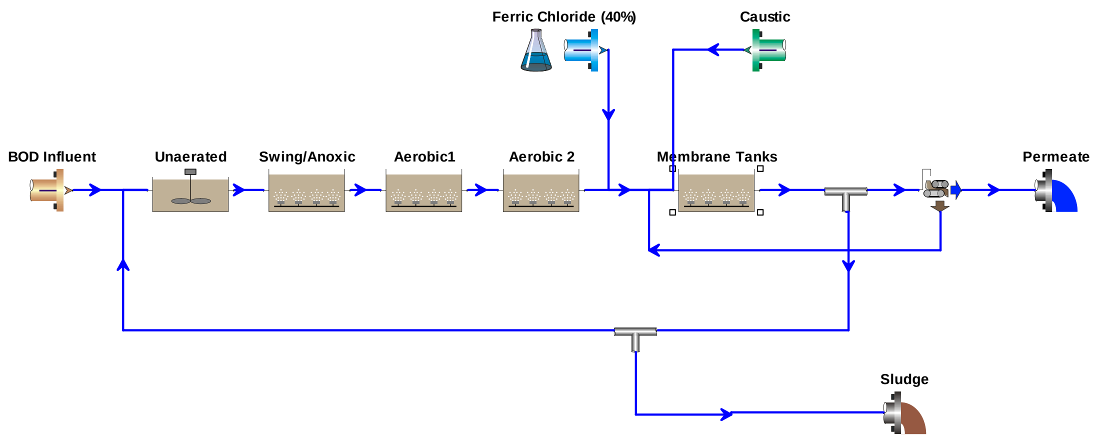
BioWin user and configuration data

Project details
Project name: North Kent Sewer Authority **Project ref.: 500354**
Plant name: NKSA **User name: JM**

Created: 2/24/2000 **Saved: 1/26/2007**

Steady state solution
SRT: 13.62
Temperature: 15.0

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Unaerated	1.1342	7980.0260	19.0
Membrane Tanks	0.2247	3533.8850	8.5
Aerobic1	1.0745	7979.9870	18.0
Aerobic 2	1.0745	7979.9870	18.0
Swing/Anoxic	1.1342	7980.0260	19.0

Configuration information for Splitter units

Operating data Average (flow/time weighted as required)

Element name	Split type	Average Split specification
Splitter	Flow paced	400.00 %
WAS Splitter	Flowrate [Side]	0.278

Configuration information for all Influent (SV) units – Sodium Hydroxide (30% w/w)

Operating data Average (flow/time weighted as required)

Element name	Caustic
Other Cations (strong bases) meq/L	9968.50
Total CO2 mmol/L	7.00
Flow	0.0041

Configuration information for all BOD Influent units

Operating data Average (flow/time weighted as required)

Element name	BOD Influent
Flow	7.491
Total Carbonaceous BOD mg/L	339.02
Volatile suspended solids mg/L	357.00
Total suspended solids mgTSS/L	446.29
Total Kjeldahl Nitrogen mgN/L	151.14
Total P mgP/L	14.12
Nitrate N mgN/L	0.00
pH	7.30
Alkalinity mmol/L	10.00
Calcium mg/L	160.00
Magnesium mg/L	51.00

Element name	BOD Influent
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.9028
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0650
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.2000
Fna - Ammonia [gNH3-N/gTKN]	0.6600
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0300
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0350
Fpo4 - Phosphate [gPO4-P/gTP]	0.5000
FupP - P:COD ratio for influent unbiodegradable part. COD [gP/gCOD]	0.0110

Configuration information for all Metal addition units – Ferric Chloride (40% w/w)

Operating data Average (flow/time weighted as required)

Element name	Ferric Chloride (40%)
Metal mg/L	195458.29
Other Anions (strong acids) meq/L	10499.67
Total CO2 mmol/L	7.00
Flow	0.0008

Configuration information for all Effluent units

BioWin Album
Album page - Summary Table

Elements	Flow [mgd]	Vol [Mil. Gal]	TSS [mg/L]	VSSs [mg/L]	CBODt [mg/L]	NH3-N [mg/L]	NO3-N [mg/L]	TP [mg/L]	DO [mg/L]	pH []
BOD Influent	7.49	0.00	446.34	357.00	339.02	99.75	0.00	14.12	0.00	7.30
Unaerated	37.18	1.13	8349.80	4872.33	1523.48	22.73	57.01	286.22	0.00	7.04
Swing /Anoxic	37.18	1.13	8339.36	4861.37	1511.95	13.96	65.60	286.22	0.25	6.70
Aerobic1	37.18	1.07	8329.23	4851.32	1501.57	5.55	73.92	286.22	0.31	6.45
Aerobic 2	37.18	1.07	8317.00	4840.87	1490.86	0.43	79.67	286.22	2.14	6.20
Membrane Tanks	181.54	0.22	10334.33	6002.67	1845.96	0.10	80.19	354.88	4.50	6.68
Permeate	7.22	0.00	0.03	0.00	0.91	0.10	80.19	0.99	4.50	6.68

Album page - Influent

BOD Influent		
Parameters	**Conc. (mg/L)**	**Mass rate (lb/d)**
Volatile suspended solids	357.00	22318.01
Total suspended solids	446.34	27903.01
Total P	14.12	882.72
Filtered TKN	124.91	7809.07
Particulate TKN	26.23	1639.51
Total Kjeldahl Nitrogen	151.14	9448.58
Filtered Carbonaceous BOD	121.08	7569.18
Total Carbonaceous BOD	339.02	21193.98
Total N	151.14	9448.58
Total inorganic N	99.75	6236.06
Alkalinity	10.00	283.56
pH	7.30	
Total inorganic suspended solids	89.34	5585.00
Ammonia N	99.75	6236.06
Nitrate N	0.00	0.00

Album page – Permeate (Effluent)

Permeate		
Parameters	**Conc. (mg/L)**	**Mass rate (lb/d)**
Volatile suspended solids	0.00	0.00
Total suspended solids	0.03	1.86
Total P	0.99	59.39
Filtered TKN	6.14	370.11
Particulate TKN	0.00	0.00
Total Kjeldahl Nitrogen	6.14	370.11
Filtered Carbonaceous BOD	0.91	54.76
Total Carbonaceous BOD	0.91	54.76
Total N	86.33	5200.39
Total inorganic N	80.29	4836.11
Alkalinity	1.71	46.74
pH	6.68	
Total inorganic suspended solids	0.03	1.86
Ammonia N	0.10	5.84
Nitrate N	80.19	4830.28

Album page – Unaerated Zone

Unaerated		
Parameters	**Conc. (mg/L)**	**Mass rate (lb/d)**
Volatile suspended solids	4872.33	1511675.10
Total suspended solids	8349.80	2590585.80
Total P	286.22	88800.79
Filtered TKN	29.26	9078.64
Particulate TKN	389.50	120845.66
Total Kjeldahl Nitrogen	418.76	129924.30
Filtered Carbonaceous BOD	1.37	426.57
Total Carbonaceous BOD	1523.48	472670.91
Total N	475.77	147610.71
Total inorganic N	79.74	24738.94
Alkalinity	13.21	1858.64
pH	7.04	
Total inorganic suspended solids	3477.47	1078910.70
Ammonia N	22.73	7052.53
Nitrate N	57.01	17686.41
Parameters	**Value**	**Units**
Flow	37.18	mgd
MLSS	8349.80	mg/L
Total oxygen uptake rate	4.90	mgO/L/hr
Carbonaceous OUR	2.91	mgO/L/hr
Nitrogenous OUR	2.00	mgO/L/hr
OTE	100.00	%
OTR	0.00	lb/hr
SOTE	100.00	%
SOTR	0.00	lb/hr
Air supply rate	0.00	ft3/min (20C, 1 atm)

Album page – Swing/Anoxic Zone

Swing/Anoxic		
Parameters	**Conc. (mg/L)**	**Mass rate (lb/d)**
Volatile suspended solids	4861.37	1508273.30
Total suspended solids	8339.36	2587344.10
Total P	286.22	88800.79
Filtered TKN	20.13	6246.60
Particulate TKN	388.91	120663.51
Total Kjeldahl Nitrogen	409.05	126910.11
Filtered Carbonaceous BOD	1.07	330.73
Total Carbonaceous BOD	1511.95	469091.76
Total N	474.65	147262.40
Total inorganic N	79.56	24683.23
Alkalinity	10.47	1473.89
pH	6.70	
Total inorganic suspended solids	3477.99	1079070.80
Ammonia N	13.96	4330.95
Nitrate N	65.60	20352.29
Parameters	**Value**	**Units**
Flow	37.18	mgd
MLSS	8339.36	mg/L
Total oxygen uptake rate	82.66	mgO/L/hr
Carbonaceous OUR	25.25	mgO/L/hr
Nitrogenous OUR	57.41	mgO/L/hr
OTE	17.10	%
OTR	785.53	lb/hr
SOTE	38.90	%
SOTR	1746.45	lb/hr
Air supply rate	4400.00	ft3/min (20C, 1 atm)

Album page – Aerobic 1

Aerobic1		
Parameters	**Conc. (mg/L)**	**Mass rate (lb/d)**
Volatile suspended solids	4851.32	1505156.40
Total suspended solids	8329.23	2584203.70
Total P	286.22	88800.79
Filtered TKN	11.60	3600.53
Particulate TKN	388.29	120471.13
Total Kjeldahl Nitrogen	399.90	124071.65
Filtered Carbonaceous BOD	0.98	304.82
Total Carbonaceous BOD	1501.57	465872.41
Total N	473.82	147006.72
Total inorganic N	79.47	24657.60
Alkalinity	7.17	1009.68
pH	6.45	
Total inorganic suspended solids	3477.91	1079047.30
Ammonia N	5.55	1722.54
Nitrate N	73.92	22935.06
Parameters	**Value**	**Units**
Flow	37.18	mgd
MLSS	8329.23	mg/L
Total oxygen uptake rate	81.68	mgO/L/hr
Carbonaceous OUR	24.57	mgO/L/hr
Nitrogenous OUR	57.11	mgO/L/hr
OTE	15.97	%
OTR	733.27	lb/hr
SOTE	36.55	%
SOTR	1640.87	lb/hr
Air supply rate	4400.00	ft3/min (20C, 1 atm)

Album page – Aerobic 2

Aerobic 2		
Parameters	**Conc. (mg/L)**	**Mass rate (lb/d)**
Volatile suspended solids	4840.87	1501913.60
Total suspended solids	8317.00	2580407.80
Total P	286.22	88800.79
Filtered TKN	6.48	2010.54
Particulate TKN	387.55	120239.07
Total Kjeldahl Nitrogen	394.03	122249.60
Filtered Carbonaceous BOD	0.93	289.36
Total Carbonaceous BOD	1490.86	462549.59
Total N	473.69	146966.84
Total inorganic N	80.09	24849.99
Alkalinity	4.90	689.67
pH	6.20	
Total inorganic suspended solids	3476.13	1078494.20
Ammonia N	0.43	132.75
Nitrate N	79.67	24717.24
Parameters	**Value**	**Units**
Flow	37.18	mgd
MLSS	8317.00	mg/L
Total oxygen uptake rate	63.61	mgO/L/hr
Carbonaceous OUR	26.77	mgO/L/hr
Nitrogenous OUR	36.85	mgO/L/hr
OTE	12.94	%
OTR	594.18	lb/hr
SOTE	36.55	%
SOTR	1640.87	lb/hr
Air supply rate	4400.00	ft3/min (20C, 1 atm)

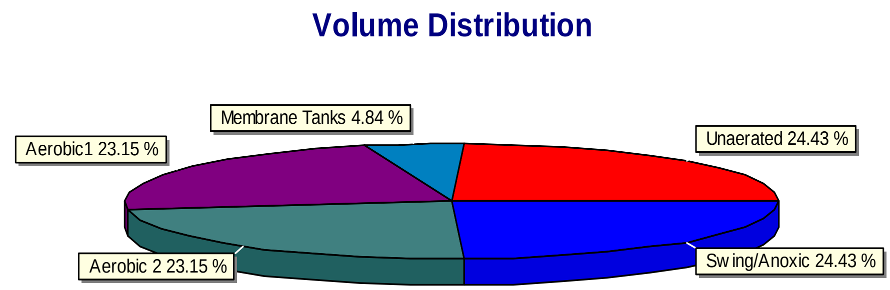
Album page – Membrane Tanks

Membrane Tanks		
Parameters	**Conc. (mg/L)**	**Mass rate (lb/d)**
Volatile suspended solids	6002.67	9094221.70
Total suspended solids	10334.33	15656820.00
Total P	354.88	537650.86
Filtered TKN	6.14	9308.70
Particulate TKN	480.57	728083.50
Total Kjeldahl Nitrogen	486.72	737392.20
Filtered Carbonaceous BOD	0.91	1377.38
Total Carbonaceous BOD	1845.96	2796683.80
Total N	566.91	858880.12
Total inorganic N	80.29	121634.69
Alkalinity	6.37	4374.51
pH	6.68	
Total inorganic suspended solids	4331.66	6562598.70
Ammonia N	0.10	146.77
Nitrate N	80.19	121487.92
Parameters	**Value**	**Units**
Flow	181.54	mgd
MLSS	10334.33	mg/L
Total oxygen uptake rate	50.30	mgO/L/hr
Carbonaceous OUR	32.96	mgO/L/hr
Nitrogenous OUR	17.34	mgO/L/hr

Album page – Sludge (WAS)

Sludge		
Parameters	**Conc. (mg/L)**	**Mass rate (lb/d)**
Volatile suspended solids	6002.67	13926.32
Total suspended solids	10334.33	23975.88
Total P	354.88	823.32
Filtered TKN	6.14	14.25
Particulate TKN	480.57	1114.94
Total Kjeldahl Nitrogen	486.72	1129.20
Filtered Carbonaceous BOD	0.91	2.11
Total Carbonaceous BOD	1845.96	4282.67
Total N	566.91	1315.24
Total inorganic N	80.29	186.26
Alkalinity	6.37	6.70
pH	6.68	
Total inorganic suspended solids	4331.66	10049.55
Ammonia N	0.10	0.22
Nitrate N	80.19	186.04

Album page - Fractions



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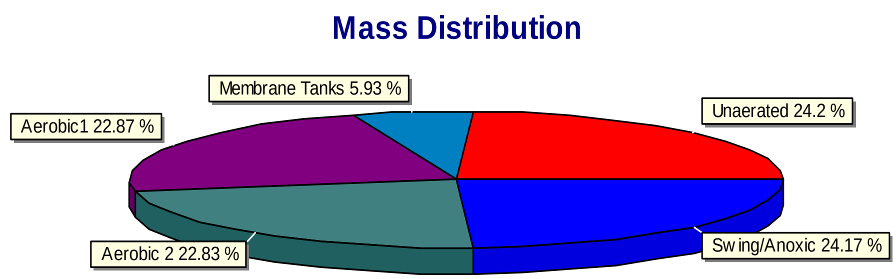

