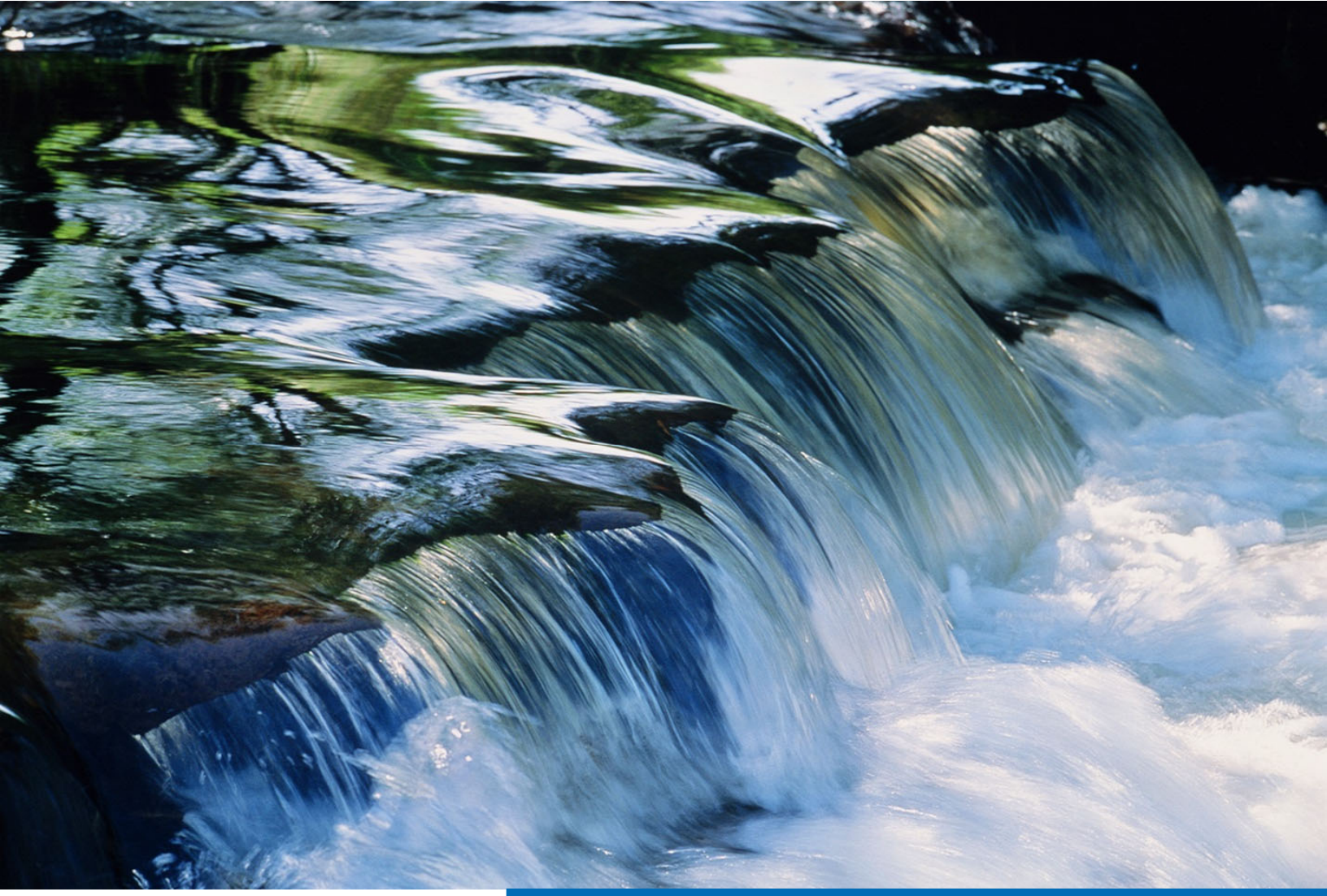

Metropolitan Water Reclamation District of Greater Chicago
Phosphorus Removal Feasibility Study

Technical Memorandum A.2 PHOSPHORUS REMOVAL FEASIBILITY STUDY FOR THE KIRIE WATER RECLAMATION PLANT

April 2022

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Illinois Design Firm Professional
Registration No. 184.006021

Metropolitan Water Reclamation District of Greater Chicago
Phosphorus Removal Feasibility Study

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April 2022

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Abbreviations

AACEI	American Association of Cost Engineers International
AADF	Annual Average Day Flow
AADL	Annual Average Day Load
ADM 1	Anaerobic Digestion Model No. 1
$AlSO_4$	Aluminum Sulfate
A/O	Anaerobic/Oxic
AOB	Ammonia Oxidizing Bacteria
ASM 2d	Activated Sludge Model No. 2d
BioMag	magnetite ballasted activated sludge
Bio P	Biological Phosphorus Removal
BNR	Biological Nutrient Removal
BOD	Biological Oxygen Demand
BOD_5	5 Day Biological Oxygen Demand
$CaHPO_4$	brushite
Carollo	Carollo Engineers, Inc.
$CBOD_5$	Carbonaceous Biological Oxygen Demand
Chem P	Chemical Phosphorus Removal
D	Depth
DAF	Design Average Flow
deg. C	Degrees Celsius
Dia.	Diameter
District	Metropolitan Water Reclamation District of Greater Chicago
DMF	Design Maximum Flow
DO	Dissolved Oxygen
Egan	John E. Egan
$FeCl_3$	Ferric Chloride
Fe/P	Iron to Phosphorus
FRP	Fiberglass Reinforced Plastic
ft	Feet
GAOs	Glycogen Accumulating Organisms
gpd	Gallons Per Day
gph	Gallons Per Hour
gpm	Gallons Per Minute
gpm/sf	gallons per minute per square foot
GPS-X	Process simulation model used to predict WRP performance
H	Height
hp	Horsepower

I&C	Instrumentation and Controls
IEPA	Illinois Environmental Protection Agency
IFAS	Integrated Fixed-Film Activated Sludge
in.	Inches
Kirie	James C. Kirie
kWH	kilowatt hours
L	Length
lb/day	Pounds Per Day
M&O	Maintenance and Operations
MABR	membrane aerated bioreactor
MBR	Membrane Bioreactor
mg	milligrams
mgd	Million Gallons Per Day
$MgHPO_4$	newberyite
mg/L	Milligrams Per Liter
mg/L-N	Milligrams Per Liter as Nitrogen
$MgNH_4PO_4$	struvite
ML	mixed liquor
MLSS	Mixed Liquor Suspended Solids
MMADF	Maximum Month Average Day Flow
MMADL	Maximum Month Average Day Load
mV	Millivolt
NAS	Nitrifying Activated Sludge
NH_3-N	Ammonia Nitrogen
NO_3	Nitrate
NPDES	National Pollutant Discharge Elimination System
NPV	Net Present Value
O&M	Operation and Maintenance
ORP	Oxidization Reduction Potential
P	Phosphorus
PAO	Polyphosphate Accumulating Organism
PE	Primary Effluent
PHA	Polyhydroxyalkanoate
RAS	Return Activated Sludge
RFP	Request for Proposal
scfm	Standard Cubic Feet per Minute
Sol-P	Soluble Phosphorus
SRT	Solids Retention Time
SVI	Sludge Volume Index

TDH	Total Dynamic Head
TKN	Total Kjeldahl Nitrogen
TM	Technical Memorandum
TP	Total Phosphorus
TSS	Total Suspended Solids
VFAs	Volatile Fatty Acids
VSS	Volatile Suspended Solids
W	Width
WAS	Waste Activated Sludge
WEF MOP 37	Water Environment Federation Manual of Practice 37
WRP	Water Reclamation Plant
WW	Wastewater

Technical Memorandum A.2

PHOSPHORUS REMOVAL FEASIBILITY STUDY FOR THE KIRIE WATER RECLAMATION PLANT

A.2.1 Introduction

The Metropolitan Water Reclamation District of Greater Chicago (District) is an independent government and taxing body, encompassing 91 percent of the land area and 98 percent of the assessed valuation of Cook County, Illinois. The District owns and operates seven water reclamation plants (WRPs). The District treats an average of 1.4 billion gallons of wastewater each day with a total wastewater treatment capacity of 2.0 billion gallons per day. Figure A.2.1 is an overview of the District's service area and seven WRPs.

The District has recently received a total phosphorus (TP) concentration limit of 1.0 milligrams per liter (mg/L) as a monthly average with associated load limits in the newly reissued National Pollutant Discharge Elimination System (NPDES) permits for the James C. Kirie (Kirie) and John E. Egan (Egan) WRPs. The District retained Carollo Engineers, Inc. (Carollo) to prepare phosphorus (P) removal Optimization and Feasibility Studies for the Kirie and Egan WRPs (Groups A and B, 16-RFP-21).

The P Removal Feasibility Studies at the Kirie WRP (Group A) and Egan WRP (Group B) were conducted in two tasks. Task 1 included the evaluation of P removal optimization opportunities with the primary goal of reducing effluent P concentrations through optimized use of the existing facilities with reasonable operational adjustments and minor facility modifications. Task 2 included development of recommended facility improvements, and estimated capital and operation and maintenance (O&M) costs to meet potential NPDES permit effluent TP limits of 1.0 mg/L, 0.5 mg/L, and 0.1 mg/L.

The purpose of this Technical Memorandum (TM) A.2 is to summarize the P Removal Feasibility Study opportunities at the Kirie WRP (Group A, Task 2). Analysis of various phosphorus removal configurations along with an estimation of related capital, O&M, and life cycle costs for potential tiered effluent TP limits of 1.0 mg/L (Tier 1), 0.5 mg/L (Tier 2), and 0.1 mg/L (Tier 3) at current flows and rated capacity are presented in this TM A.2.

A subsequent TM will summarize the P Removal Feasibility Study for the Egan WRP (TM B.2).

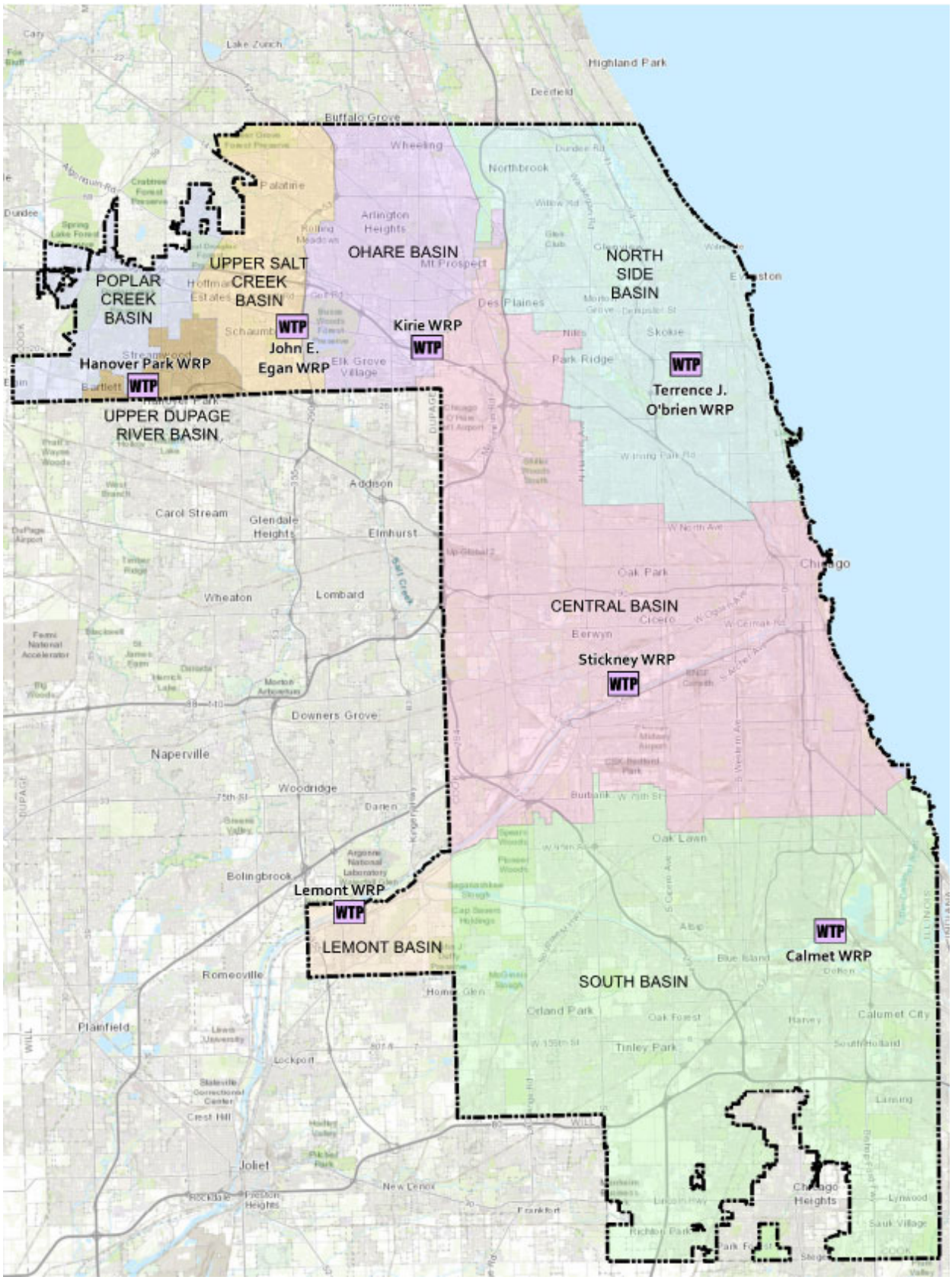

Figure A.2.1 Overview of the District's Service Area and Seven WRPs

TM A.2 is organized into 9 sections, structured as follows:

Section A.2.1 Introduction. This section describes the purpose and basis of the Feasibility Study, regulatory discussion, differences between the Feasibility and Optimization Studies, feasibility approach for different tiered effluent TP limits, and the specific objectives of this TM.