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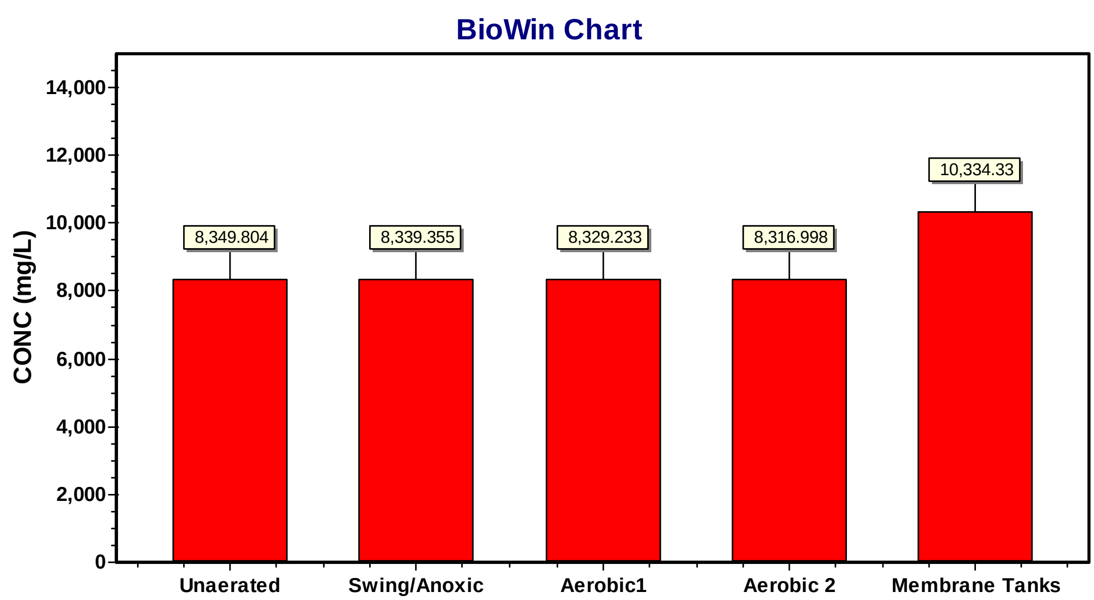

Global Parameters

Autotroph Kinetic

Name	Default	Value
Max. spec. growth rate [1/d]	0.90000	0.90000
Substrate (NH4) half sat. [mgN/L]	0.70000	0.70000
Aerobic decay rate [1/d]	0.17000	0.17000
Anoxic/anaerobic decay rate [1/d]	0.08000	0.08000
CO2 half sat. for autotrophs [mmol/L]	0.01000	0.01000

Heterotroph Kinetic

Name	Default	Value
Max. spec. growth rate [1/d]	3.20000	3.20000
Substrate half sat. [mgCOD/L]	5.00000	5.00000
Anoxic growth factor [-]	0.50000	0.50000
Aerobic decay [1/d]	0.62000	0.62000
Anoxic/anaerobic decay [1/d]	0.30000	0.30000
Hydrolysis rate (AS) [1/d]	2.10000	2.10000
Hydrolysis half sat. (AS) [-]	0.06000	0.06000
Anoxic hydrolysis factor [-]	0.28000	0.28000
Anaerobic hydrolysis factor [-]	0.50000	0.50000
Adsorption rate of colloids [L/(mgCOD d)]	0.80000	0.80000
Ammonification rate [L/(mgN d)]	0.04000	0.04000
Fermentation rate [1/d]	3.20000	3.20000
Fermentation half sat. [mgCOD/L]	5.00000	5.00000
Anaerobic growth factor (AS) [-]	0.12500	0.12500
Hydrolysis rate (AD) [1/d]	0.10000	0.10000
Hydrolysis half sat. (AD) [mgCOD/L]	0.15000	0.15000

Methanol utilizers

Name	Default	Value
Max. spec. growth rate of methanol utilizers [1/d]	6.40000	6.40000
Methanol half sat. [mgCOD/L]	0.50000	0.50000
Aerobic decay rate of methanol utilizers [1/d]	0.24000	0.24000
Anoxic/anaerobic decay rate of methanol utilizers [1/d]	0.12000	0.12000

PolyP Kinetic

Name	Default	Value
Max. spec. growth rate [1/d]	0.95000	0.95000
Max. spec. growth rate, P-limited [1/d]	0.42000	0.42000
Substrate half sat. [mgCOD/L]	0.10000	0.10000
Substrate half sat., P-limited [mgCOD/L]	0.05000	0.05000
Magnesium half sat. [mgMg/L]	0.10000	0.10000
Cation half sat. [mmol/L]	0.10000	0.10000
Calcium half sat. [mgCa/L]	0.10000	0.10000
Aerobic decay rate [1/d]	0.10000	0.10000
Anaerobic decay rate [1/d]	0.04000	0.04000
Sequestration rate [1/d]	6.00000	6.00000
Anoxic growth factor [-]	0.33000	0.33000

Propionic Acetogen Kinetic

Name	Default	Value
Max. spec. growth rate [1/d]	0.25000	0.25000
Substrate half sat. [mgCOD/L]	10.00000	10.00000
Acetate inhibition [mgCOD/L]	10000.00000	10000.00000
Decay rate [1/d]	0.05000	0.05000
Aerobic decay rate [1/d]	0.52000	0.52000

Methanogen Kinetic

Name	Default	Value
Acetoclastic Mu Max [1/d]	0.30000	0.30000
H2-utilizing Mu Max [1/d]	1.40000	1.40000
Acetoclastic Ks [mgCOD/L]	100.00000	100.00000
H2-utilizing CO2 half sat. [mmol/L]	0.10000	0.10000
H2-utilizing Ks [mgCOD/L]	0.10000	0.10000
Acetoclastic propionic inhibition [mgCOD/L]	10000.00000	10000.00000
Acetoclastic decay rate [1/d]	0.13000	0.13000
Acetoclastic aerobic decay rate [1/d]	0.60000	0.60000
H2-utilizing decay rate [1/d]	0.13000	0.13000
H2-utilizing aerobic decay rate [1/d]	0.60000	0.60000

pH Inhibition

Name	Default	Value
Heterotrophs low pH limit [-]	4.00000	4.00000
Heterotrophs high pH limit [-]	10.00000	10.00000
Methanol utilizers low pH limit [-]	4.00000	4.00000
Methanol utilizers high pH limit [-]	10.00000	10.00000
Autotrophs low pH limit [-]	5.50000	5.50000
Autotrophs high pH limit [-]	9.50000	9.50000
PolyP heterotrophs low pH limit [-]	4.00000	4.00000
Poly P heterotrophs high pH limit [-]	10.00000	10.00000
Heterotrophs low pH limit (anaerobic) [-]	5.50000	5.50000
Heterotrophs high pH limit (anaerobic) [-]	8.50000	8.50000
Propionic acetogens low pH limit [-]	4.00000	4.00000
Propionic acetogens high pH limit [-]	10.00000	10.00000
Acetoclastic methanogens low pH limit [-]	5.50000	5.50000
Acetoclastic methanogens high pH limit [-]	8.50000	8.50000
H2-utilizing methanogens low pH limit [-]	5.50000	5.50000
H2-utilizing methanogens high pH limit [-]	8.50000	8.50000

Switching Functions

Name	Default	Value
Heterotrophic DO limit [mgO2/L]	0.05000	0.05000
Aerobic denit. DO limit [mgO2/L]	0.05000	0.05000
Autotrophic DO limit [mgO2/L]	0.25000	0.25000
Anoxic NO3 limit [mgN/L]	0.10000	0.10000
NH3 nutrient limit [mgN/L]	0.00500	0.00500
NO3 nutrient limit [mgN/L]	0.00500	0.00500
PolyP limit [mgP/L]	0.01000	0.01000
VFA sequestration limit [mgCOD/L]	5.00000	5.00000
P uptake limit [mgP/L]	0.15000	0.15000
P nutrient limit [mgP/L]	0.00500	0.00500
Heterotrophic Hydrogen limit [mgCOD/L]	1.00000	1.00000
Propionic acetogens Hydrogen limit [mgCOD/L]	5.00000	5.00000

Autotroph Stoich

Name	Default	Value
Yield [mgCOD/mgN]	0.24000	0.24000
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
P in inert [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

Heterotroph Stoich

Name	Default	Value
Yield (aerobic) [-]	0.66600	0.66600
Yield (fermentation, low H2) [-]	0.10000	0.10000
Yield (fermentation, high H2) [-]	0.10000	0.10000
Yield (fermentation of methanol) [-]	0.10000	0.10000
H2 yield (fermentation low H2) [-]	0.35000	0.35000
H2 yield (fermentation high H2) [-]	0.0	0.0
H2 yield (methanol fermentation) [-]	0.35000	0.35000
Propionate yield (fermentation, low H2) [-]	0.0	0.0
Propionate yield (fermentation, high H2) [-]	0.70000	0.70000
CO2 yield (fermentation, low H2) [-]	0.50000	0.50000
CO2 yield (fermentation, high H2) [-]	0.0	0.0
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
P in inert [mgP/mgCOD]	0.02200	0.02200
Endogenous Residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield (anoxic) [-]	0.54000	0.54000
Yield propionic (aerobic) [-]	0.50000	0.50000
Yield propionic (anoxic) [-]	0.41000	0.41000
Yield acetic (aerobic) [-]	0.40000	0.40000
Yield acetic (anoxic) [-]	0.32000	0.32000
Yield methanol (aerobic) [-]	0.50000	0.50000
Adsorp. max. [-]	1.00000	1.00000

Methanol utilizer

Name	Default	Value
Yield (anoxic) [-]	0.40000	0.40000
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
P in inert [mgP/mgCOD]	0.02200	0.02200
Endogenous Residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

PolyP Stoich

Name	Default	Value
Yield (aerobic) [-]	0.63900	0.63900
Yield (anoxic) [-]	0.52000	0.52000
Aerobic P/PHA uptake [mgP/mgCOD]	0.95000	0.95000
Anoxic P/PHA uptake [mgP/mgCOD]	0.35000	0.35000
Yield of PHA on sequestration [-]	0.88900	0.88900
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in part. inert [mgN/mgCOD]	0.07000	0.07000
N in sol. inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
P in part. inert [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous part. [-]	0.25000	0.25000
Inert fraction of endogenous sol. [-]	0.20000	0.20000
P/Ac release ratio [mgP/mgCOD]	0.49000	0.49000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield of low PP [-]	0.94000	0.94000

Propionic Acetogen Stoich

Name	Default	Value
Yield [-]	0.10000	0.10000
H2 yield [-]	0.40000	0.40000
CO2 yield [-]	1.00000	1.00000
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in endogenous residue [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
P in endogenous residue [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

Methanogen Stoich

Name	Default	Value
Acetoclastic yield [-]	0.10000	0.10000
H2-utilizing yield [-]	0.10000	0.10000
N in acetoclastic biomass [mgN/mgCOD]	0.07000	0.07000
N in H2-utilizing biomass [mgN/mgCOD]	0.07000	0.07000
N in acetoclastic endog. residue [mgN/mgCOD]	0.07000	0.07000
N in H2-utilizing endog. residue [mgN/mgCOD]	0.07000	0.07000
P in acetoclastic biomass [mgP/mgCOD]	0.02200	0.02200
P in H2-utilizing biomass [mgP/mgCOD]	0.02200	0.02200
P in acetoclastic endog. residue [mgP/mgCOD]	0.02200	0.02200
P in H2-utilizing endog. residue [mgP/mgCOD]	0.02200	0.02200
Acetoclastic fraction to endog. residue [-]	0.08000	0.08000
H2-utilizing fraction to endog. residue [-]	0.08000	0.08000
Acetoclastic COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
H2-utilizing COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

General Parameters

Name	Default	Value
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000
Ash content of biomass (synthesis ISS) [%]	8.00000	8.00000
Molecular weight of other anions [mg/mmol]	35.50000	35.50000
Molecular weight of other cations [mg/mmol]	39.10000	39.10000
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	0.30000	0.30000
Cation to P mole ratio in polyphosphate [meq/mmolP]	0.30000	0.30000
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	0.05000	0.05000
Cation to P mole ratio in organic phosphate [meq/mmolP]	0.01000	0.01000
Bubble rise velocity (anaerobic digester) [cm/s]	23.90000	23.90000
Bubble Sauter mean diameter (anaerobic digester) [cm]	0.35000	0.35000

Physico-chemical rates

Name	Default	Value
Struvite precipitation rate [1/d]	3.0000E+10	3.0000E+10
Struvite redissolution rate [1/d]	3.0000E+11	3.0000E+11
Struvite half sat. [mgTSS/L]	1.00000	1.00000
HDP precipitation rate [L/(molP d)]	1.0000E+8	1.0000E+8
HDP redissolution rate [L/(mol P d)]	1.0000E+8	1.0000E+8
HAP precipitation rate [molHDP/(L d)]	5.0000E-4	5.0000E-4

Physico-chemical constants

Name	Default	Value
Struvite solubility constant [mol/L]	6.9180E-14	6.9180E-14
HDP solubility product [mol/L]	2.7500E-22	2.7500E-22
HDP half sat. [mgTSS/L]	1.00000	1.00000
Equilibrium soluble PO4 with Al dosing at pH 7 [mgP/L]	0.01000	0.01000
Al to P ratio [molAl/molP]	0.80000	0.80000
Al(OH)3 solubility product [mol/L]	1.2590E+9	1.2590E+9
AlHPO4+ dissociation constant [mol/L]	7.9430E-13	7.9430E-13
Equilibrium soluble PO4 with Fe dosing at pH 7 [mgP/L]	0.01000	0.01000
Fe to P ratio [molFe/molP]	1.60000	1.60000
Fe(OH)3 solubility product [mol/L]	0.05000	0.05000
FeH2PO4++ dissociation constant [mol/L]	5.0120E-22	5.0120E-22

Appendix B

2015 NPDES Permit

PERMIT NO. MI0057419

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act (33 U.S.C. 1251 *et seq*., as amended; the "Federal Act"); Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA); Part 41, Sewerage Systems, of the NREPA; and Michigan Executive Order 2011-1,

North Kent Sewer Authority
4775 Coit Avenue, NE
Grand Rapids, Michigan 49525

is authorized to discharge from the **PARCC Side Clean Water Plant** located at

4775 Coit Avenue
Grand Rapids, Michigan 49525

designated as **North Kent SA WWTP**

to the receiving water named the Grand River in accordance with effluent limitations, monitoring requirements, and other conditions set forth in this permit.

This permit is based on a complete application submitted on March 26, 2013 as amended through April 15, 2015.

This permit takes effect on September 1, 2015. The provisions of this permit are severable. After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked in whole or in part during its term in accordance with applicable laws and rules. On its effective date this permit shall supersede NPDES Permit No. MI0057419, expiring October 1, 2013.

This permit and the authorization to discharge shall expire at midnight, **October 1, 2018**. In order to receive authorization to discharge beyond the date of expiration, the permittee shall submit an application which contains such information, forms, and fees as are required by the Department of Environmental Quality (Department) by **April 4, 2018**.

Issued: August 27, 2015

Original signed by Philip Argiroff
Philip Argiroff, Chief
Permits Section
Water Resources Division

PERMIT FEE REQUIREMENTS

In accordance with Section 324.3120 of the NREPA, the permittee shall make payment of an annual permit fee to the Department for each October 1 the permit is in effect regardless of occurrence of discharge. The permittee shall submit the fee in response to the Department's annual notice. The fee shall be postmarked by January 15 for notices mailed by December 1. The fee is due no later than 45 days after receiving the notice for notices mailed after December 1.

Annual Permit Fee Classification: Municipal Major, less than 10 MGD (Individual Permit)

In accordance with Section 324.3132 of the NREPA, the permittee shall make payment of an annual biosolids land application fee to the Department if the permittee land applies biosolids. In response to the Department's annual notice, the permittee shall submit the fee, which shall be postmarked no later than January 31 of each year.