Section A.2.2 Background and Basis of Analysis. This section provides background on the existing Kirie WRP, summarizes findings of P removal testing conducted at the Kirie WRP, and lists the key Optimization Study conclusions and recommendations.

Section A.2.3 Bio P Evaluation Criteria and Process Simulation Modeling Summary. This section describes the design criteria for Bio P and provides an overview of the GPS-X process simulation modeling conducted to predict facility performance.

Section A.2.4 Bio P Process Alternatives. This section discusses the various Bio P removal alternatives analyzed as part of this Feasibility Study for the Kirie WRP.

Section A.2.5 Implementation of Recommended A/O Process. This section describes the implementation of Bio P process focusing on continued nitrification requirements, anaerobic zone volume requirements, and clarifier capacity analysis. This section also describes the recommended Bio P alternative in more detail, along with the Chem P polishing and tertiary filtration requirements.

Section A.2.6 Summary of Future Treatment Phased Implementation Plan. This section summarizes the recommended Bio P and Chem P process performance for a range of flows, presents planning level layouts, and project implementation schedule.

Section A.2.7 Evaluation of Potential Unintended Consequences of P Removal Implementation. This section discusses the potential unintended consequences of Bio P implementation.

Section A.2.8 Estimation of Capital, O&M, and Life Cycle Cost Estimates. This section summarizes the estimation of capital, O&M, and life cycle costs for tiered effluent TP limits of 1.0 mg/L, 0.5 mg/L, and 0.1 mg/L, at current flows and rated capacity for Kirie WRP.

Section A.2.9 Summary of P Removal Feasibility Study Conclusions and Recommendations. This section summarizes the conclusions and recommendations of the P Removal Feasibility Study for Kirie WRP.

A.2.1.1 Purpose of the Phosphorus Removal Feasibility Study

The newly reissued NPDES permit for the Kirie WRP requires a P Removal Feasibility Study. The requirement for a P Removal Feasibility Study has been included in other District NPDES permits and is consistent with the requirements in renewed permits for municipal dischargers throughout the State of Illinois.

In addition to satisfying the NPDES requirements to prepare a P Removal Feasibility Study, the District wishes to assess the ramifications of unintended consequences of P removal that may result in additional capital and O&M costs. Therefore, the purpose of the Kirie WRP P Removal Feasibility Study is to provide scope elements as required in the NPDES permit and address unintended consequences. The basic scope elements of P Removal Feasibility Study are:

- Evaluation of Bio P opportunities and Chem P requirements to meet tiered effluent TP limits.

- Identification of facilities and costs required to meet numeric permit limits for effluent TP of 1.0 mg/L, 0.5 mg/L, and 0.1 mg/L on a monthly, seasonal, and annual average basis.
- Evaluation and inclusion of costs for improvements needed to address the unintended consequences of P removal.

A.2.1.2 Distinction between Optimization and Feasibility Study Tasks

The two tasks that make up the Kirie WRP P Removal Feasibility Study, Task A.1 Optimization Study and Task A.2 Feasibility Study, have separate and distinct focus and purpose.

The Kirie Optimization Study (TM A.1) was focused on optimization of existing wastewater treatment facilities. "Optimization" was defined as the anticipated effluent TP removal that can be achieved using the existing Kirie WRP processes and equipment through operational adjustments and minor facility modifications. Simply put, optimization suggests that the District will attempt to remove as much TP as possible at the Kirie WRP with no capital investment. Therefore, optimization strategies were focused on the Bio P process generally consistent with the current WRP operations. Chem P was not considered in the Optimization Study because there were no numeric TP limits to achieve, effluent P reduction was only a goal, and Chem P requires capital investment.

The Kirie Feasibility Study presented herein (TM A.2) is focused on identifying the wastewater treatment improvements and costs to meet the numeric tiered effluent TP permit limits of 1.0 mg/L, 0.5 mg/L, and 0.1 mg/L on a monthly, seasonal, and annual average basis. Since Bio P alone was determined to be insufficient to achieve all the possible numeric permit limits reliably and consistently or as required for treatment of peak flows and loads, Chem P was also evaluated as part of the Feasibility Study. Different process configurations were analyzed to assess Bio P and nitrification performance.

Key considerations of the Kirie WRP Feasibility Study included:

- **The timing and need to activate Battery B of the aeration basins.** Activation of Battery B triggers additional facility improvements associated with tertiary filtration in order to reliably meet total suspended solids (TSS) and Tier 3 TP effluent limits.
- **Internal plant hydraulics.** Preliminary hydraulic evaluations were performed to evaluate the feasibility of deferring activation of Battery B by constructing dedicated external and/or internal anaerobic zones.
- **Nitrification capacity.** Process evaluations included maintaining adequate nitrification capacity for current flows and rated capacity.
- **Chem P systems.** Analyses for chemical dose, storage, and feed facilities required for reliable and consistent P removal under variable phosphorus loading and Bio P performance including the potential for monthly, seasonal, and annual averaging periods.
- **Unintended consequences.** Implementation of P removal with Bio P and/or Chem P can lead to ramifications that adversely impact existing treatment. The analysis attempted to capture the costs to mitigate unintended consequences as a part of the Feasibility Study.

More detailed discussion on the key considerations is included in subsequent sections of this TM.

A.2.1.3 Key Assumptions

The following section summarizes the key regulatory, flow, and cost assumptions that were used for the Kirie WRP Feasibility Study as well as justifications for the assumptions:

- **All costs were developed for the monthly averaging period.** The averaging period included in a potential NPDES permit associated with various tiered effluent TP limits has not been established. Therefore, the P Removal Feasibility Study included assessment of the impacts of monthly, seasonal, and annual averaging periods. A monthly averaging period limits the ability of the facility to adjust to periodic Bio P performance excursions and therefore will require the highest level of design safety factor and Chem P contingency measures when compared to longer averaging periods. Therefore, a monthly averaging period was used as the basis for all Bio P alternatives performance and cost assessments to establish the highest anticipated costs.
  For this study it was assumed that averaging periods primarily impact the Chem P costs. TP excursions in a Bio P treatment system associated with changes in load, temperature, operating conditions, and carbon availability will be treated using Chem P. The monthly averaging period will have a higher chemical demand and cost to mitigate excursions than a longer seasonal averaging period. Similarly, a seasonal averaging period will have higher chemical demand and cost than the annual averaging period. In order to reduce chemical costs and avoid unnecessary over design associated with higher safety factor, we encourage the District to negotiate the longest possible averaging period to balance water quality protection with treatment cost.
  TM A.2 provides an estimate of the anticipated change in Chem P dose associated with various averaging periods.
- **Facility requirements and costs to meet tiered effluent TP limits were developed at current flows and DAF rated capacity.** The current average annual day flow (AADF) for Kirie WRP is 35.8 million gallons per day (mgd), and the design average flow (DAF) rated capacity is 52.0 mgd. While significant, additional, future flow is not anticipated at the Kirie WRP, a range of flows and loads were evaluated up to the DAF rated capacity of 52.0 mgd to provide the District with current and potential future costs for a range of effluent TP numeric permit limits. Cost estimates were generated for both flows at various effluent TP numeric permit limits. This approach provides the District and regulators a roadmap for potential modifications to accommodate P limits up to the permitted Kirie WRP DAF capacity while acknowledging that the District's capital investment for modifications will be made using a phased implementation approach. If necessary, future phases are identified herein and can be implemented to treat flows and loads beyond current conditions up to rated capacity, as required.

A.2.1.4 Feasibility Study Objectives

The objectives of the Feasibility Study are to:

- Evaluate and recommend Bio P process configurations while leveraging existing facilities and assets, minimizing capital investments, and providing sufficient nitrification capacity to achieve effluent TP limits of 1.0 mg/L, 0.5 mg/L, and 0.1 mg/L.
- Evaluate and determine the Chem P needs to complement the recommended Bio P configuration to reliably and consistently meet effluent TP limits of 1.0 mg/L, 0.5 mg/L, and 0.1 mg/L.
- Provide estimated capital, O&M, and life cycle costs for the recommended Bio P and Chem P process configurations for effluent TP limits of 1.0 mg/L, 0.5 mg/L, and 0.1 mg/L, at current flows and rated capacity.
- Identify and recommend mitigation measures for addressing unintended consequences of implementing P removal and include relevant capital, O&M, and life cycle costs.

A.2.2 Background and Basis of Analysis

The following sections provide a summary of the existing Kirie WRP, review of previous Bio P testing at the Kirie WRP, effluent TP performance before and after Bio P testing, and key Optimization Study recommendations. All of these sections provide background information that formed the basis of analysis for the Kirie WRP Feasibility Study.

A.2.2.1 Summary of Existing Kirie WRP

The Kirie WRP is located at 701 West Oakton Street in Des Plaines, Illinois and has been in service since 1980. The service area is approximately 65 square miles, servicing the O'Hare Basin. The current average plant flow is 35.8 mgd with a DAF of 52.0 mgd and a design maximum flow (DMF) of 110 mgd per NPDES Permit No. IL0047741 (see Appendix A.2-A).

Figure A.2.2 shows an aerial view of the Kirie WRP with the main process areas and facilities indicated.

Kirie WRF Annotated Aerial

1. Guard House
2. Service Road
3. Parking Area
4. Administration Bldg
5. Coarse Screen Bldg
6. Influent Pump Station
7. Influent Pump Transformers
8. Screen Bldg
9. Grit Tanks
10. Transformer Switch Yard
11. Battery 'A' Aeration Tanks
12. Battery 'A' Settling Tanks
13. Air Lift Station A-1
14. Air Lift Station A-2
15. Battery 'B' Aeration Tanks
16. Battery 'B' Settling Tanks
17. Air Lift Station B-1
18. Air Lift Station B-2
19. Filter Building
20. Chlorination Tanks
21. Post Aeration Tanks
22. Power/Maintenance Bldg
23. Blower Bldg
24. Waste Sludge Pumps to Egan

Figure A.2.2 Aerial of Kirie WRP

Figure A.2.3 illustrates the process flow diagram for the Kirie WRP. The unit processes at Kirie WRP include:

- Primary Screening (Debris Baskets, Coarse Screens, Fine Screens).
- Grit Removal.
- 1st Stage Aeration.
- 1st Stage Settling.
- 2nd Stage Aeration (currently operated as pass-through).
- 2nd Stage Settling.
- Tertiary Filtration.
- Disinfection.
- Post-Aeration.

The Kirie WRP was originally designed as a two-stage nitrification facility with the 1st stage activated sludge aeration tanks and clarifiers (Battery A) configured for 5 Day Biological Oxygen Demand (BOD_5) removal and the 2nd stage activated sludge aeration tanks and clarifiers (Battery B) configured for nitrification. BOD_5 and ammonia removal (nitrification) to meet current permit limits is accomplished in the 1st stage (Battery A) aeration tanks using a single sludge system operated with adequate solids retention time (SRT) to meet effluent limits. The 2nd stage aeration tanks (Battery B) are not currently operated as aeration basins and simply used to convey the secondary effluent from Battery A to the 2nd stage settling tanks for additional TSS reduction and polishing. The polished secondary effluent meets effluent TSS criteria without the need for tertiary filtration. The tertiary filters at the Kirie WRP are not currently in service. Secondary effluent is routed to the disinfection/post-aeration facility. Disinfected effluent is discharged to Higgins Creek. Waste activated sludge (WAS) is transported via a dedicated pipeline to the Egan WRP for processing.

The aeration tanks in both Batteries A and B are configured as 3 pass basins designed for BOD_5 removal and nitrification with all three passes aerated. Operational adjustments in zone aeration have been made to encourage P reduction.

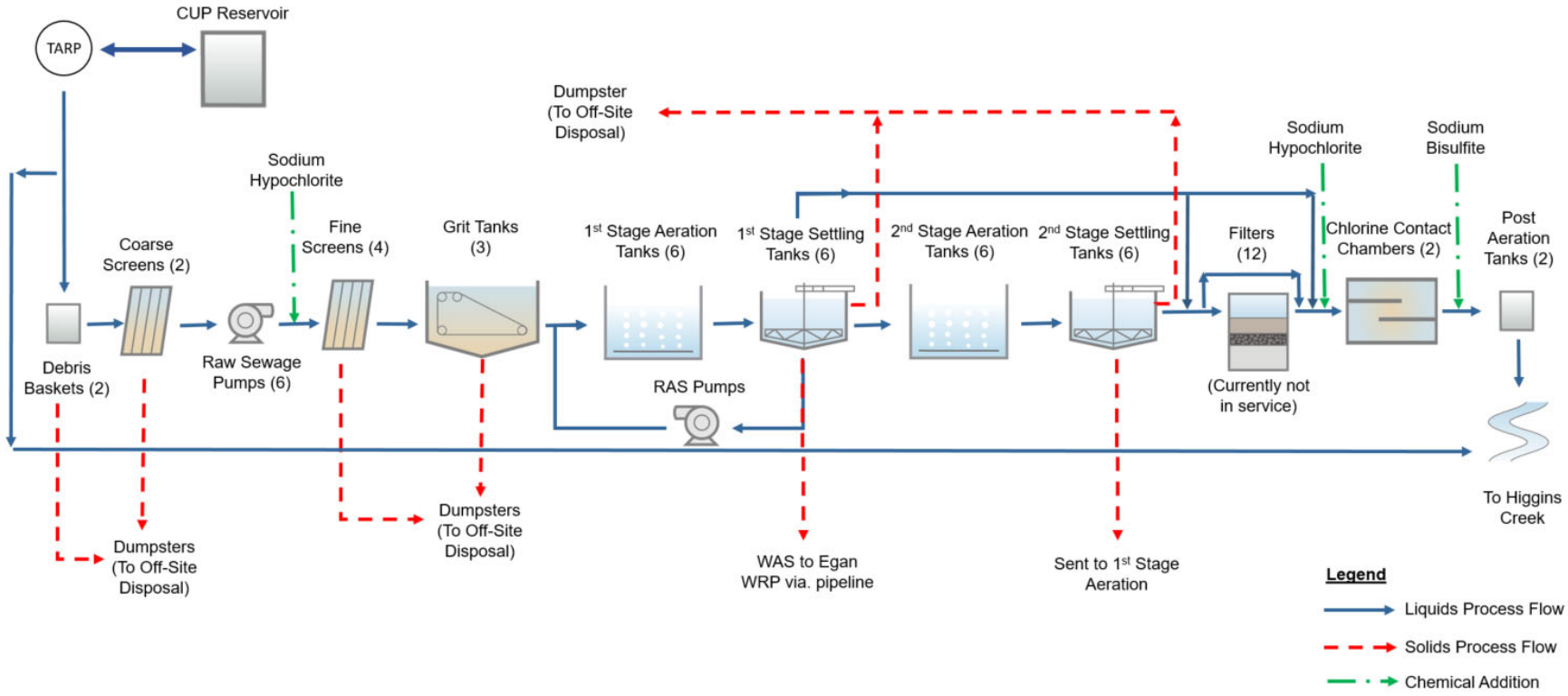

Figure A.2.3 Process Flow Diagram for Kirie WRP

A summary of existing process equipment and infrastructure sizing at the Kirie WRP is presented in Table A.2.1.

Table A.2.1 Summary of Existing Process Equipment and Infrastructure Sizing at the Kirie WRP

Process	Number of Units	Type	Capacity/Dimensions
Debris Removal	2	Basket	6.5 ft L x 6.8 ft W x 15 ft H
Coarse Screens	2	-	6 ft W, 3 in. clear opening
Raw Sewage Pumps	6	Centrifugal	2 at 38 mgd at 190 ft TDH, 2,250 hp motor; 1 at 56 mgd at 190 ft TDH, 2,250 hp motor; 2 at 35 mgd at 193 TDH, 1,500 hp motor; 1 at 55 mgd at 202 ft 2,600 hp motor
Fine Screens	4	Multi-Rake	8 ft W, 3/16 in. clear opening
Grit Tanks	3	Gravity Detritus Tanks	55 ft L x 55 ft W x 4 ft 6 in. water depth
Blowers	5	Single Stage Centrifugal	37,770 scfm; 2,500 hp
Aeration Tanks	12	Conventional or Step Feed, Three-Pass	1st & 2nd Stage – 6 ea at 250 ft L x 25.5 ft W x 16 ft water depth
Return Sludge Pumps	36	Air Lift	1st & 2nd Stage – 18 ea at 24 in. Dia., 40 mgd per stage
Settling Tanks	12	Circular	1st & 2nd Stage – 6 ea at 153 ft Dia., 15 ft water depth
Scum Pumps	4	Positive Displacement	25 gpm, 5 hp motor
Low Lift Pumps	5	Centrifugal	30,000 gpm at 35 ft TDH, 350 hp motor
Filters	12	Dual Media-Anthracite and Sand	2 beds ea at 54 ft L x 13.5 ft W x 12.5 ft water depth
Sodium Hypochlorite Feed Pumps	10	Positive Displacement	8 diaphragm – variable rate up to 75 gph 2 peristaltic – variable rate up to 158.5 gph
Chlorine Contact Chambers	2	Eight-pass	Each pass 64 ft 2 in. L x 15.5 ft W x 13 ft 8 in. water depth
Sodium Bisulfite Feed Pumps	2	Positive Displacement	variable rate up to 15.58 gph
Post Aeration Tank	2	2 cells each	each cell 61.5 ft L x 18 ft W x 13 ft 7 in. water depth

Abbreviations:

D	Depth	gpm	gallons per minute	L	Length
Dia.	diameter	H	Height	scfm	standard cubic feet per minute
ft	feet	hp	horsepower	TDH	total dynamic head
gph	gallons per hour	in.	inches	W	Width

A.2.2.2 Review of Bio P Testing at Kirie WRP

The District started conducting full-scale Bio P testing at Kirie WRP in April 2015. The objective of the testing was to evaluate the potential for Bio P using existing infrastructure at Kirie WRP and to assess unaerated zone mixing requirements. The testing was divided into the following phases:

- Phase IA - Baseline testing to establish effluent TP performance without operational adjustments using the nitrifying biological nutrient removal (BNR) plant configuration of the 1st stage aeration tanks.
- Phase IB - Isolated Bio P testing in two aeration tanks to evaluate P removal potential by turning off aeration air in the first 1/3 of the first pass and using periodic air bump mixing[1] of the anaerobic zone.
- Phase II - Evaluate the performance of Bio P by adding baffle walls in the first 2/3 and large bubble mixers in the first 1/3 of the first pass of two aeration tanks to provide isolated and mixed anaerobic zones. Supplemental testing of the overall plant performance by running two aeration tanks in Bio P mode described above and turning off the air to the diffusers in the first 1/3 of the first pass of the remaining 4 aeration tanks.

During Phase IB and supplemental testing of aeration tanks 1-4 in Phase II, the anaerobic zones of the 1st stage aeration tanks were mixed using periodic air bumping[1]. During Phase II temporary wood baffle walls were installed in aeration tanks 5 and 6 at approximately 1/3 and 2/3 of the first pass to create a defined anaerobic zone followed by a swing zone (operated as anaerobic) and encourage sludge settling and fermentation in the first zone. Large bubble mixing devices were installed in the first 1/3 of the first pass of the two test aeration tanks.

While testing has been completed, operation in the temporary Bio P mode is still ongoing in 2021. Certain operational modifications have been made, those being the removal of the temporary baffle walls in aeration tank 6 due to failure and converting operation of the swing zones in aeration tanks 5 and 6 from anaerobic to exclusively aerobic mode due to plugging of the ceramic plate diffusers. The wooden baffle walls were not reinstalled since permanent baffle walls will be installed to meet the upcoming 1.0 mg/L permit limit. Despite this change, effluent TP concentrations are in line with treatment levels achieved during Bio P testing, as highlighted in the following section, and continue to demonstrate improved removal of TP from the final effluent at Kirie WRP.

A.2.2.3 Effluent TP Performance Before and After Bio P Testing

Figure A.2.4 presents historical performance data on influent and effluent TP concentrations from 2014 through 2017 at the Kirie WRP with approximate testing phases shown. During this time period, the 30-day moving average of influent TP ranged from about 3 to 6 mg/L with minimum and maximum values of approximately 1 mg/L and 13 mg/L, respectively. The overall average influent TP concentration was approximately 3.8 mg/L. During this time period, the 30-day moving average of effluent TP ranged from about 0.2 to 2.0 mg/L with minimum and maximum values of approximately 0.1 mg/L and 2.1 mg/L, respectively. The overall average effluent TP concentration was approximately 0.74 mg/L.

[1] Air bump mixing is turning on aeration intermittently for physical mixing versus aeration to diffuse oxygen for biological treatment.

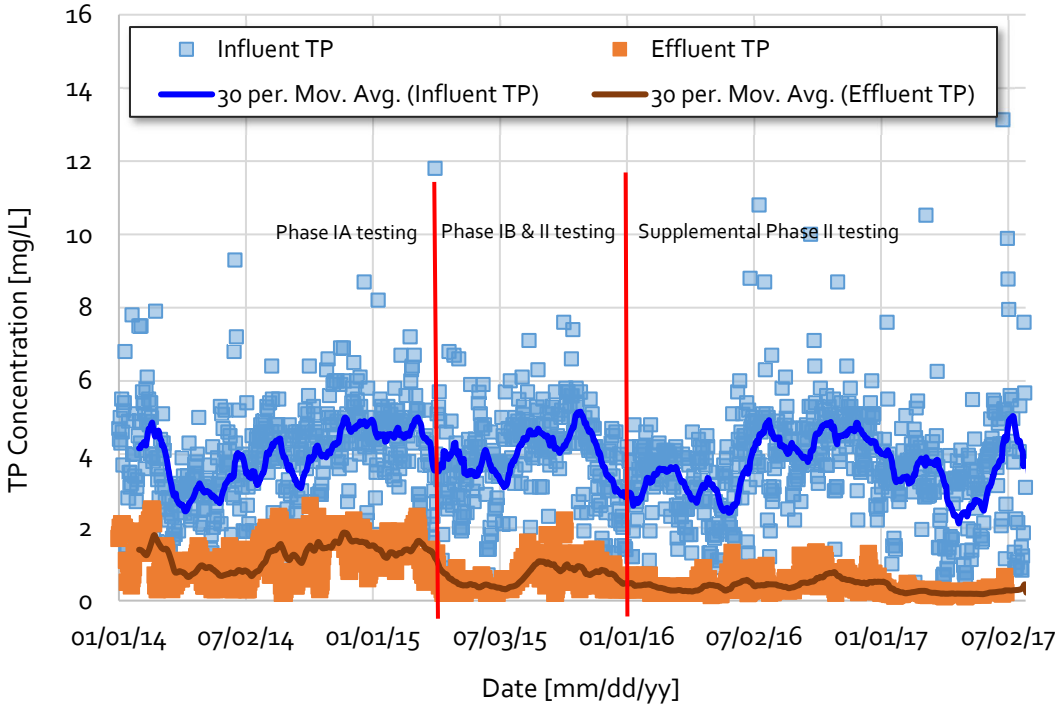

Figure A.2.4 Kirie WRP TP Concentrations during Bio P Testing

Prior to Phase IA Bio P testing from January 2014 through April 2015, the influent TP concentration averaged approximately 4 mg/L with an effluent concentration of approximately 1.2 mg/L. The baseline P removal in the unmodified aeration tanks and channels was approximately 70 percent.

Phases IB and II of testing included 2 test aeration tanks online each with 2/3 of the first pass anaerobic (~7.4 percent of the total 1st stage aeration tank volume) from April 2015 to January 2016. During this test period the influent TP concentration averaged approximately 3.8 mg/L with an effluent concentration of approximately 1.0 mg/L. The effluent TP concentrations exhibited some seasonal variations between approximately 0.5 mg/L and 1.0 mg/L. The P removal due to initial Bio P operation was approximately 74 percent.

Supplemental Phase II testing with 2 test tanks online and four aeration tanks each having 1/3 of the first pass anaerobic (~14.6 percent of the total 1st stage aeration tank volume) was conducted from January 2016 through July 2017. During the supplemental test period the influent TP concentration averaged approximately 3.7 mg/L with an effluent concentration of approximately 0.3 mg/L. This indicates improved P removal under test case conditions of approximately 90 percent P removal. During this test period the effluent TP concentrations were more stable without significant seasonal variations with only periodic excursions of approximately 1.5 mg/L.

Since the District began conducting Bio P pilot studies in April 2015, there has been a significant decrease in effluent TP concentrations and improvement of effluent quality, as seen in Figure A.2.4.

A.2.2.4 Summary of Optimization Study Conclusions and Recommendations

The following summarizes the key conclusions and recommendations of the Optimization Study for Kirie WRP (see TM A.1):

- Industrial dischargers contribute an average of 7.3 percent of the daily influent total P load to the Kirie WRP. A combined industrial TP contribution between 5 percent and 10 percent of the daily influent load is considered to have only a "slight impact" or "no impact" on the capital or O&M costs associated with P removal. Therefore, the P optimization analysis was performed assuming no reduction in industrial TP load.
- The Kirie WRP can be optimized for Bio P at current AADF wastewater flows of 35.8 mgd while maintaining complete nitrification under winter temperatures and maximum month average day load (MMADL).
- Bio P optimization is predicted to result in average effluent TP concentrations between 0.4 mg/L and 0.6 mg/L.
- A few optimization measures were implemented as part of the Bio P testing program, which achieved a partial Bio P optimization mode of operation at Kirie WRP. These measures included temporary wooden baffle walls and large bubble mixers in aeration tanks 5 and 6, as well as the air being shut off in the first 1/3 of the first pass of aeration tanks 1 – 4 to create anaerobic zones.
- Testing is complete, but operation in the temporary Bio P mode is still ongoing in 2021. Certain operational modifications have been made, those being the removal of the temporary baffle walls in aeration tank 6 due to failure and converting operation of the swing zones in aeration tanks 5 and 6 from anaerobic to exclusively aerobic mode due to plugging of the ceramic plate diffusers. Even so, since implementation of these measures in January 2016, Bio P has mostly been successful with approximately 90 percent P removal.
- Given the performance of Bio P with the optimization measures already in place, further implementation of additional measures is not recommended to be pursued as part of this effort. Any practical measures are already active and proving effective at achieving desired levels of P removal. There are diminishing performance returns with additional measures and since they are not necessary at this time, the potential performance improvements do not outweigh the additional infrastructure expenditure that would be required.