CONTACT INFORMATION

Unless specified otherwise, all contact with the Department required by this permit shall be made to the Grand Rapids District Supervisor of the Water Resources Division. The Grand Rapids District Office is located at the State Office Building, Fifth Floor, 350 Ottawa N.W., Unit 10, Grand Rapids, Michigan 49503-2341, Telephone: 616-356-0500, Fax: 616-356-0202.

CONTESTED CASE INFORMATION

Any person who is aggrieved by this permit may file a sworn petition with the Michigan Administrative Hearing System within the Michigan Department of Licensing and Regulatory Affairs, c/o the Michigan Department of Environmental Quality, setting forth the conditions of the permit which are being challenged and specifying the grounds for the challenge. The Department of Licensing and Regulatory Affairs may reject any petition filed more than 60 days after issuance as being untimely.

PART I

Section A. Limitations and Monitoring Requirements

1. Final Effluent Limitations, Monitoring Point 001A

During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the permittee is authorized to discharge treated municipal wastewater from Monitoring Point 001A through Outfall 001. Outfall 001 discharges to the Grand River. Such discharge shall be limited and monitored by the permittee as specified below.

	Maximum Limits for Quantity or Loading				Maximum Limits for Quality or Concentration					
Parameter	**Monthly**	**7-Day**	**Daily**	**Units**	**Monthly**	**7-Day**	**Daily**	**Units**	**Monitoring Frequency**	**Sample Type**
Flow	(report)	---	(report)	MGD	---	---	---	---	5x/week	Report Total Daily Flow
Carbonaceous Biochemical Oxygen Demand ($CBOD_5$)										
5/1-11/30	270	670	---	lbs/day	4	---	10	mg/l	5x/week	24-Hr Composite
12/1-4/30	1700	2700	---	lbs/day	25	40	---	mg/l	5x/week	24-Hr Composite
Total Suspended Solids										
5/1-11/30	1300	2000	---	lbs/day	20	30	---	mg/l	5x/week	24-Hr Composite
12/1-4/30	2000	3000	---	lbs/day	30	45	---	mg/l	5x/week	24-Hr Composite
Ammonia Nitrogen (as N)										
5/1-11/30	30	130	---	lbs/day	0.5	---	2.0	mg/l	5x/week	24-Hr Composite
12/1-4/30	---	---	---	---	---	---	(report)	mg/l	5x/week	24-Hr Composite
Total Phosphorus (as P)	67	---	---	lbs/day	1.0	---	---	mg/l	5x/week	24-Hr Composite
Fecal Coliform Bacteria	---	---	---	---	200	400	---	cts/100 ml	5x/week	Grab
Acute Toxicity										
Ceriodaphnia dubia	---	---	---	---	---	---	1.0	TU_A	Monthly	24-Hr Composite
Chronic Toxicity										
Ceriodaphnia dubia	---	---	---	---	18.4	---	---	TU_C	Monthly	24-Hr Composite
Total Mercury										
– Corrected	(report)	---	---	lbs/day	(report)	---	---	ng/l	Quarterly	Calculation
– Uncorrected	(report)	---	---	lbs/day	(report)	---	---	ng/l	Quarterly	Grab
– Field Duplicate	---	---	---	---	(report)	---	---	ng/l	Quarterly	Grab
– Field Blank	---	---	---	---	(report)	---	---	ng/l	Quarterly	Preparation
– Laboratory Method Blank		---	---	---	(report)	---	---	ng/l	Quarterly	Preparation
	Rolling Average				**Rolling Average**					
Total Mercury	0.00027	---	---	lbs/day	4.0	---	---	ng/l	Quarterly	Calculation
					Minimum Monthly					
$CBOD_5$ Minimum % Removal										
12/1-4/30	---	---	---	---	85	---	---	%	Monthly	Calculation
Total Suspended Solids Minimum % Removal										
12/1-4/30	---	---	---	---	85	---	---	%	Monthly	Calculation

PART I

Section A. Limitations and Monitoring Requirements

					Minimum Daily		Maximum Daily			
pH	---	---	---	---	6.5	---	9.0	S.U.	5x/week	Grab
Dissolved Oxygen	---	---	---	---	3.0	---	---	mg/l	5x/week	Grab

The following design flow was used in determining the above limitations, but is not to be considered a limitation or actual capacity: 8.0 MGD.

a. Narrative Standard
The receiving water shall contain no turbidity, color, oil films, floating solids, foams, settleable solids, or deposits as a result of this discharge in unnatural quantities which are or may become injurious to any designated use.

b. Sampling Locations
Samples for or $CBOD_5$, Total Suspended Solids, Ammonia Nitrogen, Acute and Chronic Toxicity, and Total Phosphorus shall be taken prior to disinfection. Samples for Dissolved Oxygen, Fecal Coliform Bacteria, Total Mercury, and pH shall be taken after disinfection. The Department may approve alternate sampling locations which are demonstrated by the permittee to be representative of the effluent.

c. Quarterly Monitoring
Quarterly samples shall be taken during the months of January, April, July, and October. If the facility does not discharge during these months, the permittee shall sample the next discharge occurring during that quarter. If the facility does not discharge during a quarter, a sample is not required for that quarter. For any month in which a sample is not taken, the permittee shall enter "*G" on the Discharge Monitoring Report.

d. Ultraviolet Disinfection
It is understood that ultraviolet light will be used to achieve compliance with the fecal coliform limitations. If disinfection other than ultraviolet light will be used, the permittee shall notify the Department in accordance with Part II.C.12. - Changes in Facility Operations.

e. Percent Removal Requirements
These requirements shall be calculated based on the monthly (30-day) effluent $CBOD_5$ and Total Suspended Solids concentrations and the monthly influent concentrations for approximately the same period.

PART I

Section A. Limitations and Monitoring Requirements

f. Final Effluent Limitation for Total Mercury
The final limit for total mercury is the Discharge Specific Level Currently Achievable (LCA) based on a multiple discharger variance from the water quality-based effluent limit of 1.3 ng/l, pursuant to Rule 323.1103(9) of the Water Quality Standards. Compliance with the LCA shall be determined as a 12-month rolling average, the calculation of which may be done using blank-corrected sample results. The 12-month rolling average shall be determined by adding the present monthly average result to the preceding 11 monthly average results then dividing the sum by 12. For facilities with quarterly monitoring requirements for total mercury, quarterly monitoring shall be equivalent to 3 months of monitoring in calculating the 12-month rolling average. Facilities that monitor more frequently than monthly for total mercury must determine the monthly average result, which is the sum of the results of all data obtained in a given month divided by the total number of samples taken, in order to calculate the 12-month rolling average. If the 12-month rolling average for any quarter is less than or equal to the LCA, the permittee will be considered to be in compliance for total mercury for that quarter, provided the permittee is also in full compliance with the Pollutant Minimization Program for Total Mercury, set forth in Part I.A.3.

g. Total Mercury Testing and Additional Reporting Requirements
The analytical protocol for total mercury shall be in accordance with EPA Method 1631, Revision E, “Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry,” EPA-821-R-02-019, August 2002. The quantification level for total mercury shall be 0.5 ng/l, unless a higher level is appropriate because of sample matrix interference. Justification for higher quantification levels shall be submitted to the Department within 30 days of such determination.

The use of clean technique sampling procedures is required unless the permittee can demonstrate to the Department that an alternative sampling procedure is representative of the discharge. Guidance for clean technique sampling is contained in EPA Method 1669, “Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels,” EPA-821-R96-001, July 1996. Information and data documenting the permittee's sampling and analytical protocols and data acceptability shall be submitted to the Department upon request.

In order to demonstrate compliance with EPA Method 1631E and EPA Method 1669, the permittee shall report, on the daily sheet, the analytical results of all field blanks and field duplicates collected in conjunction with each sampling event, as well as laboratory method blanks when used for blank correction. The permittee shall collect at least one (1) field blank and at least one (1) field duplicate per sampling event. If more than ten (10) samples are collected during a sampling event, the permittee shall collect at least one (1) additional field blank AND field duplicate for every ten (10) samples collected. Only field blanks or laboratory method blanks may be used to calculate a concentration lower than the actual sample analytical results (i.e. a blank correction). Only one (1) blank (field OR laboratory method) may be used for blank correction of a given sample result, and only if the blank meets the quality control acceptance criteria. If blank correction is not performed on a given sample analytical result, the permittee shall report under ‘Total Mercury – Corrected’ the same value reported under ‘Total Mercury – Uncorrected.’ The field duplicate is for quality control purposes only; its analytical result shall not be averaged with the sample result.

PART I

Section A. Limitations and Monitoring Requirements

h. Whole Effluent Toxicity Final Requirements
Test species shall include *Ceriodaphnia dubia*. Testing and reporting procedures shall follow procedures contained in EPA/600/4-91/002, "Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms (Fourth Edition)." When the effluent ammonia nitrogen (as N) concentration is greater than 3 mg/l, the pH of the toxicity test shall be maintained at a pH of 8 Standard Units. The acute toxic unit value (TU_A) and chronic toxic unit value (TU_C) shall be reported on the Discharge Monitoring Report (DMR). If multiple chronic toxicity tests are performed during the month, the maximum TU_A value and monthly average TU_C value shall be reported. Completed toxicity test reports for each test conducted shall be retained by the permittee in accordance with the requirements of Part II.B.5. of this permit and shall be available for review by the Department upon request. After eighteen (18) months of toxicity testing and upon approval from the Department, the monitoring frequency may be reduced if the test data indicate that the toxicity requirements of Rule 323.1219 of the Michigan Administrative Code are consistently being met. Toxicity test data acceptability is contingent upon validation of the test method by the testing laboratory. Such validation shall be submitted to the Department upon request.

1) When monitoring shows persistent exceedance of the 18.4 TU_C limit or the 1.0 TU_A limit for effluent toxicity, the Department will determine whether the permittee must implement the toxicity control program requirements specified in 2) below.

2) Upon written notification by the Department, the following conditions apply. Within 90 days of the notification, the permittee shall implement a Toxicity Reduction Evaluation (TRE). The objective of the TRE shall be to reduce the toxicity of the final effluent from Monitoring Point 001A to $\leq$ 18.4 TU_C and $\leq$ 1.0 TU_A. The following documents are available as guidance to reduce toxicity to acceptable levels: Phase I, EPA/600/6-91/005F (chronic), EPA/600/6-91/003 (acute); Phase II, EPA/600/R-92/080 (acute and chronic); Phase III, EPA/600/R-92/081 (acute and chronic); and Publicly Owned Treatment Works (POTWs), EPA/833B-99/002. Annual reports shall be submitted to the Department within 30 days of the completion of the last test of each annual cycle.

2. Additional Monitoring Requirements

As a condition of this permit, the permittee shall monitor the discharge from Monitoring Point 001A for the constituents identified below. This monitoring is an application requirement of 40 CFR 122.21(j), effective December 2, 1999. Testing shall be conducted in October 2015, August 2016, May 2017, and March 2018. Grab samples shall be collected for available cyanide, total phenols, and the Volatile Organic Compounds identified below. For all other parameters, 24-hour composite samples shall be collected.

The results of such additional monitoring shall be submitted with the application for reissuance (see the cover page of this permit for the application due date). The permittee shall notify the Department within 14 days of completing the monitoring for each month specified above in accordance with Part II.C.5. Additional reporting requirements are specified in Part II.C.11. If, upon review of the analysis, it is determined that additional requirements are needed to protect the receiving waters in accordance with applicable water quality standards, the permit may then be modified by the Department in accordance with applicable laws and rules.

Hardness
calcium carbonate

Metals (Total Recoverable), Cyanide and Total Phenols (Quantification levels in parentheses)

antimony (1 µg/l)	arsenic (1 µg/l)	available cyanide (2 µg/l) using Method OIA – 1677	
barium (5 µg/l)	beryllium (1 µg/l)	boron (20 µg/l)	cadmium (0.2 µg/l)
chromium (5 µg/l)	copper (1 µg/l)	lead (1 µg/l)	nickel (5 µg/l)
selenium (1 µg/l)	silver (0.5 µg/l)	thallium (1 µg/l)	zinc (5 µg/l)
total phenolic compounds			

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Section A. Limitations and Monitoring Requirements

Volatile Organic Compounds

acrolein	acrylonitrile	benzene	bromoform
carbon tetrachloride	chlorobenzene	chlorodibromomethane	chloroethane
2-chloroethylvinyl ether	chloroform	dichlorobromomethane	1,1-dichloroethane
1,2-dichloroethane	trans-1,2-dichloroethylene	1,1-dichloroethylene	1,2-dichloropropane
1,3-dichloropropylene	ethylbenzene	methyl bromide	methyl chloride
methylene chloride	1,1,2,2,-tetrachloroethane	tetrachloroethylene	toluene
1,1,1-trichloroethane	1,1,2-trichloroethane	trichloroethylene	vinyl chloride

Acid-Extractable Compounds

p-chloro-m-cresol	2-chlorophenol	2,4-dichlorophenol	2,4-dimethylphenol
4,6-dinitro-o-cresol	2,4-dinitrophenol	2-nitrophenol	4-nitrophenol
Pentachlorophenol	phenol	2,4,6-trichlorophenol	

Base/Neutral Compounds

acenaphthene	acenaphthylene	anthracene	benzidine
benzo(a)anthracene	benzo(a)pyrene	3,4-benzofluoranthene	benzo(ghi)perylene
benzo(k)fluoranthene	bis(2-chloroethoxy)methane	bis(2-chloroethyl)ether	bis(2-chloroisopropyl)ether
bis(2-ethylhexyl)phthalate	4-bromophenyl phenyl ether	butyl benzyl phthalate	2-chloronaphthalene
4-chlorophenyl phenyl ether	chrysene	di-n-butyl phthalate	di-n-octyl phthalate
dibenzo(a,h)anthracene	1,2-dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene
3,3'-dichlorobenzidine	diethyl phthalate	dimethyl phthalate	2,4-dinitrotoluene
2,6-dinitrotoluene	1,2-diphenylhydrazine	fluoranthene	fluorene
Hexachlorobenzene	hexachlorobutadiene	hexachlorocyclo-pentadiene	hexachloroethane
indeno(1,2,3-cd)pyrene	isophorone	naphthalene	nitrobenzene
n-nitrosodi-n-propylamine	n-nitrosodimethylamine	n-nitrosodiphenylamine	phenanthrene
pyrene	1,2,4-trichlorobenzene		

3. Pollutant Minimization Program for Total Mercury

The goal of the Pollutant Minimization Program is to maintain the effluent concentration of total mercury at or below 1.3 ng/l. The permittee shall develop and implement a Pollutant Minimization Program in accordance with the following schedule.

On or before December 31, 2015, the permittee shall submit to the Department an approvable Pollutant Minimization Program for mercury designed to proceed toward the goal. The Pollutant Minimization Program shall include the following:

a. an annual review and semi-annual monitoring of potential sources of mercury entering the wastewater collection system;

b. a program for quarterly monitoring of influent for mercury; and

c. implementation of reasonable cost-effective control measures when sources of mercury are discovered. Factors to be considered include significance of sources, economic considerations, and technical and treatability considerations.

The Pollutant Minimization Program shall be implemented upon approval by the Department.

On or before March 31 of each year following approval of the Pollutant Minimization Program, the permittee shall submit a status report for the previous calendar year to the Department that includes 1) the monitoring results for the previous year, 2) an updated list of potential mercury sources, and 3) a summary of all actions taken to reduce or eliminate identified sources of mercury.

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Section A. Limitations and Monitoring Requirements

Any information generated as a result of the Pollutant Minimization Program set forth in this permit may be used to support a request to modify the approved program or to demonstrate that the Pollutant Minimization Program requirement has been completed satisfactorily.

A request for modification of the approved program and supporting documentation shall be submitted in writing to the Department for review and approval. The Department may approve modifications to the approved program (approval of a program modification does not require a permit modification), including a reduction in the frequency of the requirements under items a. and b.

This permit may be modified in accordance with applicable laws and rules to include additional mercury conditions and/or limitations as necessary.

4. Untreated or Partially Treated Sewage Discharge Reporting and Testing Requirements

In accordance with Section 324.3112a of the NREPA, if untreated sewage, including sanitary sewer overflows (SSO) and combined sewer overflows (CSO), or partially treated sewage is directly or indirectly discharged from a sewer system onto land or into the waters of the state, the entity responsible for the sewer system shall immediately, but not more than 24 hours after the discharge begins, notify, by telephone, the Department, local health departments, a daily newspaper of general circulation in the county in which the permittee is located, and a daily newspaper of general circulation in the county or counties in which the municipalities whose waters may be affected by the discharge are located that the discharge is occurring.

The permittee shall also annually contact municipalities, including the superintendent of a public drinking water supply with potentially affected intakes, whose waters may be affected by the permittee's discharge of combined sewage, and if those municipalities wish to be notified in the same manner as specified above, the permittee shall provide such notification. Such notification shall also include a daily newspaper in the county of the affected municipality.

At the conclusion of the discharge, written notification shall be submitted in accordance with and on the “Report of Discharge Form” available via the internet at: http://www.deq.state.mi.us/csosso/, or, alternatively for combined sewer overflow discharges, in accordance with notification procedures approved by the Department.

In addition, in accordance with Section 324.3112a of the NREPA, each time a discharge of untreated sewage or partially treated sewage occurs, the permittee shall test the affected waters for *Escherichia coli* to assess the risk to the public health as a result of the discharge and shall provide the test results to the affected local county health departments and to the Department. The testing shall be done at locations specified by each affected local county health department but shall not exceed 10 tests for each separate discharge event. The affected local county health department may waive this testing requirement, if it determines that such testing is not needed to assess the risk to the public health as a result of the discharge event. The results of this testing shall be submitted with the written notification required above, or, if the results are not yet available, submit them as soon as they become available. This testing is not required, if the testing has been waived by the local health department, or if the discharge(s) did not affect surface waters.

Permittees accepting sanitary or municipal sewage from other sewage collection systems are encouraged to notify the owners of those systems of the above reporting and testing requirements.

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Section A. Limitations and Monitoring Requirements

5. Facility Contact

The “Facility Contact” was specified in the application. The permittee may replace the facility contact at any time, and shall notify the Department in writing within 10 days after replacement (including the name, address and telephone number of the new facility contact).

a. The facility contact shall be (or a duly authorized representative of this person):
- for a corporation, a principal executive officer of at least the level of vice president; or a designated representative if the representative is responsible for the overall operation of the facility from which the discharge originates, as described in the permit application or other NPDES form,
- for a partnership, a general partner,
- for a sole proprietorship, the proprietor, or
- for a municipal, state, or other public facility, either a principal executive officer, the mayor, village president, city or village manager or other duly authorized employee.

b. A person is a duly authorized representative only if:
- the authorization is made in writing to the Department by a person described in paragraph a. of this section; and
- the authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the facility (a duly authorized representative may thus be either a named individual or any individual occupying a named position).

Nothing in this section obviates the permittee from properly submitting reports and forms as required by law.

6. Monthly Operating Reports

Part 41 of Act 451 of 1994 as amended, specifically Section 324.4106 and associated R 299.2953, requires that the permittee file with the Department, on forms prescribed by the Department, reports showing the effectiveness of the treatment facility operation and the quantity and quality of liquid wastes discharged into waters of the state.

Since this permit includes modifications to the monitoring requirements in the previously-issued permit, the previously approved treatment facility monitoring program shall be revised. Within sixty (60) days of the effective date of this permit, the permittee shall submit to the Department a revised treatment facility monitoring program to meet this requirement. Upon approval by the Department the permittee shall implement the revised treatment facility monitoring program. The reporting forms and guidance are available on the DEQ web site at http://www.michigan.gov/deq/0,1607,7-135-3313_44117---,00.html. The permittee may use alternative operating forms if they are consistent with the approved monitoring program. These forms shall be maintained on site and shall be provided to the Department for review upon request. These treatment facility monitoring records shall be maintained for a minimum of three years.

7. Asset Management

The requirements of an Asset Management Program function to achieve the goals of effective performance, adequate funding, and adequate operator staffing and training. Asset management is a planning process for ensuring that optimum value is gained for each asset and that financial resources are available to rehabilitate and replace those assets when necessary. Asset management is centered on a framework of five (5) core elements: the current state of the assets; the required sustainable level of service; the assets critical to sustained performance; the minimum life-cycle costs; and the best long-term funding strategy.

a. Asset Management Program Requirements
On or before March 31, 2016, the permittee shall submit to the Department an Asset Management Plan for review and approval. An approvable Asset Management Plan shall contain a schedule for the

PART I

Section A. Limitations and Monitoring Requirements

development and implementation of an Asset Management Program that meets the requirements outlined below. A copy of any Asset Management Program requirements already completed by the permittee should be submitted as part of the Asset Management Plan. Upon approval by the Department the permittee shall implement the Asset Management Plan.

1) *Maintenance Staff.* The permittee shall provide an adequate staff to carry out the operation, maintenance, repair, and testing functions required to ensure compliance with the terms and conditions of this permit.

2) *Collection System Map.* The permittee shall complete a map of the sewer collection system owned by the permittee. The map shall be of sufficient detail and at a scale to allow easy interpretation. The collection system information shown on the map shall be based on current conditions and shall be kept up-to-date and available for review by the Department. Such map(s) shall include but not be limited to the following:

a) all sanitary sewer lines and related manholes;

b) all outfalls, including the treatment plant outfall(s);

e) all pump stations and force mains;

f) the wastewater treatment facility(ies), including all treatment processes;

g) all surface waters (labeled);

h) other major appurtenances such as inverted siphons and air release valves;

i) a numbering system which uniquely identifies manholes, catch basins, and outfalls;

j) the scale and a north arrow;

k) the pipe diameter, type of material, approximate age, distance between manholes, and the direction of flow; and

l) the manhole interior material, rim elevation, and invert elevations.

3) *Inventory and assessment of fixed assets.* The permittee shall complete an inventory and assessment of operations-related fixed assets. Capitalized fixed assets will include buildings and fixed equipment with a replacement value greater than $5,000. The inventory and assessment shall be based on current conditions and shall be updated periodically and available for review by the Department.

a) The fixed asset inventory shall include the following:

(1) a brief description of the fixed asset with tag number, its design capacity (e.g., pump: 120 gallons per minute), and its level of redundancy;

(2) the location of the fixed asset;

(3) the year the fixed asset was installed;

(4) the present condition of the fixed asset (e.g., excellent, good, fair, poor);

(5) the depreciated value of the fixed asset in dollars for year specified in accordance with approved schedules; and

(6) the current replacement cost of the fixed asset in dollars for year specified in accordance with approved schedules;

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Section A. Limitations and Monitoring Requirements

b) The fixed asset assessment shall include an evaluation of expected useful life and the criticality of the fixed asset based on a methodology to be determined by the permittee and acceptable to the Authorities Financial counsel and Board of Directors (Board), as defined in the Articles of Incorporation of North Kent Sewer Authority.

4) *Operation, Maintenance & Replacement (OM&R) Budget.* The permittee shall complete an annual assessment of its Operational Fund Budget, Debit Fund Budget, and Capital Replacement Fund Budget, including the following:

a) beginning and end dates of fiscal year;

b) name of the Board that approves OM&R Budgets and date of approval;

c) audits will include all fund balances and will be provided to the Department;

d) Capital Improvement Budget indicating a five-year projected replacement schedule with funding provided to the Department;

e) the permittee shall provide the calculation on how the rates are set for each constituent municipality;

f) the permittee's OM&R budget for the fiscal year, including revenues to be charged to all constituent municipalities, to meet projected expenses will be provided; and

g) rate calculation demonstrating sufficient revenues to cover OM&R expenses will be provided by the permittee. The ultimate goal of the Asset Management Program is to ensure sufficient revenues to cover OM&R expenses.

b. Reporting
The permittee shall develop a written report that summarizes asset management activities completed during the previous year and planned for the upcoming year. The written report shall be submitted to the Department on or before <u>January 31 of each year</u>. The written report shall include:

1) a description of the staffing levels maintained during the year;

2) a printout summation and a brief description of the number of preventative and corrective work orders completed during the previous year;

3) a summary of assets scheduled for replacement in the upcoming year based on the accepted methodology in Part I.A.7.a.3.b. of this permit;

4) budget reports indicating the permittee's treatment and collection system maintenance expenditures for the fiscal year;

5) approved budgets and updated CIP budgets for the upcoming year, and an updated asset inventory; and

6) an updated OM&R budget with an updated rate schedule that includes the amount of insufficient revenues, if any.

PART I

Section B. Storm Water Pollution Prevention

Section B. Storm Water Pollution Prevention is not required for this permit.

PART I

Section C. Industrial Waste Pretreatment Program

1. Federal Industrial Pretreatment Program

a. The permittee shall implement the Federal Industrial Pretreatment Program approved on January 10, 2011, and any subsequent modifications approved up to the issuance of this permit. Approval of substantial program modifications after the issuance of this permit shall be incorporated into this permit by minor modification in accordance with 40 CFR 122.63.

b. The permittee shall comply with R 323.2301 through R 323.2317 of the Michigan Administrative Code (Part 23 Rules), the General Pretreatment Regulations for Existing and New Sources of Pollution (40 CFR Part 403), and the approved Federal Industrial Pretreatment Program.

c. The permittee shall have the legal authority and necessary interjurisdictional agreements that provide the basis for the implementation and enforcement of the approved Federal Industrial Pretreatment Program throughout the service area. The legal authority and necessary interjurisdictional agreements shall include, at a minimum, the authority to carry out the activities specified in R 323.2306(a).

d. The permittee shall develop procedures which describe, in sufficient detail, program commitments which enable implementation of the approved Federal Industrial Pretreatment Program, 40 CFR Part 403, and the Part 23 Rules in accordance with R 323.2306(c).

e. The permittee shall establish an interjurisdictional agreement (or comparable document) with all tributary governmental jurisdictions. Each interjurisdictional agreement shall contain, at a minimum, the following:

1) identification of the agency responsible for the implementation and enforcement of the approved Federal Industrial Pretreatment Program within the tributary governmental jurisdiction's boundaries; and

2) the provision of the legal authority which provides the basis for the implementation and enforcement of the approved Federal Industrial Pretreatment Program within the tributary governmental jurisdiction's boundaries.

f. The permittee shall prohibit discharges that:

1) cause, in whole or in part, the permittee's failure to comply with any condition of this permit or the NREPA;

2) restrict, in whole or in part, the permittee's management of biosolids;

3) cause, in whole or in part, operational problems at the treatment facility or in its collection system;

4) violate any of the general or specific prohibitions identified in R 323.2303(1) and (2);

5) violate categorical standards identified in R 323.2311; and

6) violate local limits established in accordance with R 323.2303(4).

g. The permittee shall maintain a list of its nondomestic users that meet the criteria of a significant industrial user as identified in R 323.2302(cc).

h. The permittee shall develop an enforcement response plan which describes, in sufficient detail, program commitments which will enable the enforcement of the approved Federal Industrial Pretreatment Program, 40 CFR Part 403, and the Part 23 Rules in accordance with R 323.2306(g).

PART I

Section C. Industrial Waste Pretreatment Program

i. The Department may require modifications to the approved Federal Industrial Pretreatment Program which are necessary to ensure compliance with 40 CFR Part 403 and the Part 23 Rules in accordance with R 323.2309.

j. The permittee shall not implement changes or modifications to the approved Federal Industrial Pretreatment Program without notification to the Department. Any substantial modification shall be subject to Department public noticing and approval in accordance with R 323.2309.

k. The permittee shall maintain an adequate revenue structure and staffing level for effective implementation of the approved Federal Industrial Pretreatment Program.

l. The permittee shall develop and maintain, for a minimum of three (3) years, all records and information necessary to determine nondomestic user compliance with 40 CFR Part 403, Part 23 Rules and the approved Federal Industrial Pretreatment Program. This period of retention shall be extended during the course of any unresolved enforcement action or litigation regarding a nondomestic user or when requested by the Department or the United States Environmental Protection Agency. All of the aforementioned records and information shall be made available upon request for inspection and copying by the Department and the United States Environmental Protection Agency.

m. The permittee shall evaluate the approved Federal Industrial Pretreatment Program for compliance with the 40 CFR Part 403, Part 23 Rules and the prohibitions stated in item f. (above). Based upon this evaluation, the permittee shall propose to the Department all necessary changes or modifications to the approved Federal Industrial Pretreatment Program no later than the next Industrial Pretreatment Program Annual Report due date (see item o. below).

n. The permittee shall develop and enforce local limits to implement the prohibitions listed in item f above. Local limits shall be based upon data representative of actual conditions demonstrated in a maximum allowable headworks loading analysis. An evaluation of whether the existing local limits need to be revised shall be submitted to the Department by October 1, 2016. The submittal shall provide a technical evaluation of the basis upon which this determination was made which includes information regarding the maximum allowable headworks loading, collection system protection criteria, and worker health and safety, based upon data collected since the last local limits review.

The following pollutants shall be evaluated:

1) Arsenic, Cadmium, Chromium, Copper, Cyanide, Lead, Mercury, Nickel, Silver, and Zinc;

2) Pollutants that are subject to limits or monitoring in this permit;

3) Pollutants that have an existing local limit; and,

4) Other pollutants of concern which would reasonably be expected to be discharged or transported by truck or rail or otherwise introduced into the POTW.

o. On or before April 1st of each year, the permittee shall submit to the Department, as required by R 323.2310(8), an Industrial Pretreatment Program Annual Report on the status of program implementation and enforcement activities. The reporting period shall begin on January 1st and end on December 31st. At a minimum, the Industrial Pretreatment Program Annual Report shall contain the following items:

1) additions, deletions, and any other modifications to the permittee's previously submitted nondomestic user inventory (R 323.2306(c)(i));

2) additions, deletions, and any other modifications to the permittee's approved Significant Industrial User List (R 323.2306(h));

PART I

Section C. Industrial Waste Pretreatment Program

3) a listing of the names of Significant Industrial Users not inspected by the permittee at least once during the reporting period or at the frequency committed to in the approved Federal Industrial Pretreatment Program;

4) a listing of the names of Significant Industrial Users not sampled for all required pollutants by the permittee at least once during the reporting period or at the frequency committed to in the approved Federal Industrial Pretreatment Program;

5) a listing of the names of Significant Industrial Users without a permit at any time during the reporting period;

6) a listing of the names of nondomestic industrial users in significant noncompliance for each of the criteria as defined in R 323.2302(dd)(i)-(viii);

7) proof of publication of all nondomestic users in significant noncompliance in the largest daily newspaper in the permittee's area;

8) a summary of the enforcement activities by the permittee during the report period. This Summary shall include:

a) a listing of the names of nondomestic users which were the subject of an enforcement action;

b) the enforcement action taken and the date the action was taken; and

c) whether the nondomestic user returned to compliance by the end of the reporting period (include date nondomestic user returned to compliance).