A.2.3 Bio P Evaluation Criteria and Process Simulation Modeling Summary

This section describes the evaluation criteria for Bio P processes and provides an overview of the GPS-X wastewater process simulation modeling (or process modeling) conducted to predict facility performance. Process modeling was used to assess different wastewater treatment configurations and operating conditions and identify a recommended configuration to meet each effluent TP of 1.0 mg/L, 0.5 mg/L, and 0.1 mg/L based on a monthly averaging period.

A.2.3.1 Criteria Used for Feasibility Study Analysis

NPDES Permit No. IL0047741 establishes the effluent discharge criteria for the Kirie WRP (see Appendix A.2-A). These criteria for other regulated pollutants beyond TP were used as the basis of the P removal Feasibility Study and are consistent with the Optimization Study analysis.

A.2.3.1.1 Current NPDES Effluent Discharge Criteria

Table A.2.2 summarizes key effluent discharge criteria that must be achieved for future permit compliance at the Kirie WRP.

Table A.2.2 Key Effluent Discharge Criteria at the Kirie WRP

Parameter	Units	Criteria	Averaging Period (4)
$CBOD_5$	mg/L	4	Monthly Average
TSS	mg/L	5	Monthly Average
Ammonia-N(1)	mg/L - N	1.6	Monthly Average
Ammonia-N (2)	mg/L - N	2.1	Monthly Average
Ammonia-N (3)	mg/L - N	4.0	Monthly Average

Notes:
(1) The Kirie WRP permit contains revised ammonia limits for June through August of 1.6 mg/L as a maximum monthly average.
(2) The Kirie WRP permit contains revised ammonia limits for March through May and September through October of 2.1 mg/L as a maximum monthly average.
(3) The Kirie WRP permit contains revised ammonia limits for November through February of 4.0 mg/L as a maximum monthly average.
(4) Process simulation modeling of P removal based on static conditions that represent daily average values. Monthly average permit limits on effluent parameters provide additional performance safety factor.

Abbreviations:
$CBOD_5$ Five-day Carbonaceous Biological Oxygen Demand

Effluent ammonia concentrations are regulated seasonally. The 2.1 mg/L effluent ammonia requirement shown in Table A.2.2 is the lowest effluent concentration associated with cold weather operation which dictates nitrification capacity.

A.2.3.1.2 Raw Wastewater Characteristics

Historical records from July 2015 through July 2017 were used to develop raw influent wastewater characteristics for process simulation modeling at the Kirie WRP. The selected time range for this analysis corresponds with the Kirie WRP Bio P testing and allows for improved calibration of the process simulation models for Bio P. More recent influent flow and load data (2017 – 2019) has been reviewed and is consistent with the original influent characteristics used in the model, such that updates or adjustments to the data were deemed not necessary. The Feasibility Study analysis was performed for current and design annual average day load (AADL) conditions and average water temperatures, as well as current and design MMADL conditions and winter temperatures (see Section A.2.3.1.3 for water temperature assumptions). This assumption provides a conservative approach to verify if effluent discharge criteria can be met at Kirie WRP under average conditions, periods of high loading, and periods of cold temperature winter conditions. It should be noted that periods of low flow present an additional variable and challenge, forcing operators to take tanks out of service to improve phosphorus removal when periods of low flow are extended.

Table A.2.3 presents the flow and load peaking factors used for the P Feasibility Study analysis.

Table A.2.3 Kirie WRP Flow and Load Peaking Factors

Parameter	Value
Flow Peaking Factors	
Current MMADF / AADF	1.68
Design DMF / AADF	2.11
Load Peaking Factors, MMADL / AADL	
BOD_5	1.30
TSS	1.58
TKN	1.21
NH_3-N	1.16
TP	1.34

Notes:
(1) Peak hourly flow and peak instantaneous flow were not used in the analysis.
(2) AADF = Average flow for a rolling 365 consecutive day period from July 2015 through July 2017.
(3) AADL = Average load for a rolling 365 consecutive day period from July 2015 through July 2017.
(4) Maximum Month Average Day Flow (MMADF) = Highest 30 day running average flow.
(5) MMADL = Highest 30 day running average load.
(6) DMF = Design Maximum Flow
Abbreviations:
MMADF Maximum Month Average Day Flow NH_3-N Ammonia Nitrogen
TKN Total Kjeldahl Nitrogen

Table A.2.4 presents the influent criteria used to evaluate P removal facility upgrades and performance under current and design conditions at the Kirie WRP.

Table A.2.4 Kirie WRP Influent Characteristics

Influent Parameter	Current Value	Design Value
AADF, mgd	35.8	52 (1)
MMADF, mgd	60.1	87.4
DMF, mgd	110 (1)	110 (1)
Influent Concentrations at AADF		
BOD_5, mg/L	133	133
TSS, mg/L	166	166
TKN, mg/L	26.3	26.3
NH_3-N, mg/L	15.1	15.1
TP, mg/L	3.8	3.8
Influent Load at AADL		
BOD_5, lb/day	39,710	57,679
TSS, lb/day	49,563	71,991
TKN, lb/day	7,852	11,406
NH_3-N, lb/day	4,508	6,549
TP, lb/day	1,135	1,648

Table A.2.4 Kirie WRP Influent Characteristics (continued)

Influent Parameter	Current Value	Design Value
Influent Concentrations at MMADF		
BOD_5, mg/L	103	103
TSS, mg/L	156	156
TKN, mg/L	18.9	18.9
NH_3-N, mg/L	10.4	10.4
TP, mg/L	3.0	3.0
Influent Load at MMADL		
BOD_5, lb/day	51,627	75,078
TSS, lb/day	78,193	113,711
TKN, lb/day	9,473	13,777
NH_3-N, lb/day	5,213	7,581
TP, lb/day	1,504	2,187

Notes:
(1) Per NPDES Permit No. IL0047741.
(2) AADF = Average flow for a 365 consecutive day period.
(3) MMADF = Highest 30 day running average flow.
(4) AADL = Average load for a 365 consecutive day period.
(5) MMADL = Highest 30 day running average load.
Abbreviations:
lb/day pounds per day

A.2.3.1.3 Water Temperature Criteria

Historical daily influent temperature data from January 2014 to July 2017 were used to establish the winter, average, and maximum temperatures used for the analysis of secondary treatment. Average temperatures were used to estimate average capacity and treatment performance and minimum temperatures during winter were used to predict a worst-case scenario for nitrification performance.

Table A.2.5 shows influent temperatures used for the Kirie WRP P Feasibility Study, consistent with the optimization opportunities analysis. The minimum influent wastewater temperature represents the weekly average value measured during the lowest temperature week of the year. The maximum influent wastewater temperature represents the weekly average value measured during the highest temperature week of the year.

Table A.2.5 Influent Wastewater Temperatures

Criteria	Value [1]
Minimum Temperature, deg. C	10.0
Average Temperature, deg. C	17.9
Maximum Temperature, deg. C	23.2

Notes:
(1) Based on historical daily raw wastewater temperature recorded from Jan 2014 to July 2017.
Abbreviations:
deg. C degrees Celsius

A.2.3.2 Process Simulation Model Development

GPS-X Version 7.0 (Hydromantis Environmental Solutions, Inc.: Hamilton, Ontario), a commercially available biological and physical treatment simulation software, was used to predict process performance for the P Feasibility Study analysis. GPS-X incorporates carbon, nitrogen, and P models based on the Activated Sludge Model No. 2d (ASM 2d) and the Anaerobic Digestion Model No. 1 (ADM 1).

Key aspects of the modeling evaluation included:

- Data collection and reconciliation.
- Kirie WRP configuration model setup.
- Calibration and validation.
- Simulation of Bio P performance and interpretation of results.

Historical performance data and operational parameters were collected during normal operations, during the Bio P test period, and as part of other special sampling campaigns. These data were used in model setup, calibration, and validation.

A.2.3.2.1 Kirie WRP Model Configuration used for Calibration

As indicated in Section A.2.2.1, the Kirie WRP is currently operated as a single stage nitrification process with only Battery A aeration tanks and clarifiers in service. Battery B clarifiers are operated in series with Battery A without the Battery B aeration tanks activated.

It should be noted that the process simulation model that follows is configured according to the Bio P testing program setup, though operation has been adjusted in response to observed issues that resulted from that mode of operation. Due to plugging of the ceramic plate diffusers which was found to be detrimental to overall aeration system performance, the swing zones in Aeration Tank Nos. 5 and 6 are exclusively operated in aerobic mode. So, while the process simulation model reflects the Bio P testing mode of operation, given the observed fouling issues, such a configuration will not be replicated at the plant in the future unless there are significant modifications made to the aeration system.

Figure A.2.5 illustrates the configuration of the Kirie WRP process simulation model calibrated against existing operating data, including the Bio P testing period.

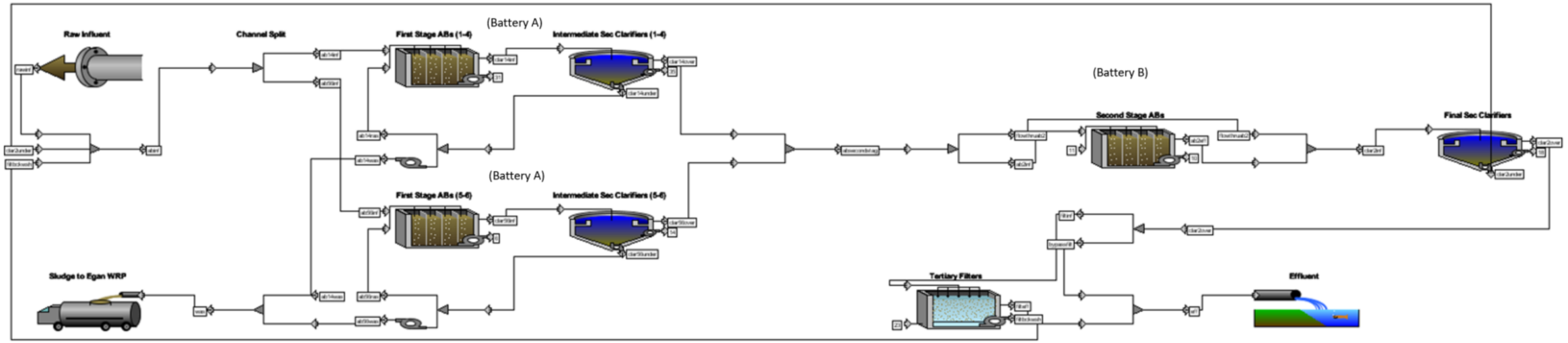

Figure A.2.5 Kirie WRP Process Simulation Model Configuration - Calibration

A.2.3.2.2 Process Simulation Model Calibration

Process simulation model calibration at average day conditions (AADF, AADL) was performed to verify adequate prediction of key operating parameters and effluent quality.

After calibration, all simulated operating parameter values agreed well with historical data. Acceptable calibration agreement for a planning level process evaluation is generally within +/- 10 percent.

In order to achieve the calibration, only a few default parameters required adjustment. All key operating parameters (e.g. SRT, MLSS, VS %) were within 10 percent agreement. Predicted effluent values for TP and Sol P were also within 10 percent. This calibration is considered adequate for P optimization and feasibility planning level purposes.

A winter validation was performed to ensure adequate model calibration during winter months when nitrification requires higher SRT and mixed liquor suspended solids (MLSS) concentrations. All operating parameters were found to be within 10 percent of historical winter values and the effluent pollutant concentrations predicted within acceptable margins.

A.2.3.2.3 Kirie WRP Model Configuration Used for Feasibility Study Bio P Performance Evaluation

The model configuration used for the Feasibility Study was configured similarly to the calibration configuration. Each aeration tank is assumed to have the same allocation of aerated and unaerated zones. Therefore, all aeration tanks were condensed into a single element with the appropriate volume and aeration configuration. Flow was assumed to be split evenly between the aeration tanks, which allowed the secondary clarifiers to be modeled as a single element. Figure A.2.6 presents the process model configuration used for Bio P performance evaluations.

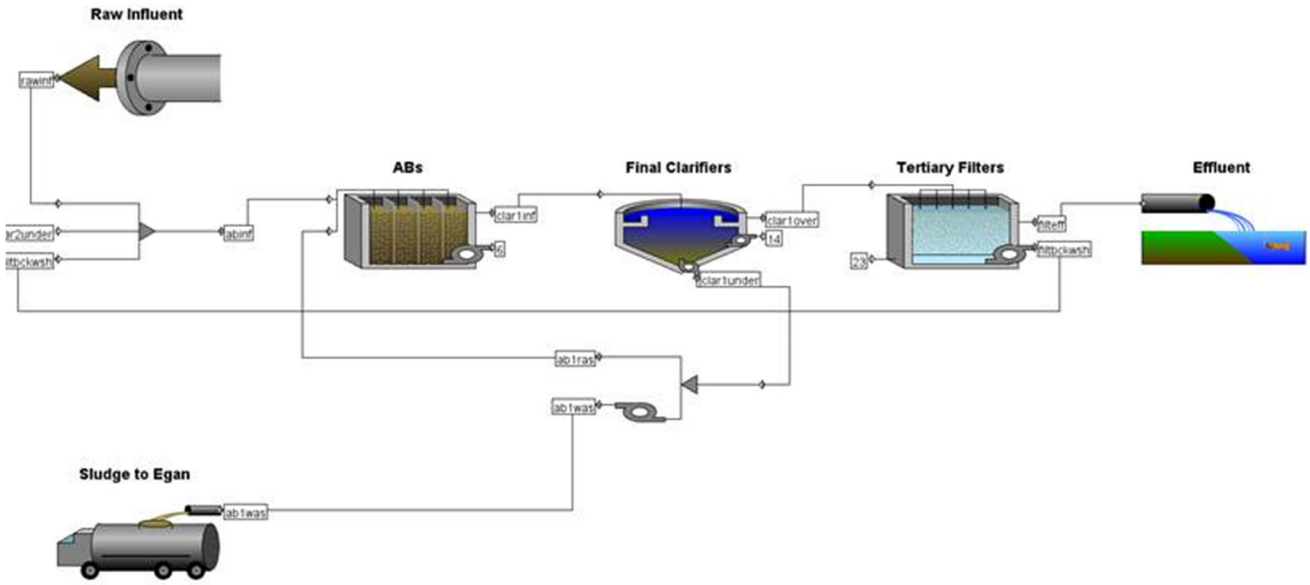

Figure A.2.6 Kirie WRP Process Simulation Model Configuration for Feasibility Study

A.2.4 Bio P Process Alternatives

Phosphorus can be removed from the influent wastewater via Bio P, Chem P, or through a combination of Bio P and Chem P. For the Feasibility Study analysis, a combination of Bio P and Chem P was evaluated to meet the potential effluent TP limits.

Bio P is achieved by exposing the activated sludge biomass to anaerobic environmental conditions in the presence of short-chain volatile fatty acids (VFAs). The anaerobic zones favor the growth of polyphosphate accumulating organisms (PAOs) that uptake and store VFA carbon within their cells as polyhydroxyalkanoate (PHA) while releasing P. The PAOs are subsequently exposed to aerobic environmental conditions where they take up both the released P and the P in the influent wastewater for biogrowth. The PAOs can uptake and store more P than necessary for biogrowth known as "luxury P uptake." The biomass rich with phosphorus is separated during sedimentation, and the phosphorus is removed from the system as WAS. The WAS from a conventional activated sludge process contains approximately 2 percent phosphorus, while the WAS in a Bio P activated sludge process contains between 3 to 8 percent phosphorus.

Figure A.2.7 illustrates the biological P release and P uptake under anaerobic and aerobic conditions.

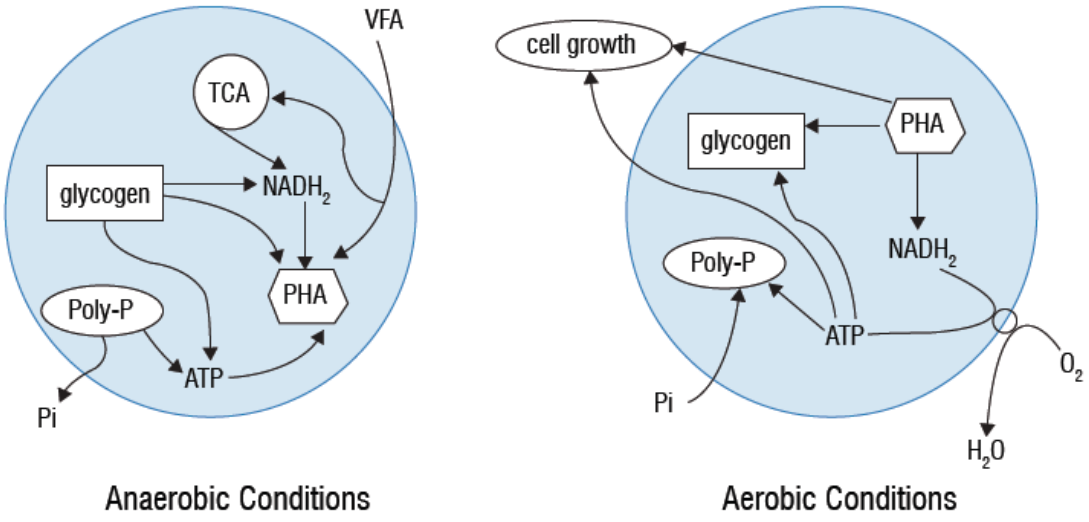

Figure A.2.7 Illustration of Bio P under Anaerobic and Aerobic Conditions

Chem P involves the use of metal salts fed at proper locations and concentrations to convert soluble phosphorus into particulate phosphorus, thus enabling the precipitation of phosphorus from the process stream. It is usually achieved using metal salts of aluminum and iron to chemically bind phosphorus. Ferric salts are the most commonly used phosphate-binding chemical. For the purposes of this Feasibility Study, Chem P at Kirie WRP was evaluated using ferric chloride.

The Kirie WRP is designed to remove ammonia using nitrifying activated sludge (NAS). The NAS process is one of several BNR processes that can remove nutrients including ammonia, nitrogen, and phosphorus. BNR processes remove different nutrients to different levels by creating and managing specific biomass populations in anaerobic, anoxic, and aerobic environmental

conditions within the aeration tanks. The NAS process designed at the Kirie WRP operates entirely in aerobic conditions.

A common configuration for P removal in a BNR activated sludge plant includes an anaerobic zone for P release followed by aerobic zones for both P uptake and nitrification of ammonia. This configuration is known as an Anaerobic/Oxic (A/O) process. When using an A/O process with nitrification the anaerobic zone sizing is often extended to allow initial denitrification of nitrate contained in the return activated sludge (RAS) prior to establishing true anaerobic conditions required for PAO growth. Nitrate laden RAS will preferentially use influent biological oxygen demand (BOD) as a carbon source in the anaerobic zone prior to allowing excess carbon to be used for P release. Where adequate carbon is available, both RAS denitrification and P release can be achieved in the same anaerobic zone. Sometimes, an external RAS denitrification zone can also be added to the A/O process to denitrify RAS before it enters the anaerobic zones. This configuration is known as a "modified A/O" configuration. Removal of nitrate in the RAS can prevent nitrate poisoning of the anaerobic zones and improve the efficiency of Bio P. The A/O process is the simplest configuration for Bio P and nitrification. There are more complex configurations with multiple anaerobic or anoxic zones for various levels of nitrogen and P removal.

A number of Bio P alternatives were analyzed as part of this Feasibility Study analysis. The Bio P alternatives that were analyzed included:

1. Alternative 1: A/O Process Options:
   a. A/O Process within Existing Tankage.
   b. A/O Process with External or Internal Dedicated Anaerobic Tanks.
   c. A/O Process with Additional Aeration and Settling Tanks South of Battery A.
2. Alternative 2: Modified A/O Process Using External RAS Denitrification.
3. Alternative 3: High-Rate Bio P Treatment Processes.

These process alternatives are described in further detail below.

A.2.4.1 Alternative 1: A/O Process Options

Three variations of the A/O process were evaluated as a part of the Feasibility Study. The following sections describe each of the three variations of the A/O process.

A.2.4.1.1 A/O Process within Existing Tankage

The A/O process is the simplest configuration for Bio P and nitrification. Figure A.2.8 illustrates an A/O process schematic. The A/O process was also used for P optimization analysis as it has already shown good performance during testing by the District and requires the least cost to construct, operate, and maintain. Other more complex Bio P configurations require additional tankage and higher capital investment and operating costs and were therefore not considered as various A/O configurations were model predicted to be capable of meeting the Tier 1 and Tier 2 effluent TP limits.

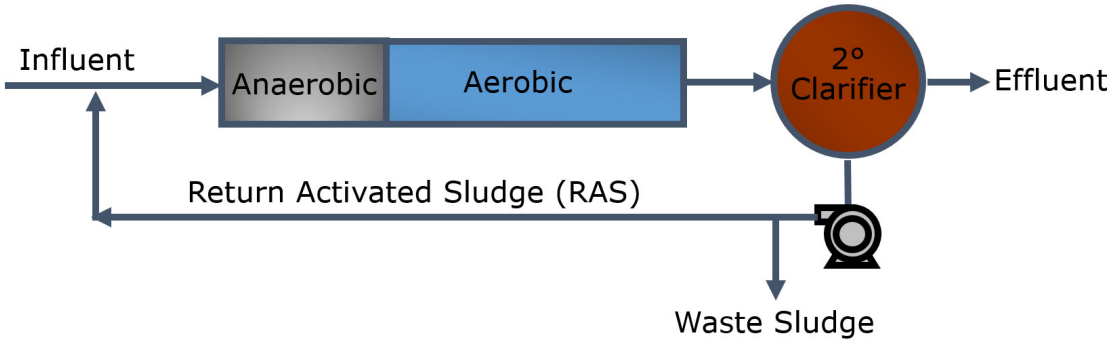

Figure A.2.8 A/O Process Flow Schematic

As indicated in Section A.2.2.1, the use of Battery B final secondary clarifiers in series with Battery A intermediate secondary clarifiers provides compliant effluent TSS concentrations without the need for effluent filtration. In order to extend the capacity of the Battery A aeration tanks without activating Battery B aeration tanks, two variations of the A/O process configuration were evaluated as follows:

- Alternative 1.II A/O Process with External or Internal Dedicated Anaerobic Tanks.
- Alternative 1.III A/O Process with Additional Aeration and Settling Tanks South of Battery A.

These alternatives are described and evaluated in the following sections.

A.2.4.1.2 A/O Process with External or Internal Dedicated Anaerobic Tanks

As discussed in the Optimization Study (TM A.1), the Kirie WRP can be optimized for Bio P at current AADF wastewater flows of 35.8 mgd by converting the first pass of the 1st stage aeration tanks into 3 semi-equal zones (an anaerobic zone, a swing zone [anaerobic or aerobic], and an aerobic zone). The Feasibility Study evaluated the need for meeting permitted effluent TP numeric limits while maintaining complete nitrification through current flows up to DAF rated capacity of 52.0 mgd. As such, additional anaerobic zone volume will be needed beyond the Optimization Study recommendations.

Additional anaerobic zone volume and treatment capacity can be gained by constructing dedicated anaerobic zones, either externally or internally. The A/O process was evaluated with two new dedicated external anaerobic tanks and with retrofit of two dedicated internal anaerobic tanks in Battery B.

Construction of new external anaerobic tanks were sized to provide the required anaerobic zone volume for Bio P while utilizing the existing Battery A aeration basins in aerobic conditions for nitrification. This alternative is more capital intensive than activating Battery B due to the construction of two new external tanks. However, this alternative offsets the capital and O&M cost of activating effluent filters due to the loss of in series clarification.

The total volume of the external anaerobic tanks to accommodate up to 52.0 mgd DAF capacity is equivalent to two aeration tanks. Figure A.2.9 illustrates the layout of the external anaerobic tanks south of the existing aeration tanks. Raw wastewater and RAS would be routed through the external anaerobic tanks and distributed back to the head of each existing aerobic aeration

tank in Battery A. This requires extensive piping and channel modifications to accommodate increased flow. This alternative would also add significant O&M cost for double pumping all flows at the facility or extensive modifications upstream of Battery A potentially in the grit basins to raise the weir elevation.

An alternative to construction of two new dedicated external anaerobic tanks is the retrofit of existing Battery B aeration tanks to serve as dedicated anaerobic tanks and provide the required anaerobic zone volume for a Bio P process. This alternative may represent a lower capital cost for retrofit of existing tanks compared to construction of new external tanks. Figure A.2.10 represents the layout of the internal anaerobic tanks placed in existing aeration tanks in Battery B.

Similar to external anaerobic tanks, the use of internal dedicated anaerobic tanks requires that all raw wastewater and primary effluent (PE) be routed through the internal anaerobic tanks and then distributed back to the head of each existing aerobic aeration tank in Battery A. Due to the lower hydraulic elevation of the Battery B aeration tanks, this alternative would require an anaerobic zone effluent pump station sized to handle the entire influent and RAS flow. This alternative would also require extensive piping and channel modifications to accommodate increased flow through existing channels and piping. This alternative would add significant O&M cost for double pumping all flows at the facility.