9) a listing of the names of Significant Industrial Users who did not submit pretreatment reports in accordance with requirements specified in their permit during the reporting period;

10) a listing of the names of Significant Industrial Users who did not self-monitor in accordance with requirements specified in their permit during the reporting period;

11) a summary of results of all the sampling and analyses performed of the wastewater treatment plant's influent, effluent, and biosolids conducted in accordance with approved methods during the reporting period. The summary shall include the monthly average, daily maximum, quantification level, and number of samples analyzed for each pollutant. At a minimum, the results of analyses for all locally limited parameters for at least one monitoring event that tests influent, effluent and biosolids during the reporting period shall be submitted with each report, unless otherwise required by the Department. Sample collection shall be at intervals sufficient to provide pollutant removal rates, unless the pollutant is not measurable; and

12) any other relevant information as requested by the Department.

PART I

Section D. Residuals Management Program

2. Residuals Management Program for Land Application of Biosolids

A permittee seeking authorization to land-apply bulk biosolids or prepare bulk biosolids for land application shall develop and submit a Residuals Management Program (RMP) to the Department (see Part I.D.1.e) for approval. Effective upon Department approval of the permittee's RMP, the permittee is authorized to land-apply bulk biosolids or prepare bulk biosolids for land application in accordance with the requirements established in R 323.2401 through R 323.2418 of the Michigan Administrative Code (Part 24 Rules) which can be obtained via the internet (http://www.michigan.gov/deq/ and on the left side of the screen click on Water, Biosolids & Industrial Pretreatment, Biosolids, then click on Biosolids Laws and Rules Information which is under the Laws & Rules banner in the center of the screen). The permittee's approved RMP, and any approved modifications thereto, are enforceable requirements of this permit. Incineration, landfilling and other residual disposal activities shall be conducted in accordance with Part II.D.7. of this permit.

a. RMP Approval and Implementation
A permittee seeking approval of an RMP shall submit the RMP to the Department (see Part I.D.1.e) at least 180 days prior to the land application of biosolids. The permittee may utilize the RMP Electronic Form which can be obtained via the internet (http://www.michigan.gov/deq/ and on the left side of the screen click on Water, Biosolids & Industrial Pretreatment, Biosolids then click on RMP Electronic Form which is under the Downloads banner in the center of the screen) or obtain detailed requirements from the Department. The RMP shall become effective and shall be implemented by the permittee upon written approval by the Department.

b. Annual Report
On or before October 30 of each year, the permittee shall submit an annual report to the Biosolids Program, Water Resources Division, Department of Environmental Quality, P.O. Box 30458, Lansing, MI 48909-7958 for the previous fiscal year of October 1 through September 30. At a minimum, the report shall contain:

1) a certification that current residuals management practices are in accordance with the approved RMP, or a proposal for modification to the approved RMP; and

2) a completed Biosolids Annual Report Form which can be obtained via the internet (http:/www.michigan.gov/deq/ and on the left side of the screen click on Water, Biosolids & Industrial Pretreatment, Biosolids then click on Biosolids Annual Report Form which is under the Downloads banner in the center of the screen) or from the Department.

c. Modifications to the Approved RMP
Prior to implementation of modifications to the RMP, the permittee shall submit proposed modifications to the Department (see Part I.D.1.e.) for approval. The approved modification shall become effective upon the date of approval. Upon written notification, the Department may impose additional requirements and/or limitations to the approved RMP as necessary to protect public health and the environment from any adverse effect of a pollutant in the biosolids.

d. Record Keeping
Records required by the Part 24 Rules shall be kept for a minimum of five years. However, the records documenting cumulative loading for sites subject to cumulative pollutant loading rates shall be kept as long as the site receives biosolids.

e. Contact Information
RMP related submittals to the Department shall be to the Grand Rapids District Supervisor of the Water Resources Division. The Grand Rapids District Office is located at the State Office Building, Fifth Floor, 350 Ottawa N.W., Unit 10, Grand Rapids, Michigan 49503-2341, Telephone: 616-356-0500, Fax: 616-356-0202.

PART II

Part II may include terms and /or conditions not applicable to discharges covered under this permit.

Section A. Definitions

Acute toxic unit (TU_A) means $100/LC_{50}$ where the LC_{50} is determined from a whole effluent toxicity (WET) test which produces a result that is statistically or graphically estimated to be lethal to 50% of the test organisms.

Annual monitoring frequency refers to a calendar year beginning on January 1 and ending on December 31. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

Authorized public agency means a state, local, or county agency that is designated pursuant to the provisions of section 9110 of Part 91 of the NREPA to implement soil erosion and sedimentation control requirements with regard to construction activities undertaken by that agency.

Best management practices (BMPs) means structural devices or nonstructural practices that are designed to prevent pollutants from entering into storm water, to direct the flow of storm water, or to treat polluted storm water.

Bioaccumulative chemical of concern (BCC) means a chemical which, upon entering the surface waters, by itself or as its toxic transformation product, accumulates in aquatic organisms by a human health bioaccumulation factor of more than 1000 after considering metabolism and other physiochemical properties that might enhance or inhibit bioaccumulation. The human health bioaccumulation factor shall be derived according to R 323.1057(5). Chemicals with half-lives of less than 8 weeks in the water column, sediment, and biota are not BCCs. The minimum bioaccumulation concentration factor (BAF) information needed to define an organic chemical as a BCC is either a field-measured BAF or a BAF derived using the biota-sediment accumulation factor (BSAF) methodology. The minimum BAF information needed to define an inorganic chemical as a BCC, including an organometal, is either a field-measured BAF or a laboratory-measured bioconcentration factor (BCF). The BCCs to which these rules apply are identified in Table 5 of R 323.1057 of the Water Quality Standards.

Biosolids are the solid, semisolid, or liquid residues generated during the treatment of sanitary sewage or domestic sewage in a treatment works. This includes, but is not limited to, scum or solids removed in primary, secondary, or advanced wastewater treatment processes and a derivative of the removed scum or solids.

Bulk biosolids means biosolids that are not sold or given away in a bag or other container for application to a lawn or home garden.

Certificate of Coverage (COC) is a document, issued by the Department, which authorizes a discharge under a general permit.

Chronic toxic unit (TU_C) means 100/MATC or $100/IC_{25}$, where the maximum acceptable toxicant concentration (MATC) and IC_{25} are expressed as a percent effluent in the test medium.

Class B biosolids refers to material that has met the Class B pathogen reduction requirements or equivalent treatment by a Process to Significantly Reduce Pathogens (PSRP) in accordance with the Part 24 Rules. Processes include aerobic digestion, composting, anaerobic digestion, lime stabilization and air drying.

Combined sewer system is a sewer system in which storm water runoff is combined with sanitary wastes.

PART II

Section A. Definitions

Daily concentration is the sum of the concentrations of the individual samples of a parameter divided by the number of samples taken during any calendar day. If the parameter concentration in any sample is less than the quantification limit, regard that value as zero when calculating the daily concentration. The daily concentration will be used to determine compliance with any maximum and minimum daily concentration limitations (except for pH and dissolved oxygen). When required by the permit, report the maximum calculated daily concentration for the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the Discharge Monitoring Reports (DMRs).

For pH, report the maximum value of any *individual* sample taken during the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs and the minimum value of any *individual* sample taken during the month in the "MINIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs. For dissolved oxygen, report the minimum concentration of any *individual* sample in the "MINIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs.

Daily loading is the total discharge by weight of a parameter discharged during any calendar day. This value is calculated by multiplying the daily concentration by the total daily flow and by the appropriate conversion factor. The daily loading will be used to determine compliance with any maximum daily loading limitations. When required by the permit, report the maximum calculated daily loading for the month in the "MAXIMUM" column under "QUANTITY OR LOADING" on the DMRs.

Daily monitoring frequency refers to a 24-hour day. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

Department means the Michigan Department of Environmental Quality.

Detection level means the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated level of probability.

Discharge means the addition of any waste, waste effluent, wastewater, pollutant, or any combination thereof to any surface water of the state.

Discharge point is the location where the point source discharge is directed to surface waters of the state or to a separate storm sewer. It includes the location of all point source discharges where storm water exits the facility, including *outfalls* which discharge directly to surface waters of the state, and *points of discharge* which discharge directly into separate storm sewer systems.

EC_{50} means a statistically or graphically estimated concentration that is expected to cause 1 or more specified effects in 50% of a group of organisms under specified conditions.

Fecal coliform bacteria monthly
FOR WWSLs THAT COLLECT AND STORE WASTEWATER AND ARE AUTHORIZED TO DISCHARGE ONLY IN THE SPRING AND/OR FALL ON AN INTERMITTENT BASIS – Fecal coliform bacteria monthly is the geometric mean of all daily concentrations determined during a discharge event. Days on which no daily concentration is determined shall not be used to determine the calculated monthly value. The calculated monthly value will be used to determine compliance with the maximum monthly fecal coliform bacteria limitations. When required by the permit, report the calculated monthly value in the "AVERAGE" column under "QUALITY OR CONCENTRATION" on the DMR. If the period in which the discharge event occurred was partially in each of two months, the calculated monthly value shall be reported on the DMR of the month in which the last day of discharge occurred.

FOR ALL OTHER DISCHARGES – Fecal coliform bacteria monthly is the geometric mean of all daily concentrations determined during a reporting month. Days on which no daily concentration is determined shall not be used to determine the calculated monthly value. The calculated monthly value will be used to determine compliance with the maximum monthly fecal coliform bacteria limitations. When required by the permit, report the calculated monthly value in the "AVERAGE" column under "QUALITY OR CONCENTRATION" on the DMR.

PART II

Section A. Definitions

Fecal coliform bacteria 7-day
FOR WWSLs THAT COLLECT AND STORE WASTEWATER AND ARE AUTHORIZED TO DISCHARGE ONLY IN THE SPRING AND/OR FALL ON AN INTERMITTENT BASIS – Fecal coliform bacteria 7-day is the geometric mean of the daily concentrations determined during any 7 consecutive days of discharge during a discharge event. If the number of daily concentrations determined during the discharge event is less than 7 days, the number of actual daily concentrations determined shall be used for the calculation. Days on which no daily concentration is determined shall not be used to determine the value. The calculated 7-day value will be used to determine compliance with the maximum 7-day fecal coliform bacteria limitations. When required by the permit, report the maximum calculated 7-day geometric mean value for the month in the “MAXIMUM” column under “QUALITY OR CONCENTRATION” on the DMRs. If the 7-day period was partially in each of two months, the value shall be reported on the DMR of the month in which the last day of discharge occurred.

FOR ALL OTHER DISCHARGES – Fecal coliform bacteria 7-day is the geometric mean of the daily concentrations determined during any 7 consecutive days in a reporting month. If the number of daily concentrations determined is less than 7, the actual number of daily concentrations determined shall be used for the calculation. Days on which no daily concentration is determined shall not be used to determine the value. The calculated 7-day value will be used to determine compliance with the maximum 7-day fecal coliform bacteria limitations. When required by the permit, report the maximum calculated 7-day geometric mean for the month in the “MAXIMUM” column under “QUALITY OR CONCENTRATION” on the DMRs. The first calculation shall be made on day 7 of the reporting month, and the last calculation shall be made on the last day of the reporting month.

Flow-proportioned sample is a composite sample with the sample volume proportional to the effluent flow.

General permit means a National Pollutant Discharge Elimination System permit issued authorizing a category of similar discharges.

Geometric mean is the average of the logarithmic values of a base 10 data set, converted back to a base 10 number.

Grab sample is a single sample taken at neither a set time nor flow.

IC_{25} means the toxicant concentration that would cause a 25% reduction in a nonquantal biological measurement for the test population.

Illicit connection means a physical connection to a municipal separate storm sewer system that primarily conveys non-storm water discharges other than uncontaminated groundwater into the storm sewer; or a physical connection not authorized or permitted by the local authority, where a local authority requires authorization or a permit for physical connections.

Illicit discharge means any discharge to, or seepage into, a municipal separate storm sewer system that is not composed entirely of storm water or uncontaminated groundwater. Illicit discharges include non-storm water discharges through pipes or other physical connections; dumping of motor vehicle fluids, household hazardous wastes, domestic animal wastes, or litter; collection and intentional dumping of grass clippings or leaf litter; or unauthorized discharges of sewage, industrial waste, restaurant wastes, or any other non-storm water waste directly into a separate storm sewer.

Individual permit means a site-specific NPDES permit.

Inlet means a catch basin, roof drain, conduit, drain tile, retention pond riser pipe, sump pump, or other point where storm water or wastewater enters into a closed conveyance system prior to discharge off site or into waters of the state.

PART II

Section A. Definitions

Interference is a discharge which, alone or in conjunction with a discharge or discharges from other sources, both: 1) inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal; and 2) therefore, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or, of the prevention of sewage sludge use or disposal in compliance with the following statutory provisions and regulations or permits issued thereunder (or more stringent state or local regulations): Section 405 of the Clean Water Act, the Solid Waste Disposal Act (SWDA) (including Title II, more commonly referred to as the Resource Conservation and Recovery Act (RCRA), and including state regulations contained in any state sludge management plan prepared pursuant to Subtitle D of the SWDA), the Clean Air Act, the Toxic Substances Control Act, and the Marine Protection, Research and Sanctuaries Act. [This definition does not apply to sample matrix interference].

Land application means spraying or spreading biosolids or a biosolids derivative onto the land surface, injecting below the land surface, or incorporating into the soil so that the biosolids or biosolids derivative can either condition the soil or fertilize crops or vegetation grown in the soil.

LC_{50} means a statistically or graphically estimated concentration that is expected to be lethal to 50% of a group of organisms under specified conditions.

Maximum acceptable toxicant concentration (MATC) means the concentration obtained by calculating the geometric mean of the lower and upper chronic limits from a chronic test. A lower chronic limit is the highest tested concentration that did not cause the occurrence of a specific adverse effect. An upper chronic limit is the lowest tested concentration which did cause the occurrence of a specific adverse effect and above which all tested concentrations caused such an occurrence.

Maximum extent practicable means implementation of best management practices by a public body to comply with an approved storm water management program as required by a national permit for a municipal separate storm sewer system, in a manner that is environmentally beneficial, technically feasible, and within the public body's legal authority.

MGD means million gallons per day.

Monthly concentration is the sum of the daily concentrations determined during a reporting period divided by the number of daily concentrations determined. The calculated monthly concentration will be used to determine compliance with any maximum monthly concentration limitations. Days with no discharge shall not be used to determine the value. When required by the permit, report the calculated monthly concentration in the "AVERAGE" column under "QUALITY OR CONCENTRATION" on the DMR.

For minimum percent removal requirements, the monthly influent concentration and the monthly effluent concentration shall be determined. The calculated monthly percent removal, which is equal to 100 times the quantity [1 minus the quantity (monthly effluent concentration divided by the monthly influent concentration)], shall be reported in the "MINIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs.

Monthly loading is the sum of the daily loadings of a parameter divided by the number of daily loadings determined during a reporting period. The calculated monthly loading will be used to determine compliance with any maximum monthly loading limitations. Days with no discharge shall not be used to determine the value. When required by the permit, report the calculated monthly loading in the "AVERAGE" column under "QUANTITY OR LOADING" on the DMR.

Monthly monitoring frequency refers to a calendar month. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

Municipal separate storm sewer means a conveyance or system of conveyances designed or used for collecting or conveying storm water which is not a combined sewer and which is not part of a publicly-owned treatment works as defined in the Code of Federal Regulations at 40 CFR 122.2.