In order to assess the feasibility of using external or internal dedicated anaerobic tanks to avoid activating Battery B, a preliminary hydraulic analysis was performed. The analysis showed that there is insufficient hydraulic head between the grit basin effluent channel and the aeration basin splitter box to allow gravity flow through dedicated anaerobic tanks. Therefore, alternatives using dedicated anaerobic tanks were not evaluated further. Only those A/O process configurations that incorporate anaerobic zones into the existing basin hydraulic profile are feasible without extensive hydraulic modifications to the entire facility or double pumping.

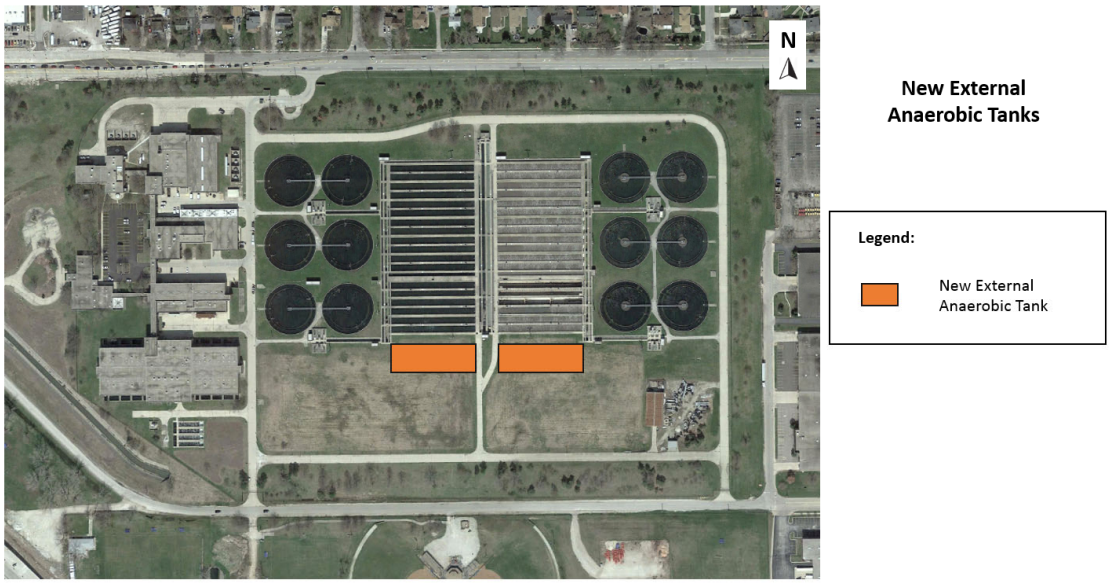

Figure A.2.9 Alternative 1.II - New External Anaerobic Tanks

Figure A.2.10 Alternative 1.II - Retrofit of Existing Battery B Aeration Tanks into Dedicated Anaerobic Tanks

A.2.4.1.3 A/O Process with Additional Aeration and Settling Tanks South of Battery A

A second A/O alternative to avoid activating Battery B is the addition of new aeration and settling tanks just south of Battery A. Figure A.2.11 shows the potential layout of new aeration and settling tanks under this option. This option would provide adequate A/O capacity up to 52.0 mgd and avoid the need to activate Battery B by continued use of the Battery B clarifiers for series clarification. This alternative will also prevent the need for tertiary filtration in order to meet TSS and Tier 1 and Tier 2 TP requirements. Note that tertiary filtration will still be required to meet Tier 3 effluent TP of 0.1 mg/L.

The alternative to construct 4 new aeration and settling tanks is capital intensive. Planning level cost comparison of the construction of new aeration tanks and clarifiers indicates a higher cost compared to modification and use of existing Battery B aeration tanks in the A/O process even when the cost of reactivation of the effluent filters is included. Due to the capital-intensive nature, this scenario was not evaluated in further detail. It is recommended to reevaluate these costs if and when filters are needed.

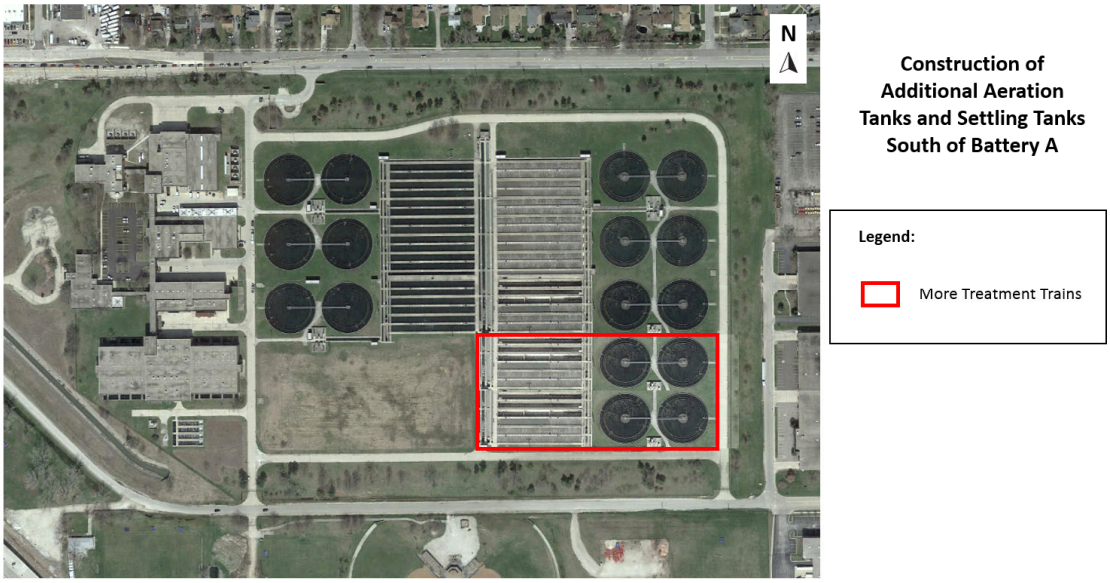

Figure A.2.11 Alternative 1.III - Construction of Additional Aeration and Settling Tanks

A.2.4.2 Alterative 2: Modified A/O Process Using External RAS Denitrification

An economical and effective enhancement to dedicated anaerobic zones is the use of a smaller dedicated RAS denitrification zone in a Modified A/O configuration, sometimes referred to as the Block and Hong process. Endogenous respiration in the highly concentrated RAS denitrification zone releases BOD that drives denitrification of the RAS, reducing the nitrate returned to the anaerobic zone and maximizing influent BOD availability for Bio P. Figure A.2.12 illustrates a Modified A/O process schematic.

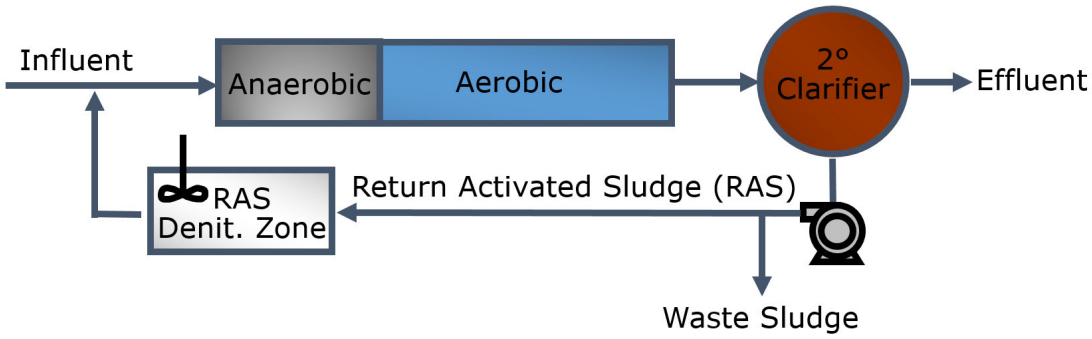

Figure A.2.12 Process Flow Schematic of a Modified A/O, or Block and Hong Process

The Modified A/O process alternative was evaluated to assess the improvement of Bio P performance, and slightly reduce the anaerobic zone requirements for each tiered effluent TP limit. Process simulation modeling was performed to determine the size of the external RAS denitrification zone to be one pass of one aeration tank (1/3 of one tank volume).

Overall, the predicted improvement in Bio P performance with an external RAS denitrification zone equivalent to a single pass of one aeration tank was less than 0.1 mg/L TP. Since this

alternative predicted insignificant improvement in Bio P without the use of an external carbon, the Modified A/O process alternative was not further considered at the Kirie WRP.

A.2.4.3 Alternative 3: High-Rate Treatment Processes

In some cases where existing tankage and land area are limited, intensified or high-rate treatment processes can be considered. High-rate treatment processes typically include the addition of a growth media or ballast into existing aeration tanks or the use of membrane filters to allow increased biomass inventory within the aeration tanks and improved liquid-solids separation. Examples of high-rate processes include integrated fixed-film activated sludge (IFAS), magnetite ballasted activated sludge (BioMag), membrane aerated bioreactor (MABR), and membrane bioreactor (MBR). Although high-rate treatment processes have the capability to achieve P removal down to low levels (~0.1 mg/L TP), the cost to implement these processes at Kirie WRP is not justified. High-rate processes were not further evaluated as part of this Feasibility Study due to high capital, high O&M, and high lifecycle costs compared to conventional A/O treatment where adequate infrastructure is already in place.

A.2.4.4 Recommended Bio P Alternative

Process modeling and preliminary hydraulic analyses showed that the A/O process within the existing available tankage at Kirie WRP (Alternative A.I.) is the apparent best option to meet the numeric permit limits for effluent TP of 1.0 mg/L, 0.5 mg/L, and 0.1 mg/L with effluent filtration also needed at 0.1 mg/L. The A/O process implemented during Bio P testing is still currently being used by the District and is consistent with the process recommendations of the Optimization Study as it requires the least cost to construct, operate, and maintain.

A.2.5 Implementation of Recommended A/O Process

Complete nitrification is required at the Kirie WRP to meet current and future discharge criteria. The A/O process will require some existing aeration tank volume to be converted from aerobic to anaerobic conditions. Conversion of volume to anaerobic conditions decreases the aerobic volume available for nitrification. Determining the number of A/O aeration basins required at current and design capacity includes evaluation of the aerobic SRT and nitrification capacity followed by assessment of anaerobic volume requirements and Bio P performance.

Critical elements of the A/O process feasibility analysis are:

- Maintaining sufficient aerobic SRT for complete nitrification for a range of temperatures and loads.
- Providing adequate anaerobic contact time (zone volume) to promote P release.
- Verifying adequate carbon, in readily available form, is available to support P release.

Operation of Bio P requires that these elements are present, consistent, and controllable.

A.2.5.1 SRT Required for Nitrification

The Kirie WRP has historically operated at an aerobic SRT between 7 and 15 days while meeting effluent ammonia requirements. The corresponding MLSS concentrations range from 2,500 to 3,500 mg/L

Bio P feasibility process simulation modeling was performed under a variety of load, temperature, effluent ammonia requirements to establish the boundary conditions for Bio P analysis. For all evaluated scenarios, an effluent ammonia concentration limit of 1.5 mg/L was

established according to the draft NPDES permit that was used for guidance when the process simulation modeling was originally performed. The actual permitted limit for March and the lowest effluent concentration associated with cold weather operation is 2.1 mg/L. Therefore, the nitrification analysis for winter temperature conditions is slightly conservative, but the conclusions still apply.

Process simulation modeling was performed to determine the boundary condition of minimum SRT required for complete nitrification at maximum month flows, maximum month loads, and winter temperature. Based on the determination of the minimum SRT required for complete nitrification, modeling was used to establish operating MLSS. Results of process simulation model runs to evaluate SRT and MLSS for nitrification under A/O configuration are presented in Table A.2.6.

Table A.2.6 Process Simulation Model Runs to Evaluate Nitrification

Run	Condition	Temperature (deg. C)	Effluent Ammonia Permit Limit (mg/L-N)	Aerobic SRT for Nitrification (days)	Aeration Tank MLSS (mg/L)
1	Current AADF, AADL	Average Temperature = 17.9 deg. C	1.5	5.3	2,300
2	Current AADF, AADL	Winter Temperature = 10.0 deg. C	1.5	7.0	3,100
3	Current MMADF, MMADL	Winter Temperature = 10.0 deg. C	1.5	7.0	5,200
4	DAF rated Capacity MMADF, MMADL	Winter Temperature = 10.0 deg. C	1.5	7.0	4,500

Notes:
(1) Scenarios 1, 2, and 3 are with Aeration Tank Nos. 1 through 6 in service. Scenario 4 is with Aeration Tank Nos. 1 through 10 in service. Each scenario assumes 22% anaerobic zone (swing zone unaerated).
Abbreviations:
mg/L-N Milligrams Per Liter as Nitrogen

Under normal conditions most WRPs operate aeration basins at MLSS between 2,500 and 3,500 mg/L. Under peak loading conditions some plants can operate with MLSS concentrations in excess of 4,000 mg/L if clarifier capacity is available. A clarifier state point analysis was performed at each condition listed in Table A.2.6. Results for Runs 1, 2, and 3 are shown in the Optimization Study TM (TM A.1). Under current average loading conditions and summer or winter temperatures (Run 1 and Run 2) the MLSS required for complete nitrification at the Kirie WRP ranges from 2,300 to 3,100 mg/L. Under current maximum loading conditions and winter temperatures (Run 3) the MLSS required for complete nitrification at the Kirie WRP is 5,200 mg/L. Secondary clarifier capacity is sufficient for Runs 1 through 3.

Under DAF rated capacity with maximum loading conditions and winter temperatures (Run 4) the MLSS required for complete nitrification at the Kirie WRP is 4,500 mg/L. Secondary clarifier capacity is sufficient for Run 4.

Operating the clarifiers under the conditions indicated for Runs 3 and 4 in Table A.2.6 for extended periods of time is not recommended because treatment performance could be compromised due to the high MLSS concentrations. However, the probability of simultaneous occurrence of maximum month flows and loads and cold temperatures is low. Figure A.2.13 presents Kirie WRP influent BOD_5 load and wastewater temperatures from 2014 through mid-2017. The figure indicates that peak loads rarely if ever coincide exactly with low temperatures. Therefore, the likelihood or the duration of operating conditions that would require 4,500 to 5,200 mg/L MLSS concentrations is low.

If worst case conditions occur simultaneously, the District has limited operational flexibility to accommodate the occurrence. For example, the following operational mitigation is available:

- 30 day or longer averaging period to accommodate temporary excursions of ammonia or P.

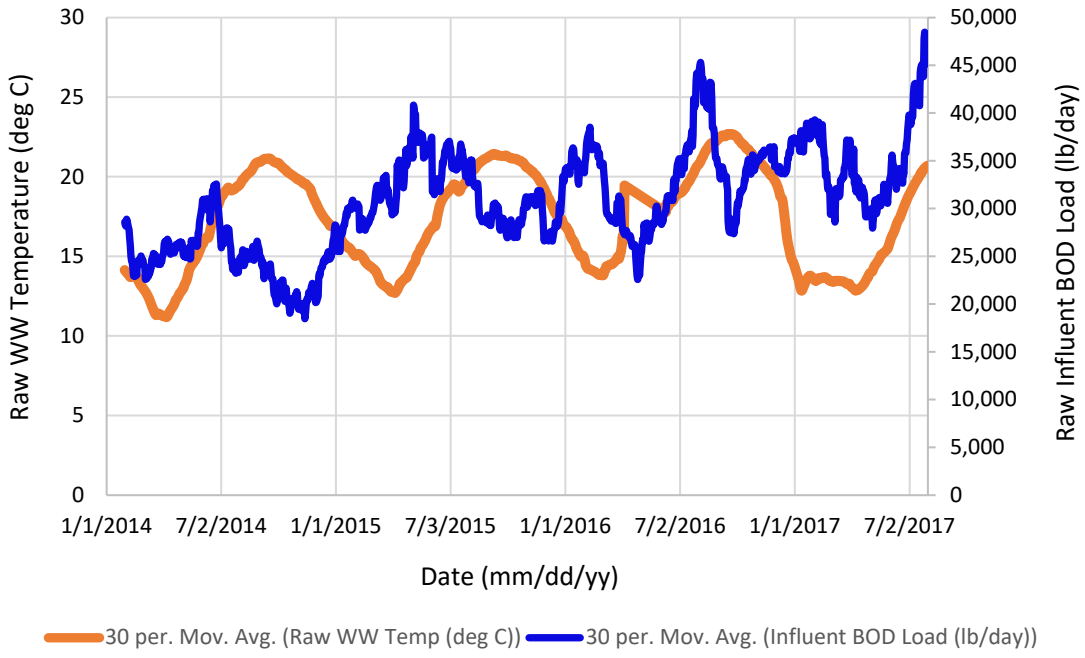

Figure A.2.13 Kirie WRP Influent BOD_5 Load and Influent Temperature

With the swing zone active (aerated), the aeration tank MLSS for Scenario 3 in Table A.2.6 drops to 4,800 mg/L. The aeration tank MLSS for Scenario 4 drops to 4,100 mg/L. Both scenarios offer increased clarification safety factors and improved operational flexibility.

A.2.5.1.1 Alkalinity Demand for Nitrification and Alkalinity Recovery through Denitrification

The nitrification reaction consumes alkalinity in the wastewater. As alkalinity drops, the buffering capacity to prevent pH reduction is lost. Ammonia Oxidizing Bacteria (AOB) are sensitive to inhibition at lower pH values. As AOB are inhibited, the nitrifier growth rate drops, and the nitrification efficiency decreases. Therefore, adequate alkalinity is essential for efficient nitrification. The NAS process can become alkalinity limited when the residual effluent alkalinity reaches between 75 mg/L and 100 mg/L. If the NAS process is alkalinity limited, either supplemental alkalinity addition using lime (or similar chemical) or alkalinity recovery is required.

Denitrification in a BNR process can recover some of the alkalinity that is consumed during nitrification. The Kirie WRP, has a historical average effluent alkalinity of 322 mg/L and exhibits sufficient residual alkalinity to support complete nitrification. Therefore, more complex BNR configurations that incorporate denitrification are not required and were not evaluated.

A.2.5.2 Optimization of Anaerobic Zone Volume Percentage for Bio P

Bio P performance was evaluated as a function of the size of the anaerobic zone within the first pass of 1st stage aeration tanks. The calibrated process simulation model was configured with two equal sized anaerobic zones in series. Each zone was approximately one third of the first pass or 11 percent of the total tank volume. The second anaerobic zone can be operated as a swing zone either under aerobic or anaerobic conditions. The remaining aeration tank volume is operated as an aerobic zone. The anticipated Bio P performance expressed as effluent soluble P and TP was predicted at AADF with AADL conditions.

A.2.5.2.1 Kirie Bio P Process Performance at Current Flows

The analysis of Bio P process performance indicates that most P release occurs in the first anaerobic zone at approximately 11 percent of the total aeration tank volume. The model predicts an effluent soluble P concentration of approximately 0.4 mg/L and an effluent TP concentration between 0.5 mg/L and 0.6 mg/L with 11 percent anaerobic zone. The model predicts additional P removal to a soluble P effluent concentration between 0.2 mg/L and 0.3 mg/L and a TP effluent concentration of approximately 0.4 mg/L at 22 percent of the total aeration tank volume. Under varying operating and loading conditions that are expected at any WRP, it is prudent to provide anaerobic zone volume beyond the minimum required to prevent washout of PAO population and rapidly declining Bio P performance. Therefore, we recommend that two anaerobic zones, each approximately 11 percent of the total aeration tank volume (or 2/3 of the first pass) be incorporated into the Bio P configurations.

Designing the first pass of the aeration tanks with 1/3 anaerobic zone and 1/3 swing zone (either aerobic or anaerobic) with the remaining 1/3 being aerobic provides the flexibility to balance nitrification SRT, P removal performance, and MLSS concentrations to accommodate a wide range of operating conditions.

A.2.5.3 A/O Performance and Chemical Requirements to Meet Tiered Effluent TP Limits

This section discusses the following aspects of the recommended A/O process:

- Bio P performance at current flows.
- Bio P performance at DAF rated capacity.
- Bio P upgrades to Battery A and Battery B aeration tanks.
- Chem P requirements.
- Tertiary filtration.

A.2.5.3.1 Anticipated Bio P Performance at Current Flows

Table A.2.7 presents the anticipated Bio P performance, at current flows, with 11 percent or 22 percent anaerobic zone volume. The nitrification capacity signifies the max month flow that can be fully nitrified by Kirie WRP at design conditions described in Section A.2.5.1. The equivalent AADF is calculated from the current max month to average day flow ratio of 1.68, which is expected to remain relatively constant during the planning horizon. The last column of Table A.2.7 indicates the tier for which Chem P is required to supplement Bio P. At current flows, Chem P addition is required to meet the Tier 3 effluent TP of 0.1 mg/L.

Table A.2.7 Anticipated Bio P Performance at Current Flows

Aeration Tanks in Service	Settling Tanks in Service	Anaerobic Zone Percentage (%)	Nitrification Capacity (mgd)	Equivalent AADF (mgd)	Average Day Bio P Performance, TP (mg/L)	Chem P Required for Trim
6	6	22	61	36	0.33	Tier 3
6	6	11	67	40	0.47	Tier 3

A.2.5.3.2 Anticipated Bio P Performance at DAF Rated Capacity (52.0 mgd)

Bio P performance was analyzed for future flows up to the DAF rated capacity of 52.0 mgd. A modular expansion approach was used to evaluate capacity and anticipated Bio P performance of the A/O process under increasing flows. Two additional aeration and settling tanks were used at each modular expansion step. This resulted in three expansion steps beyond current capacity including 8 tanks, 10 tanks, and 12 tanks in service. All of the expansion steps to provide Bio P beyond current flows require activation of Battery B aeration tanks.

The Bio P performance was evaluated with either 1/3 or 2/3 anaerobic volume in the first pass of all active aeration tanks. This represents approximately 11 percent or 22 percent of the total aeration tank volume in anaerobic conditions. Scenarios with 11 percent anaerobic zone volume provide higher nitrification capacity and reduced Bio P performance. Scenarios with 22 percent anaerobic zone volume provide a lower nitrification capacity and improved Bio P performance.

Table A.2.8 presents the anticipated Bio P performance for each modular expansion step with 11 percent and 22 percent anaerobic zone. The last column of Table A.2.8 indicates the tier for which Chem P will be required to supplement Bio P. Chem P addition will be required to meet the Tier 3 effluent TP of 0.1 mg/L.

Table A.2.8 Anticipated Bio P Performance at Future Flows

Aeration Tanks in Service	Settling Tanks in Service	Anaerobic Zone Percentage (%)	Nitrification Capacity (mgd)	Equivalent AADF (mgd)	Average Day Bio P Performance TP (mg/L)	Chem P Required for Trim
8	8	22	69	41	0.24	Tier 3
8	8	11	76	55	0.39	Tier 3
10	10	22	93	55	0.22	Tier 3
10	10	11	102	61	0.37	Tier 3
12	12	22	117	70	0.21	Tier 3
12	12	11	127	76	0.36	Tier 3

As illustrated in Table A.2.8, the DAF rated capacity of 52.0 mgd can be achieved with 10 aeration and settling tanks in service and 22 percent of each tank operating under anaerobic conditions. This modular step provides up to 55 mgd capacity. With 10 tanks in service nitrification capacity is available for maximum loading and minimum temperature up to 93 mgd maximum month flow and 102 mgd peak flow. Bio P performance is anticipated to be approximately 0.22 mg/L TP. All AADF effluent ammonia concentrations were calculated to be less than 0.2 mg/L as N.

In summary:

- The average day Bio P performance with 8, 10, and 12 tanks in service and either 11 or 22 percent anaerobic volume is anticipated to be 0.30 (±0.08) mg/L effluent TP.
- The average day Bio P performance with 8, 10, and 12 tanks in service and 22 percent anaerobic zone evaluated is anticipated to be 0.22 (±0.01) mg/L effluent TP.
- The average day Bio P performance with 8, 10, and 12 tanks in service and 11 percent anaerobic zone evaluated is anticipated to be 0.37 (±0.01) mg/L effluent TP.

The model predicted Bio P performance matches closely to the performance during Supplemental Phase II Bio P testing. During that testing a total equivalent anaerobic zone volume of ~14.6 percent resulted in an operating effluent TP of approximately 0.3 mg/L.

Additional capacity for nitrification and Bio P can be obtained with all 12 aeration and settling tanks in service. This capacity is not required to provide effluent ammonia and TP treatment at the rated capacity but could be used for redundancy and reliability.

Carbon Availability for P Removal

Adequate carbon is a critical component of the Bio P process. In general, facilities that do not use primary treatment such as the Kirie WRP have more carbon available to support Bio P. Treatment facilities in warm climates and with long and flat collection systems typically treat raw wastewater with more readily degradable VFA concentrations to support Bio P.

The amount of available carbon for Bio P is commonly expressed as the BOD_5:TP ratio entering the activated sludge aeration tanks. A BOD_5:TP ratio ranging from 20:1 to 30:1 is typically required for effective Bio P. Figure A.2.14 shows the measured BOD_5:TP ratios at the Kirie WRP. The 30 day moving average influent BOD_5:TP ratio typically ranges between 30 to 40, with high values approaching 50:1. Although the BOD_5:TP ratio is variable with influent flow conditions, the ratio rarely drops below 20:1.

The influent BOD_5:TP ratio and the effluent TP performance at the Kirie WRP indicates that there is adequate carbon available for efficient Bio P. Based on these results supplemental carbon addition or advanced carbon management is not required and was not evaluated for the Feasibility Study.