PART II

Section A. Definitions

Municipal separate storm sewer system (MS4) means all separate storm sewers that are owned or operated by the United States, a state, city, village, township, county, district, association, or other public body created by or pursuant to state law, having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under state law, such as a sewer district, flood control district, or drainage district, or similar entity, or a designated or approved management agency under Section 208 of the Federal Act that discharges to the waters of the state. This term includes systems similar to separate storm sewer systems in municipalities, such as systems at military bases, large hospital or prison complexes, and highways and other thoroughfares. The term does not include separate storm sewers in very discrete areas, such as individual buildings.

National Pretreatment Standards are the regulations promulgated by or to be promulgated by the Federal Environmental Protection Agency pursuant to Section 307(b) and (c) of the Federal Act. The standards establish nationwide limits for specific industrial categories for discharge to a POTW.

No observed adverse effect level (NOAEL) means the highest tested dose or concentration of a substance which results in no observed adverse effect in exposed test organisms where higher doses or concentrations result in an adverse effect.

Noncontact cooling water is water used for cooling which does not come into direct contact with any raw material, intermediate product, by-product, waste product or finished product.

Nondomestic user is any discharger to a POTW that discharges wastes other than or in addition to water-carried wastes from toilet, kitchen, laundry, bathing or other facilities used for household purposes.

Outfall is the location at which a point source discharge enters the surface waters of the state.

Part 91 agency means an agency that is designated by a county board of commissioners pursuant to the provisions of section 9105 of Part 91 of the NREPA; an agency that is designated by a city, village, or township in accordance with the provisions of section 9106 of Part 91 of the NREPA; or the Department for soil erosion and sedimentation activities under Part 615, Part 631, or Part 632 pursuant to the provisions of section 9115 of Part 91 of the NREPA.

Part 91 permit means a soil erosion and sedimentation control permit issued by a Part 91 agency pursuant to the provisions of Part 91 of the NREPA.

Partially treated sewage is any sewage, sewage and storm water, or sewage and wastewater, from domestic or industrial sources that is treated to a level less than that required by the permittee's National Pollutant Discharge Elimination System permit, or that is not treated to national secondary treatment standards for wastewater, including discharges to surface waters from retention treatment facilities.

Point of discharge is the location of a point source discharge where storm water is discharged directly into a separate storm sewer system.

Point source discharge means a discharge from any discernible, confined, discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, or rolling stock. Changing the surface of land or establishing grading patterns on land will result in a point source discharge where the runoff from the site is ultimately discharged to waters of the state.

Polluting material means any material, in solid or liquid form, identified as a polluting material under the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code).

POTW is a publicly owned treatment work.

Pretreatment is reducing the amount of pollutants, eliminating pollutants, or altering the nature of pollutant properties to a less harmful state prior to discharge into a public sewer. The reduction or alteration can be by physical, chemical, or biological processes, process changes, or by other means. Dilution is not considered pretreatment unless expressly authorized by an applicable National Pretreatment Standard for a particular industrial category.

PART II

Section A. Definitions

Public (as used in the MS4 individual permit) means all persons who potentially could affect the authorized storm water discharges, including, but not limited to, residents, visitors to the area, public employees, businesses, industries, and construction contractors and developers.

Public body means the United States; the state of Michigan; a city, village, township, county, school district, public college or university, or single-purpose governmental agency; or any other body which is created by federal or state statute or law.

Qualifying storm event means a storm event causing greater than 0.1 inch of rainfall and occurring at least 72 hours after the previous measurable storm event that also caused greater than 0.1 inch of rainfall.

Quantification level means the measurement of the concentration of a contaminant obtained by using a specified laboratory procedure calculated at a specified concentration above the detection level. It is considered the lowest concentration at which a particular contaminant can be quantitatively measured using a specified laboratory procedure for monitoring of the contaminant.

Quarterly monitoring frequency refers to a three month period, defined as January through March, April through June, July through September, and October through December. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

Regional Administrator is the Region 5 Administrator, U.S. EPA, located at R-19J, 77 W. Jackson Blvd., Chicago, Illinois 60604.

Regulated area means the permittee's urbanized area, where urbanized area is defined as a place and its adjacent densely-populated territory that together have a minimum population of 50,000 people as defined by the United States Bureau of the Census and as determined by the latest available decennial census.

Secondary containment structure means a unit, other than the primary container, in which significant materials are packaged or held, which is required by State or Federal law to prevent the escape of significant materials by gravity into sewers, drains, or otherwise directly or indirectly into any sewer system or to the surface or ground waters of this state.

Separate storm sewer system means a system of drainage, including, but not limited to, roads, catch basins, curbs, gutters, parking lots, ditches, conduits, pumping devices, or man-made channels, which is not a combined sewer where storm water mixes with sanitary wastes, and is not part of a POTW.

Significant industrial user is a nondomestic user that: 1) is subject to Categorical Pretreatment Standards under 40 CFR 403.6 and 40 CFR Chapter I, Subchapter N; or 2) discharges an average of 25,000 gallons per day or more of process wastewater to a POTW (excluding sanitary, noncontact cooling and boiler blowdown wastewater); contributes a process waste stream which makes up five (5) percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant; or is designated as such by the permittee as defined in 40 CFR 403.12(a) on the basis that the industrial user has a reasonable potential for adversely affecting the POTW's treatment plant operation or violating any pretreatment standard or requirement (in accordance with 40 CFR 403.8(f)(6)).

Significant materials Significant Materials means any material which could degrade or impair water quality, including but not limited to: raw materials; fuels; solvents, detergents, and plastic pellets; finished materials such as metallic products; hazardous substances designated under Section 101(14) of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (see 40 CFR 372.65); any chemical the facility is required to report pursuant to Section 313 of Emergency Planning and Community Right-to-Know Act (EPCRA); polluting materials as identified under the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code); Hazardous Wastes as defined in Part 111 of the NREPA; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with storm water discharges.

Significant spills and significant leaks means any release of a polluting material reportable under the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code).

PART II

Section A. Definitions

Special-use area means secondary containment structures required by state or federal law; lands on Michigan's List of Sites of Environmental Contamination pursuant to Part 201, Environmental Remediation, of the NREPA; and/or areas with other activities that may contribute pollutants to the storm water for which the Department determines monitoring is needed.

Stoichiometric means the quantity of a reagent calculated to be necessary and sufficient for a given chemical reaction.

Storm water means storm water runoff, snow melt runoff, surface runoff and drainage, and non-storm water included under the conditions of this permit.

SWPPP means the Storm Water Pollution Prevention Plan prepared in accordance with this permit.

Tier I value means a value for aquatic life, human health or wildlife calculated under R 323.1057 of the Water Quality Standards using a tier I toxicity database.

Tier II value means a value for aquatic life, human health or wildlife calculated under R 323.1057 of the Water Quality Standards using a tier II toxicity database.

Total maximum daily loads (TMDLs) are required by the Federal Act for waterbodies that do not meet water quality standards. TMDLs represent the maximum daily load of a pollutant that a waterbody can assimilate and meet water quality standards, and an allocation of that load among point sources, nonpoint sources, and a margin of safety.

Toxicity reduction evaluation (TRE) means a site-specific study conducted in a stepwise process designed to identify the causative agents of effluent toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in effluent toxicity.

Water Quality Standards means the Part 4 Water Quality Standards promulgated pursuant to Part 31 of the NREPA, being R 323.1041 through R 323.1117 of the Michigan Administrative Code.

Weekly monitoring frequency refers to a calendar week which begins on Sunday and ends on Saturday. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

WWSL is a wastewater stabilization lagoon.

WWSL discharge event is a discrete occurrence during which effluent is discharged to the surface water up to 10 days of a consecutive 14 day period.

3-portion composite sample is a sample consisting of three equal-volume grab samples collected at equal intervals over an 8-hour period.

PART II

Section A. Definitions

7-day concentration
FOR WWSLs THAT COLLECT AND STORE WASTEWATER AND ARE AUTHORIZED TO DISCHARGE ONLY IN THE SPRING AND/OR FALL ON AN INTERMITTENT BASIS – The 7-day concentration is the sum of the daily concentrations determined during any 7 consecutive days of discharge during a WWSL discharge event divided by the number of daily concentrations determined. If the number of daily concentrations determined during the WWSL discharge event is less than 7 days, the number of actual daily concentrations determined shall be used for the calculation. The calculated 7-day concentration will be used to determine compliance with any maximum 7-day concentration limitations. When required by the permit, report the maximum calculated 7-day concentration for the WWSL discharge event in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMR. If the WWSL discharge event was partially in each of two months, the value shall be reported on the DMR of the month in which the last day of discharge occurred.

FOR ALL OTHER DISCHARGES – The 7-day concentration is the sum of the daily concentrations determined during any 7 consecutive days in a reporting month divided by the number of daily concentrations determined. If the number of daily concentrations determined is less than 7, the actual number of daily concentrations determined shall be used for the calculation. The calculated 7-day concentration will be used to determine compliance with any maximum 7-day concentration limitations in the reporting month. When required by the permit, report the maximum calculated 7-day concentration for the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMR. The first 7-day calculation shall be made on day 7 of the reporting month, and the last calculation shall be made on the last day of the reporting month.

7-day loading
FOR WWSLs THAT COLLECT AND STORE WASTEWATER AND ARE AUTHORIZED TO DISCHARGE ONLY IN THE SPRING AND/OR FALL ON AN INTERMITTENT BASIS – The 7-day loading is the sum of the daily loadings determined during any 7 consecutive days of discharge during a WWSL discharge event divided by the number of daily loadings determined. If the number of daily loadings determined during the WWSL discharge event is less than 7 days, the number of actual daily loadings determined shall be used for the calculation. The calculated 7-day loading will be used to determine compliance with any maximum 7-day loading limitations. When required by the permit, report the maximum calculated 7-day loading for the WWSL discharge event in the "MAXIMUM" column under "QUANTITY OR LOADING" on the DMR. If the WWSL discharge event was partially in each of two months, the value shall be reported on the DMR of the month in which the last day of discharge occurred

FOR ALL OTHER DISCHARGES – The 7-day loading is the sum of the daily loadings determined during any 7 consecutive days in a reporting month divided by the number of daily loadings determined. If the number of daily loadings determined is less than 7, the actual number of daily loadings determined shall be used for the calculation. The calculated 7-day loading will be used to determine compliance with any maximum 7-day loading limitations in the reporting month. When required by the permit, report the maximum calculated 7-day loading for the month in the "MAXIMUM" column under "QUANTITY OR LOADING" on the DMR. The first 7-day calculation shall be made on day 7 of the reporting month, and the last calculation shall be made on the last day of the reporting month.

24-hour composite sample is a flow-proportioned composite sample consisting of hourly or more frequent portions that are taken over a 24-hour period. A time-proportioned composite sample may be used upon approval of the Department if the permittee demonstrates it is representative of the discharge.

PART II

Section B. Monitoring Procedures

1. Representative Samples

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. Test Procedures

Test procedures for the analysis of pollutants shall conform to regulations promulgated pursuant to Section 304(h) of the Federal Act (40 CFR Part 136 – Guidelines Establishing Test Procedures for the Analysis of Pollutants), unless specified otherwise in this permit. **Test procedures used shall be sufficiently sensitive to determine compliance with applicable effluent limitations**. Requests to use test procedures not promulgated under 40 CFR Part 136 for pollutant monitoring required by this permit shall be made in accordance with the Alternate Test Procedures regulations specified in 40 CFR 136.4. These requests shall be submitted to the Chief of the Permits Section, Water Resources Division, Michigan Department of Environmental Quality, P.O. Box 30458, Lansing, Michigan, 48909-7958. The permittee may use such procedures upon approval.

The permittee shall periodically calibrate and perform maintenance procedures on all analytical instrumentation at intervals to ensure accuracy of measurements. The calibration and maintenance shall be performed as part of the permittee’s laboratory Quality Control/Quality Assurance program.

3. Instrumentation

The permittee shall periodically calibrate and perform maintenance procedures on all monitoring instrumentation at intervals to ensure accuracy of measurements.

4. Recording Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information: 1) the exact place, date, and time of measurement or sampling; 2) the person(s) who performed the measurement or sample collection; 3) the dates the analyses were performed; 4) the person(s) who performed the analyses; 5) the analytical techniques or methods used; 6) the date of and person responsible for equipment calibration; and 7) the results of all required analyses.

5. Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation shall be retained for a minimum of three (3) years, or longer if requested by the Regional Administrator or the Department.

PART II

Section C. Reporting Requirements

1. Start-up Notification

If the permittee will not discharge during the first 60 days following the effective date of this permit, the permittee shall notify the Department within 14 days following the effective date of this permit, and then 60 days prior to the commencement of the discharge.

2. Submittal Requirements for Self-Monitoring Data

Part 31 of the NREPA (specifically Section 324.3110(7)); and R 323.2155(2) of Part 21, Wastewater Discharge Permits, promulgated under Part 31 of the NREPA, allow the Department to specify the forms to be utilized for reporting the required self-monitoring data. Unless instructed on the effluent limitations page to conduct "Retained Self-Monitoring" the permittee shall submit self-monitoring data via the Department's Electronic Environmental Discharge Monitoring Reporting (e2-DMR) system.

The permittee shall utilize the information provided on the e2-Reporting website at https://secure1.state.mi.us/e2rs/ to access and submit the electronic forms. Both monthly summary and daily data shall be submitted to the Department no later than the 20th day of the month following each month of the authorized discharge period(s). The permittee may be allowed to submit the electronic forms after this date if the Department has granted an extension to the submittal date.

3. Retained Self-Monitoring Requirements

If instructed on the effluent limits page (or otherwise authorized by the Department in accordance with the provisions of this permit) to conduct retained self-monitoring, the permittee shall maintain a year-to-date log of retained self-monitoring results and, upon request, provide such log for inspection to the staff of the Department. Retained self-monitoring results are public information and shall be promptly provided to the public upon request.

The permittee shall certify, in writing, to the Department, on or before January 10th (April 1st for animal feeding operation facilities) of each year, that: 1) all retained self-monitoring requirements have been complied with and a year-to-date log has been maintained; and 2) the application on which this permit is based still accurately describes the discharge. With this annual certification, the permittee shall submit a summary of the previous year's monitoring data. The summary shall include maximum values for samples to be reported as daily maximums and/or monthly maximums and minimum values for any daily minimum samples.

Retained self-monitoring may be denied to a permittee by notification in writing from the Department. In such cases, the permittee shall submit self-monitoring data in accordance with Part II.C.2., above. Such a denial may be rescinded by the Department upon written notification to the permittee. Reissuance or modification of this permit or reissuance or modification of an individual permittee's authorization to discharge shall not affect previous approval or denial for retained self-monitoring unless the Department provides notification in writing to the permittee.

4. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Discharge Monitoring Report. Such increased frequency shall also be indicated.

Monitoring required pursuant to Part 41 of the NREPA or Rule 35 of the Mobile Home Park Commission Act (Act 96 of the Public Acts of 1987) for assurance of proper facility operation shall be submitted as required by the Department.

PART II

Section C. Reporting Requirements

5. Compliance Dates Notification

Within 14 days of every compliance date specified in this permit, the permittee shall submit a *written* notification to the Department indicating whether or not the particular requirement was accomplished. If the requirement was not accomplished, the notification shall include an explanation of the failure to accomplish the requirement, actions taken or planned by the permittee to correct the situation, and an estimate of when the requirement will be accomplished. If a written report is required to be submitted by a specified date and the permittee accomplishes this, a separate written notification is not required.

6. Noncompliance Notification

Compliance with all applicable requirements set forth in the Federal Act, Parts 31 and 41 of the NREPA, and related regulations and rules is required. All instances of noncompliance shall be reported as follows:

a. 24-Hour Reporting
Any noncompliance which may endanger health or the environment (including maximum and/or minimum daily concentration discharge limitation exceedances) shall be reported, verbally, within 24 hours from the time the permittee becomes aware of the noncompliance. A written submission shall also be provided within five (5) days.

b. Other Reporting
The permittee shall report, in writing, all other instances of noncompliance not described in a. above at the time monitoring reports are submitted; or, in the case of retained self-monitoring, within five (5) days from the time the permittee becomes aware of the noncompliance.

Written reporting shall include: 1) a description of the discharge and cause of noncompliance; and 2) the period of noncompliance, including exact dates and times, or, if not yet corrected, the anticipated time the noncompliance is expected to continue, and the steps taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.

7. Spill Notification

The permittee shall immediately report any release of any polluting material which occurs to the surface waters or groundwaters of the state, unless the permittee has determined that the release is not in excess of the threshold reporting quantities specified in the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code), by calling the Department at the number indicated on the second page of this permit (or, if this is a general permit, on the COC); or, if the notice is provided after regular working hours, call the Department's 24-hour Pollution Emergency Alerting System telephone number, 1-800-292-4706 (calls from **out-of-state** dial 1-517-373-7660).

Within ten (10) days of the release, the permittee shall submit to the Department a full written explanation as to the cause of the release, the discovery of the release, response (clean-up and/or recovery) measures taken, and preventative measures taken or a schedule for completion of measures to be taken to prevent reoccurrence of similar releases.

PART II

Section C. Reporting Requirements

8. Upset Noncompliance Notification

If a process "upset" (defined as an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee) has occurred, the permittee who wishes to establish the affirmative defense of upset, shall notify the Department by telephone within 24 hours of becoming aware of such conditions; and within five (5) days, provide in writing, the following information:

a. that an upset occurred and that the permittee can identify the specific cause(s) of the upset;

b. that the permitted wastewater treatment facility was, at the time, being properly operated and maintained (note that an upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation); and

c. that the permittee has specified and taken action on all responsible steps to minimize or correct any adverse impact in the environment resulting from noncompliance with this permit.

No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

In any enforcement proceedings, the permittee, seeking to establish the occurrence of an upset, has the burden of proof.

9. Bypass Prohibition and Notification

a. Bypass Prohibition
Bypass is prohibited, and the Department may take an enforcement action, unless:

1) bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

2) there were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass; and

3) the permittee submitted notices as required under 9.b. or 9.c. below.

b. Notice of Anticipated Bypass
If the permittee knows in advance of the need for a bypass, it shall submit prior notice to the Department, if possible at least ten (10) days before the date of the bypass, and provide information about the anticipated bypass as required by the Department. The Department may approve an anticipated bypass, after considering its adverse effects, if it will meet the three (3) conditions listed in 9.a. above.

c. Notice of Unanticipated Bypass
The permittee shall submit notice to the Department of an unanticipated bypass by calling the Department at the number indicated on the second page of this permit (if the notice is provided after regular working hours, use the following number: 1-800-292-4706) as soon as possible, but no later than 24 hours from the time the permittee becomes aware of the circumstances.

PART II

Section C. Reporting Requirements

d. Written Report of Bypass
A written submission shall be provided within five (5) working days of commencing any bypass to the Department, and at additional times as directed by the Department. The written submission shall contain a description of the bypass and its cause; the period of bypass, including exact dates and times, and if the bypass has not been corrected, the anticipated time it is expected to continue; steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass; and other information as required by the Department.

e. Bypass Not Exceeding Limitations
The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to ensure efficient operation. These bypasses are not subject to the provisions of 9.a., 9.b., 9.c., and 9.d., above. This provision does not relieve the permittee of any notification responsibilities under Part II.C.11. of this permit.

f. Definitions

1) Bypass means the intentional diversion of waste streams from any portion of a treatment facility.

2) Severe property damage means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

10. Bioaccumulative Chemicals of Concern (BCC)

Consistent with the requirements of R 323.1098 and R 323.1215 of the Michigan Administrative Code, the permittee is prohibited from undertaking any action that would result in a lowering of water quality from an increased loading of a BCC unless an increased use request and antidegradation demonstration have been submitted and approved by the Department.

11. Notification of Changes in Discharge

The permittee shall notify the Department, in writing, as soon as possible but no later than 10 days of knowing, or having reason to believe, that any activity or change has occurred or will occur which would result in the discharge of: 1) detectable levels of chemicals on the current Michigan Critical Materials Register, priority pollutants or hazardous substances set forth in 40 CFR 122.21, Appendix D, or the Pollutants of Initial Focus in the Great Lakes Water Quality Initiative specified in 40 CFR 132.6, Table 6, which were not acknowledged in the application or listed in the application at less than detectable levels; 2) detectable levels of any other chemical not listed in the application or listed at less than detection, for which the application specifically requested information; or 3) any chemical at levels greater than five times the average level reported in the complete application (see the first page of this permit, for the date(s) the complete application was submitted). Any other monitoring results obtained as a requirement of this permit shall be reported in accordance with the compliance schedules.

PART II

Section C. Reporting Requirements

12. Changes in Facility Operations

Any anticipated action or activity, including but not limited to facility expansion, production increases, or process modification, which will result in new or increased loadings of pollutants to the receiving waters must be reported to the Department by a) submission of an increased use request (application) and all information required under R 323.1098 (Antidegradation) of the Water Quality Standards or b) by notice if the following conditions are met: 1) the action or activity will not result in a change in the types of wastewater discharged or result in a greater quantity of wastewater than currently authorized by this permit; 2) the action or activity will not result in violations of the effluent limitations specified in this permit; 3) the action or activity is not prohibited by the requirements of Part II.C.10.; and 4) the action or activity will not require notification pursuant to Part II.C.11. Following such notice, the permit or, if applicable, the facility's COC may be modified according to applicable laws and rules to specify and limit any pollutant not previously limited.

13. Transfer of Ownership or Control

In the event of any change in control or ownership of facilities from which the authorized discharge emanates, the permittee shall submit to the Department 30 days prior to the actual transfer of ownership or control a written agreement between the current permittee and the new permittee containing: 1) the legal name and address of the new owner; 2) a specific date for the effective transfer of permit responsibility, coverage and liability; and 3) a certification of the continuity of or any changes in operations, wastewater discharge, or wastewater treatment.

If the new permittee is proposing changes in operations, wastewater discharge, or wastewater treatment, the Department may propose modification of this permit in accordance with applicable laws and rules.

14. Operations and Maintenance Manual

For wastewater treatment facilities that serve the public (and are thus subject to Part 41 of the NREPA), Section 4104 of Part 41 and associated Rule 2957 of the Michigan Administrative Code allow the Department to require an Operations and Maintenance (O&M) Manual from the facility. An up-to-date copy of the O&M Manual shall be kept at the facility and shall be provided to the Department upon request. The Department may review the O&M Manual in whole or in part at its discretion and require modifications to it if portions are determined to be inadequate.

At a minimum, the O&M Manual shall include the following information: permit standards; descriptions and operation information for all equipment; staffing information; laboratory requirements; record keeping requirements; a maintenance plan for equipment; an emergency operating plan; safety program information; and copies of all pertinent forms, as-built plans, and manufacturer's manuals.

Certification of the existence and accuracy of the O&M Manual shall be submitted to the Department at least sixty days prior to start-up of a new wastewater treatment facility. Recertification shall be submitted sixty days prior to start-up of any substantial improvements or modifications made to an existing wastewater treatment facility.

PART II

Section C. Reporting Requirements

15. Signatory Requirements

All applications, reports, or information submitted to the Department in accordance with the conditions of this permit and that require a signature shall be signed and certified as described in the Federal Act and the NREPA.

The Federal Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance, shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

The NREPA (Section 3115(2)) provides that a person who at the time of the violation knew or should have known that he or she discharged a substance contrary to this part, or contrary to a permit, COC, or order issued or rule promulgated under this part, or who intentionally makes a false statement, representation, or certification in an application for or form pertaining to a permit or COC or in a notice or report required by the terms and conditions of an issued permit or COC, or who intentionally renders inaccurate a monitoring device or record required to be maintained by the Department, is guilty of a felony and shall be fined not less than $2,500.00 or more than $25,000.00 for each violation. The court may impose an additional fine of not more than $25,000.00 for each day during which the unlawful discharge occurred. If the conviction is for a violation committed after a first conviction of the person under this subsection, the court shall impose a fine of not less than $25,000.00 per day and not more than $50,000.00 per day of violation. Upon conviction, in addition to a fine, the court in its discretion may sentence the defendant to imprisonment for not more than 2 years or impose probation upon a person for a violation of this part. With the exception of the issuance of criminal complaints, issuance of warrants, and the holding of an arraignment, the circuit court for the county in which the violation occurred has exclusive jurisdiction. However, the person shall not be subject to the penalties of this subsection if the discharge of the effluent is in conformance with and obedient to a rule, order, permit, or COC of the Department. In addition to a fine, the attorney general may file a civil suit in a court of competent jurisdiction to recover the full value of the injuries done to the natural resources of the state and the costs of surveillance and enforcement by the state resulting from the violation.

16. Electronic Reporting

Upon notice by the Department that electronic reporting tools are available for specific reports or notifications, the permittee shall submit electronically all such reports or notifications as required by this permit.

PART II

Section D. Management Responsibilities

1. Duty to Comply

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit, more frequently than, or at a level in excess of, that authorized, shall constitute a violation of the permit.

It is the duty of the permittee to comply with all the terms and conditions of this permit. Any noncompliance with the Effluent Limitations, Special Conditions, or terms of this permit constitutes a violation of the NREPA and/or the Federal Act and constitutes grounds for enforcement action; for permit or Certificate of Coverage (COC) termination, revocation and reissuance, or modification; or denial of an application for permit or COC renewal.

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

2. Operator Certification

The permittee shall have the waste treatment facilities under direct supervision of an operator certified at the appropriate level for the facility certification by the Department, as required by Sections 3110 and 4104 of the NREPA. Permittees authorized to discharge storm water shall have the storm water treatment and/or control measures under direct supervision of a storm water operator certified by the Department, as required by Section 3110 of the NREPA.

3. Facilities Operation

The permittee shall, at all times, properly operate and maintain all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance includes adequate laboratory controls and appropriate quality assurance procedures.

4. Power Failures

In order to maintain compliance with the effluent limitations of this permit and prevent unauthorized discharges, the permittee shall either:

a. provide an alternative power source sufficient to operate facilities utilized by the permittee to maintain compliance with the effluent limitations and conditions of this permit; or

b. upon the reduction, loss, or failure of one or more of the primary sources of power to facilities utilized by the permittee to maintain compliance with the effluent limitations and conditions of this permit, the permittee shall halt, reduce or otherwise control production and/or all discharge in order to maintain compliance with the effluent limitations and conditions of this permit.

5. Adverse Impact

The permittee shall take all reasonable steps to minimize or prevent any adverse impact to the surface waters or groundwaters of the state resulting from noncompliance with any effluent limitation specified in this permit including, but not limited to, such accelerated or additional monitoring as necessary to determine the nature and impact of the discharge in noncompliance.

PART II

Section D. Management Responsibilities

6. Containment Facilities

The permittee shall provide facilities for containment of any accidental losses of polluting materials in accordance with the requirements of the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code). For a Publicly Owned Treatment Work (POTW), these facilities shall be approved under Part 41 of the NREPA.

7. Waste Treatment Residues

Residuals (i.e. solids, sludges, biosolids, filter backwash, scrubber water, ash, grit, or other pollutants or wastes) removed from or resulting from treatment or control of wastewaters, including those that are generated during treatment or left over after treatment or control has ceased, shall be disposed of in an environmentally compatible manner and according to applicable laws and rules. These laws may include, but are not limited to, the NREPA, Part 31 for protection of water resources, Part 55 for air pollution control, Part 111 for hazardous waste management, Part 115 for solid waste management, Part 121 for liquid industrial wastes, Part 301 for protection of inland lakes and streams, and Part 303 for wetlands protection. Such disposal shall not result in any unlawful pollution of the air, surface waters or groundwaters of the state.

8. Right of Entry

The permittee shall allow the Department, any agent appointed by the Department, or the Regional Administrator, upon the presentation of credentials and, for animal feeding operation facilities, following appropriate biosecurity protocols:

a. to enter upon the permittee's premises where an effluent source is located or any place in which records are required to be kept under the terms and conditions of this permit; and

b. at reasonable times to have access to and copy any records required to be kept under the terms and conditions of this permit; to inspect process facilities, treatment works, monitoring methods and equipment regulated or required under this permit; and to sample any discharge of pollutants.

9. Availability of Reports

Except for data determined to be confidential under Section 308 of the Federal Act and Rule 2128 (R 323.2128 of the Michigan Administrative Code), all reports prepared in accordance with the terms of this permit, shall be available for public inspection at the offices of the Department and the Regional Administrator. As required by the Federal Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Section 309 of the Federal Act and Sections 3112, 3115, 4106 and 4110 of the NREPA.

10. Duty to Provide Information

The permittee shall furnish to the Department, within a reasonable time, any information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or the facility's COC, or to determine compliance with this permit. The permittee shall also furnish to the Department, upon request, copies of records required to be kept by this permit.

Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or information.

PART II

Section E. Activities Not Authorized by This Permit

1. Discharge to the Groundwaters
This permit does not authorize any discharge to the groundwaters. Such discharge may be authorized by a groundwater discharge permit issued pursuant to the NREPA.

2. POTW Construction
This permit does not authorize or approve the construction or modification of any physical structures or facilities at a POTW. Approval for the construction or modification of any physical structures or facilities at a POTW shall be by permit issued under Part 41 of the NREPA.

3. Civil and Criminal Liability
Except as provided in permit conditions on "Bypass" (Part II.C.9. pursuant to 40 CFR 122.41(m)), nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance, whether or not such noncompliance is due to factors beyond the permittee’s control, such as accidents, equipment breakdowns, or labor disputes.

4. Oil and Hazardous Substance Liability
Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee may be subject under Section 311 of the Federal Act except as are exempted by federal regulations.

5. State Laws
Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation under authority preserved by Section 510 of the Federal Act.

6. Property Rights
The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize violation of any federal, state or local laws or regulations, nor does it obviate the necessity of obtaining such permits, including any other Department of Environmental Quality permits, or approvals from other units of government as may be required by law.

Appendix D

Project Cost Estimates

COST ESTIMATE
Project No. 1 Alternative No. 1: Remove Comminutors and Install Coarse Screens

Item	Description	Quantity	Unit	Unit Price	Amount
1.	Demolition	1	lsum	$30,000	$30,000
2.	Elevated Deck	1	lsum	$50,000	$50,000
3.	Bar Screens, Washer Compactors, Controls	1	lsum	$830,000	$830,000
4.	Plant Water Connection	1	lsum	$10,000	$10,000
5.	Building	1	lsum	$240,000	$240,000
6.	HVAC Plumbing & Mechanical	1	lsum	$95,000	$95,000
7.	Electrical	1	lsum	$75,000	$75,000
8.	SCADA Integration	1	lsum	$35,000	$35,000
9.	Modify FRP Covers	1	lsum	$10,000	$10,000
10.	Yard Piping Odor Control	1	lsum	$25,000	$25,000
11.	Restoration	1	lsum	$20,000	$20,000
12.	General Conditions	1	lsum	$256,000	$256,000
	TOTAL CONSTRUCTION:				**$1,676,000**
	Engineering, Legal, Administration, Contingencies				$503,000
	TOTAL:				**$2,179,000**

All work quantities and costs are estimated for preliminary planning purposes only.
Costs estimated in 2022 Dollars

NORTH KENT SEWER AUTHORITY
SRF PROJECT PLAN

COST ESTIMATE
Project No. 2 Alternative No. 1: Pressure Filters

Item	Description	Quantity	Unit	Unit Price	Amount
1.	Bypass Pumping	1	lsum	$50,000	$50,000
2.	Excavation, Backfill & Dewatering	1	lsum	$400,000	$400,000
3.	Site Fill	1	lsum	$70,000	$70,000
4.	Building	1	lsum	$4,000,000	$4,000,000
5.	Wet Well & Equalization Basin	1	lsum	$400,000	$400,000
6.	Outfall Structures & Overflow Weir	1	lsum	$100,000	$100,000
7.	Site Piping	1	lsum	$100,000	$100,000
8.	Activated Carbon Filters	1	lsum	$8,000,000	$8,000,000
9.	Filter Pumps	1	lsum	$1,000,000	$1,000,000
10.	Backwash Pumps	1	lsum	$500,000	$500,000
11.	Valves	1	lsum	$570,000	$570,000
12.	Meters	1	lsum	$200,000	$200,000
13.	Process Piping	1	lsum	$1,755,000	$1,755,000
14.	Chemical Storage, Skid & Feed Line	1	lsum	$100,000	$100,000
15.	Controls & Instrumentation	1	lsum	$420,000	$420,000
16.	Electrical	1	lsum	$500,000	$500,000
17.	HVAC & Plumbing	1	lsum	$450,000	$450,000
18.	Paving & Restoration	1	lsum	$90,000	$90,000
19.	Utility Services	1	lsum	$10,000	$10,000
20.	General Conditions	1	lsum	$1,872,000	$1,872,000
	TOTAL CONSTRUCTION:				**$20,587,000**
	Engineering, Legal, Administration, Contingencies				$6,176,000
	TOTAL:				**$26,763,000**

All work quantities and costs are estimated for preliminary planning purposes only.
Costs estimated in 2022 Dollars

COST ESTIMATE
Project No. 3 Alternative No. 1: Fine Screens, Conveyors, and Compactors

Item	Description	Quantity	Unit	Unit Price	Amount
1.	Demolition	1	lsum	$150,000	$150,000
2.	Temporary Screening Coneyance System	1	lsum	$20,000	$20,000
3.	Fine Screens, Conveyors, Compactors	1	lsum	$1,525,000	$1,525,000
4.	Piping & Supports	1	lsum	$25,000	$25,000
5.	Odor Control Ductwork	1	lsum	$220,000	$220,000
6.	Control Panel	1	lsum	$65,000	$65,000
7.	SCADA Integration	1	lsum	$20,000	$20,000
8.	General Conditions	1	lsum	$304,000	$304,000
	TOTAL CONSTRUCTION:				**$2,329,000**
	Engineering, Legal, Administration, Contingencies				$699,000
	TOTAL:				**$3,028,000**

All work quantities and costs are estimated for preliminary planning purposes only.
Costs estimated in 2022 Dollars

COST ESTIMATE
Project No. 4 Alternative 1: Increase Membrane Filtration Capacity

Item	Description	Quantity	Unit	Unit Price	Amount
I. Membrane Aeration					
1.	Membrane Aeration Blower	1	lsum	$280,000	$280,000
2.	Blower Piping & Valves	1	lsum	$75,000	$75,000
3.	Electrical & Instrumentation	1	lsum	$55,000	$55,000
4.	Coating	1	lsum	$10,000	$10,000
5.	General Conditions	1	lsum	$63,000	$63,000
	Membrane Aeration Subtotal:				$483,000
II. Membrane Equipment					
1.	Trains 6 & 7 LEAPmbr Membrane Cassettes	1	lsum	$2,420,000	$2,420,000
2.	Permeate Pumps	1	lsum	$110,000	$110,000
3.	Permeate Valves & Piping	1	lsum	$132,000	$132,000
4.	Aeration Valves & Piping	1	lsum	$220,000	$220,000
5.	Tank & Grating Modifications	1	lsum	$27,500	$27,500
6.	Tank Coating	1	lsum	$400,000	$400,000
7.	Tank Drain Valve - Pneumatic Actuators	1	lsum	$30,000	$30,000
8.	Instrumentation & Controls	1	lsum	$106,000	$106,000
9.	General Conditions	1	lsum	$517,000	$517,000
	Membrane Equipment Subtotal:				$3,962,500
	TOTAL CONSTRUCTION:				**$4,445,500**
	Engineering, Legal, Administration, Contingencies				$1,334,000
	TOTAL:				**$5,779,500**

All work quantities and costs are estimated for preliminary planning purposes only.
Costs estimated in 2022 Dollars

COST ESTIMATE
Project No. 4 Alternative No. 2: Equalization Basin and Chemical System

Item	Description	Quantity	Unit	Unit Price	Amount
1.	Excavation, Fill & Dewatering	1	lsum	$275,000	$275,000
2.	Anti-Floatation Piles	1	lsum	$308,000	$308,000
3.	Equalization Tank	1	lsum	$1,640,000	$1,640,000
4.	Electrically Actuated Valves	1	lsum	$70,000	$70,000
5.	Inlet Piping	1	lsum	$77,000	$77,000
6.	Overflow Piping	580	lf	$165	$95,700
7.	Sanitary Manholes	2	ea	$16,500	$33,000
8.	Outlet Piping	200	lf	$165	$33,000
9.	FRP Outlet Weir	1	lsum	$16,500	$16,500
10.	Meter Chambers	1	lsum	$50,000	$50,000
11.	Chlorine Disinfection System	1	lsum	$44,000	$44,000
12.	Bisulfite Dechlorination System	1	lsum	$55,000	$55,000
13.	Tank Flushing System	1	lsum	$220,000	$220,000
14.	SCADA Integration	1	lsum	$15,000	$15,000
15.	Restoration	1	lsum	$50,000	$50,000
16.	General Conditions	1	lsum	$448,000	$448,000
	TOTAL CONSTRUCTION:				**$3,430,200**
	Engineering, Legal, Administration, Contingencies				$1,029,000
	TOTAL:				**$4,459,200**

All work quantities and costs are estimated for preliminary planning purposes only.
Costs estimated in 2022 Dollars

NORTH KENT SEWER AUTHORITY
SRF PROJECT PLAN

COST ESTIMATE
Project No. 4 Alternative No. 3: Bioreactor No. 4

Item	Description	Quantity	Unit	Unit Price	Amount
I. Bioreactor #4					
1.	Excavation, Dewatering & Backfill	1	lsum	$350,000	$350,000
2.	Anti-Floatation Piles	1	lsum	$308,000	$308,000
3.	Bioreactor Tank No. 4	1	lsum	$1,665,000	$1,665,000
4.	Electrically Actuated Inlet Gate & Drain Valve	1	lsum	$35,000	$35,000
5.	Aluminum Guardrail	1	lsum	$33,000	$33,000
6.	Tank Flushing System	1	lsum	$260,000	$260,000
7.	Return Force Main	1	lsum	$25,000	$25,000
8.	Meter Chamber	1	lsum	$25,000	$25,000
9.	SCADA Integration	1	lsum	$15,000	$15,000
10.	Restoration	1	lsum	$20,000	$20,000
11.	General Conditions	1	lsum	$411,000	$411,000
	Bioreactor Tank No. 4 Subtotal:				$3,147,000
II. Bioreactor Lift Station					
12.	MH S-9 Modifications	1	lsum	$10,000	$10,000
14.	Pump and Piping	1	lsum	$83,000	$83,000
15.	Controls & Instrumentation	1	lsum	$60,000	$60,000
16.	Electrical	1	lsum	$30,000	$30,000
17.	Concrete	1	lsum	$5,000	$5,000
17.	General Conditions	1	lsum	$29,000	$29,000
	Bioreactor Lift Station Subtotal:				$217,000
	TOTAL CONSTRUCTION:				**$3,364,000**
	Engineering, Legal, Administration, Contingencies				$1,009,000
	TOTAL:				**$4,373,000**

All work quantities and costs are estimated for preliminary planning purposes only.
Costs estimated in 2022 Dollars

COST ESTIMATE

Project No. 5 Alternative No. 1: Aluminum Membrane Tank Covers and Exhaust Fan System

Item	Description	Quantity	Unit	Unit Price	Amount
1.	Demolition	1	lsum	$5,000	$5,000
2.	Aluminum Covers	1	lsum	$300,000	$300,000
3.	Cover Installation	1	lsum	$130,000	$130,000
4.	Exhaust Fan & Ductwork	1	lsum	$55,000	$55,000
5.	Electrical	1	lsum	$16,000	$16,000
6.	General Conditions	1	lsum	$92,000	$92,000
	TOTAL CONSTRUCTION:				**$598,000**
	Engineering, Legal, Administration, Contingencies				$179,000
	TOTAL:				**$777,000**

All work quantities and costs are estimated for preliminary planning purposes only.
Costs estimated in 2022 Dollars

Appendix E

Present Worth Analysis

NORTH KENT SEWER AUTHORITY SRF PROJECT PLAN
PRESENT WORTH ANALYSIS

	Project 1 Alt 1	*Project 2 Alt 1*	*Project 3 Alt 1*	*Project 4 Alt 1*	*Project 4 Alt 2*	*Project 4 Alt 3*	*Project 5 Alt 1*
Project Description	Remove Comminutors and Install Coarse Screens	Pressure Filters	Fine Screens, Conveyors, and Compactors	Increase Membrane Filtration Capacity	Equalization Basin and Chemical System	Bioreactor No. 4	Aluminum Membrane Tank Covers and Exhaust Fan System
	FY2023	Future	FY2023			Future	FY2023
SRF Eligible Capital Costs (including ELAC)							
Structures (50 yr)	$358,000	$5,060,000	$0	$482,000	$2,406,000	$2,240,000	$0
Process Equipment (20 yr)	$1,111,000	$13,833,000	$1,947,000	$3,594,000	$502,000	$444,000	$534,000
Auxiliary Equipment (15 yr)	$39,000	$1,012,000	$94,000	$178,000	$17,000	$116,000	$18,000
Incidental Construction Costs	$337,000	$2,742,000	$522,000	$638,000	$851,000	$902,000	$107,000
Planning	$84,000	$1,030,000	$117,000	$223,000	$172,000	$169,000	$30,000
Design / Construction Engineering	$250,000	$3,086,000	$348,000	$664,500	$511,200	$502,000	$88,000
Project Cost (SRF Eligible)	$2,179,000	$26,763,000	$3,028,000	$5,779,500	$4,459,200	$4,373,000	$777,000
(A) 20-yr Present Worth of Capital Costs [1]	$2,408,772	$29,585,109	$3,347,297	$6,388,938	$4,929,414	$4,834,125	$858,933
Operation, Maintenance & Replacement (OM&R)							
Energy Cost Savings	($11,000)	($51,000)	$50	($163,000)	$0	($50)	($3,000)
Annual O&M [2]	$10,000	$3,000,000	$10,000	$3,000	$3,200	$500	$1,000
Process Equipment Replacement (20 yr)	$1,005,022	$12,513,477	$1,761,277	$3,251,170	$454,114	$401,647	$483,062
Auxiliary Equipment Replacement (15 yr)	$36,175	$938,700	$87,191	$165,107	$15,769	$107,598	$16,696
(B) 20-yr Present Worth of OM&R [1]	$210,896	$63,268,902	$210,896	$63,269	$67,487	$10,545	$21,090
(C) 20-yr Present Worth of Energy Cost Savings [3]	$351,329	$1,628,888	($1,597)	$5,206,054	$0	$1,597	$95,817
Salvage Value of Capital							
Salvage value at 20 years	$214,800	$3,036,000	$0	$289,200	$1,443,600	$1,344,000	$0
(D) 20-yr Present Worth of Salvage [1]	$237,450	$3,356,141	$0	$319,696	$1,595,825	$1,485,722	$0
Total Present Worth (A + B + C - D)	$2,733,546	$91,126,759	$3,556,596	$11,338,565	$3,401,076	$3,360,544	$975,840
Equivalent Annual Cost [4]	$165,165	$5,506,014	$214,895	$685,093	$205,498	$203,049	$58,962
Total Existing Residential Equivalent Units (REUs)							
NKSA Sewer Authority REUs:	25,499						
Unit of Government Responsible for Payment for:	Project 1 Alt 1	Project 4 Alt 2	Project 3 Alt 1	Project 4 Alt 1	Project 4 Alt 2	Project 4 Alt 2	Project 4 Alt 2
North Kent Sewer Authority	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
North Kent Sewer Authority Annual Cost per REU	$6.48	$215.93	$8.43	$26.87	$8.06	$7.96	$2.31
North Kent Sewer Authority Monthly Cost per REU	$0.54	$17.99	$0.70	$2.24	$0.67	$0.66	$0.19

Total Proposed Project Cost FY2023 / Future:	**$5,984,000**	/	**$31,136,000**
Total Present Worth FY2023 / Future:	**$7,265,983**	/	**$94,487,303**
Total Equivalent Annual Cost FY2023 / Future:	**$439,021**	/	**$5,709,063**

	Annual [4]	**Monthly** [4]
Total NKSA Cost per REU (FY2023 Projects)	**$17.22**	**$1.43**
Total NKSA Cost per REU (Future Projects)	**$223.89**	**$18.66**

Notes:

[1] U.S. EPA Discount rate for Year 2021 is -0.500%

[2] Negative value indicates reduction in Annual O&M

[3] Assumed energy cost rate of escalation is 3.75%

[4] Based on Total Present Worth and interest rate of 1.875% 1.875%

Appendix F

Annual Cost Summary

2220316
April 2022

NORTH KENT SEWER AUTHORITY
KENT COUNTY, MICHIGAN
SRF PROJECT PLAN
ANNUAL COST SUMMARY

No.	Project	SRF Project Cost Estimate	Annual Debt Service*	Operation & Maintenance Increase/Decrease	Total Annual Cost
FY 2023 - SRF					
1.	Remove Comminutors and Install Coarse Screens	$2,179,000	$131,658	$10,000	$141,658
3.	Fine Screens, Conveyors, and Compactors	$3,028,000	$182,956	$10,000	$192,956
5.	Aluminum Membrane Tank Covers and Exhaust Fan System	$777,000	$46,947	$1,000	$47,947
	Total FY 2021:	$5,984,000	$361,562	$21,000	$382,562
	Existing REU's				25,499
	Annual REU Cost**				$17.22
	Monthly REU Cost**				$1.43
Future - SRF					
2.	Pressure Filters	$26,763,000	$1,617,060	$3,000,000	$4,617,060
4.	Bioreactor No. 4	$4,373,000	$264,223	$500	$264,723
	Total FY 2023:	$31,136,000	$1,881,283	$3,000,500	$4,881,783
	Existing REU's				25,499
	Annual REU Cost**				$223.89
	Monthly REU Cost**				$18.66

*Annual debt service based on 20 year loan with a 1.875% interest rate.
**REU Cost based on total present worth