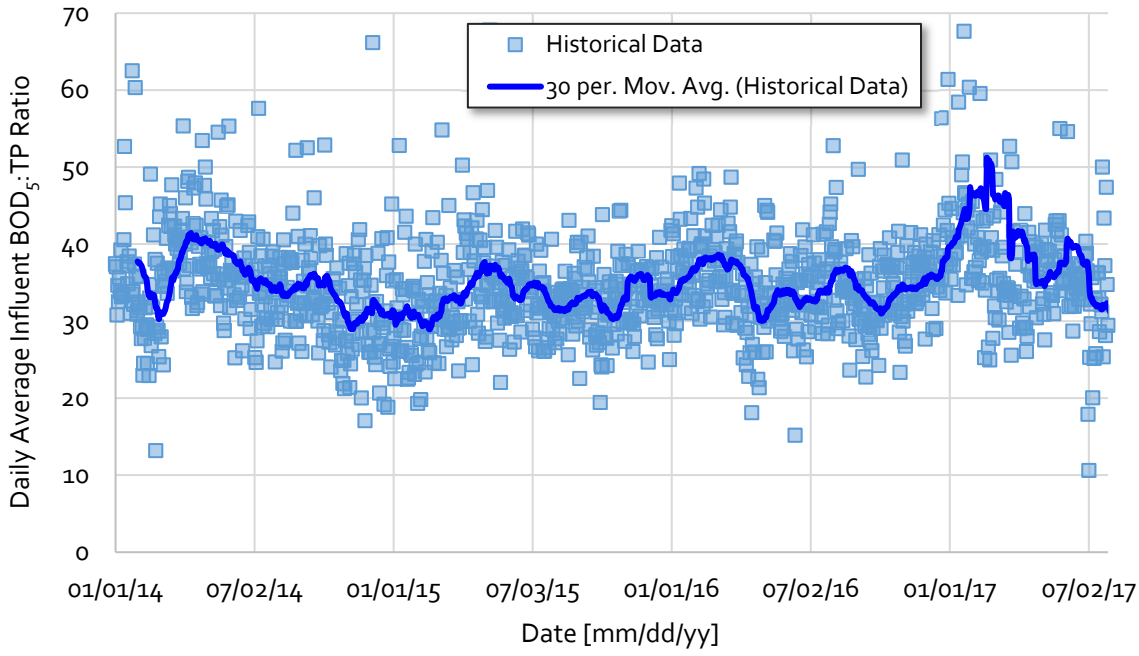

Figure A.2.14 Daily Average Influent BOD_5:TP Ratio at Kirie WRP

A.2.5.3.3 Aeration Tank Modifications for Bio P Improvements

Bio P improvements to meet Tier 1 and 2 TP limits will include:

- Zone Baffle Wall Installation - to create distinct zone boundaries, avoid scum trapping, reduce filament growth, and minimize back mixing.
- Anaerobic Zone Mixing - to provide control of mixing, minimize physical obstructions, and prevent excess introduction of dissolved oxygen (DO) into anaerobic zones.
- Aeration Diffusers and Control Valves in Swing and Aerobic Zones in the First Pass – to supply and control aeration air.
- Membrane diffusers in the Swing and Aerobic Zones of the First Pass - to prevent biofouling of ceramic diffusers and create equivalent first pass air headloss conditions.

The basic recommendations for each aeration tank are described below.

Baffle Wall Recommendations

To create a permanent and well-designed A/O process configuration, two baffle walls are recommended in the first pass of all the active aeration tanks. Baffle walls should generally be located between drop legs 4 and 5 and between drop legs 8 and 9 to create three zones operated under anaerobic, swing (anaerobic or aerobic), and aerobic conditions. With baffle walls placed in these locations in the first pass, zone sizes are 10.3 percent, 10.3 percent, and 12.7 percent of the total aeration tank volume. Figure A.2.15 shows the recommended zone layout and baffle wall position in the first pass of the modified aeration tanks. The blue dots represent the location of the existing air header drop legs. The red lines indicate recommended locations of zone baffle walls in the first pass.

Figure A.2.15 Recommended Zone Layout and Baffle Walls in the First Pass of all the Active Aeration Tanks

Permanent baffle walls can be constructed of either concrete, wood, or fiberglass reinforced plastic (FRP). Based on discussion with staff and our design experience at other BNR plants and consistent with the recommendations in TM A.1 - Optimization Opportunities, we recommend concrete baffle walls be used for the Feasibility Study.

Anaerobic and Swing Zone Mixer Recommendations

Several types of anaerobic zone mixers are available on the market today. These include:

- Large bubble intermittent burst mixers.
- Vertical top entry bladed mixers.
- Top mounted hyperboloid-type mixers.
- Wall mounted impeller mixers.
- Banana blade mixers.

Providing adequate access, bridges, and power and control conduit routing without creating an obstruction can be challenging with electric motor driven mixers. For this reason, the large bubble mixers are gaining popularity in the industry.

The Kirie WRP installed large bubble mixers in a portion of the anaerobic zones in aeration tanks 5 and 6 during the Bio P testing program. The large bubble mixing air is supplied from the instrument air system. The mixers performed well and are preferred by the staff. We recommend use of similar large bubble mixers in the anaerobic and swing zones of all aeration tanks for continuity as part of the P removal Feasibility Study. During design, verification that the existing instrumentation air system can be used for additional large bubble mixers should be confirmed.

Aeration Air Diffuser Recommendations

The existing aeration tanks at the Kirie WRP use ceramic plate diffusers embedded in the floor of each pass. Ceramic diffusers are commonly used for aerobic zones in a BNR facility but can be challenging in swing zones due to their risk of biofouling when unaerated. As part of the P removal Feasibility Study, it is recommended that the existing aeration air diffuser system be replaced with new membrane aeration diffusers in the swing zone and aerobic zone in the first pass of each active aeration tank.

A.2.5.3.4 Chem P to Supplement Bio P

In order to meet the numeric permit limits for Tier 3 effluent TP limits of 0.1 mg/L, Chem P is required to supplement Bio P. At the Kirie WRP, Bio P will be effective to effluent TP levels between 0.2 mg/L and 0.4 mg/L. Therefore, Chem P will be required on a daily basis to meet Tier 3 limits.

In addition, due to normal variations in BOD and TP influent load, temperature, and other operating conditions, periodic excursions of phosphorus are anticipated when using the Bio P process. Therefore, to avoid discharge violations, we recommend that chemical feed facilities be provided for all tier effluent TP limits and effluent averaging periods.

The following section summarizes:

- Methodology for predicting phosphorus excursions.
- Chemical selection and molar dose ratios.
- Chem P requirements for various averaging periods.
- Chemical quantities for supplemental treatment and excursion trimming.
- Recommended Chem P systems.

A separate project memorandum was developed to outline the approach to developing Chem P dosing estimates (see Appendix A.2-B).

Methodology for Predicting Phosphorus Excursions

For days when a higher-than-average influent TP is received at the facility, effluent TP excursions may occur that exceed the numeric limit and require chemical dosing to trim effluent phosphorus. Bio P performance was evaluated during periods of peak phosphorus loading to estimate chemical feed quantities required to prevent TP excursions and effluent violations. Chemical addition to trim for excursions is predicted to occur only for the few days each year.

Peak phosphorus loading was determined using a frequency distribution of the influent TP. Influent TP values above the 92nd percentile were used to predict effluent TP concentrations during high loading. The 92nd percentile method assumes Bio P will be sufficient to produce the predicted results 92 percent of the time and excursions will occur 8 percent of the time.

Table A.2.9 presents the Bio P performance using a different number of tanks and percentages of anaerobic zone during average day and days of excursions. Process modeling was used to predict the average day Bio P performance and the Bio P performance during excursions for the different configurations presented in the table below. The table indicates that Bio P produces effluent less than the Tier 1 criteria of 1.0 mg/L TP and Tier 2 criteria of 0.5 mg/L TP under average conditions. Therefore, supplemental chemical feed is not required on a daily basis to meet Tier 1 or Tier 2 effluent criteria. Conversely, Bio P effluent exceeds the Tier 3 criteria of 0.1 mg/L under all conditions. Therefore, supplemental chemical is required on a daily basis to meet Tier 3. The supplemental daily chemical dose is calculated as the amount required to remove TP from the average day Bio P effluent value down to 0.1 mg/L. The excursion dose is calculated as the amount required to remove the expected TP during excursions down to the effluent tier permit limit. Excursion dosing is anticipated to occur 8 percent of the time.

Table A.2.9 Bio P Performance during Average Conditions and Days of Excursions

Aeration Tanks in Service	Settling Tanks in Service	Anaerobic Zone Percentage %	Nitrification Capacity mgd	Equivalent AADF mgd	Average Day Bio P Performance Effluent TP (mg/L)	Bio P Performance during Excursions Effluent TP (mg/L)
6	6	22	61	36	0.33	1.02
6	6	11	67	40	0.47	1.95
8	8	22	69	41	0.24	1.09
8	8	11	76	55	0.39	2.93
10	10	22	93	55	0.22	1.12
10	10	11	102	61	0.37	3.16
12	12	22	117	70	0.21	1.17
12	12	11	127	76	0.36	3.28

Chemical Selection and Molar Dose Ratios

Metal salts are used to remove phosphorus chemically. Metal salts can be either Ferric Chloride, $FeCl_3$ (Ferric) or Aluminum Sulfate, $AlSO_4$ (Alum). Either chemical is effective for Chem P and each has advantages and disadvantages related to cost, storage, and handling. For purposes of the Feasibility Study, it was assumed that Ferric would be used for Chem P treatment. The components and costs for storage, feed, and distribution of either chemical are similar. It is recommended that the District evaluate and verify the selection of the most appropriate chemical for Chem P prior to implementation.

Information from Chem P studies conducted by the District, see Appendix A.2-B, together with Water Environment Federation Manual of Practice 37 (WEF MOP 37) were used to estimate the ferric molar ratios required to meet the tiered effluent TP limits.

Data from previous studies is presented in Figure A.2.16. The molar dose ratio curve published in WEF MOP 37 is also depicted in Figure A.2.16.

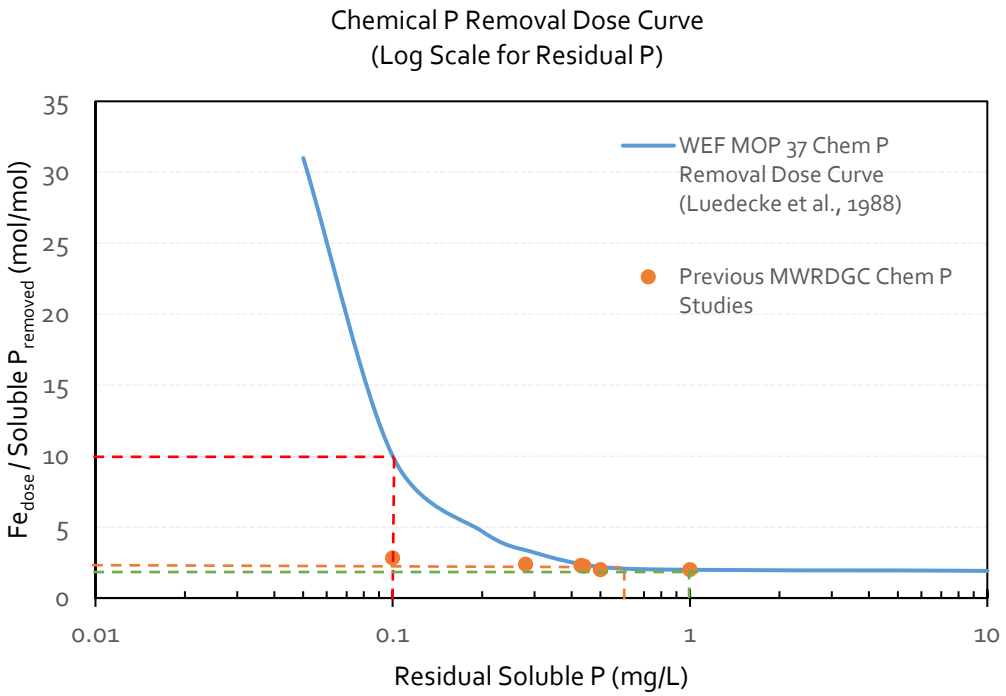

Figure A.2.16 Comparison of Ferric Dose Chem P (WEF MOP 37) and Results of District Chem P Studies

The molar dose ratio for Tier 1 and Tier 2 limits determined from the previous District studies matched the WEF MOP 37 dose response curve values. For very low effluent TP (less than 0.2 mg/L), the chemical dose can vary due to water chemistry differences (e.g. alkalinity, pH, and the carbonate equilibria), as well as physical differences at each plant (e.g. number and locations of chemical application points, type and degree of mixing, contact time, etc.). For Tier 3, the District study found a significantly lower molar dose ratio than predicted by WEF MOP 37 dose response curve. In order to assure that the costs for Chem P were not underestimated, a molar dose ratio of 10 based on the WEF MOP 37 curve was used for Tier 3.

Based on Figure A.2.16, the following Chem P dose ratios were used to calculate the $FeCl_3$ (ferric) feed requirements:

- 10.5 mg $FeCl_3$ /mg soluble phosphorus (Sol-P) for Tier 1 - 1.0 mg/L TP (iron to phosphorus [Fe/P] molar ratio of 2:1).
- 12 mg $FeCl_3$ /mg Sol-P for Tier 2 - 0.5 mg/L TP (Fe/P molar ratio of 2.3:1).
- 52.4 mg $FeCl_3$ /mg Sol-P for Tier 3 - 0.1 mg/L TP (Fe/P molar ratio of 10:1).

Chem P Requirements for Various Averaging Periods

An "equivalent average daily" ferric dose was calculated by combining the base daily supplemental dose required to meet the tier limit plus the excursion dose required to cover high influent TP loads anticipated to occur 8 percent of the time. The equivalent average day ferric

dose is dependent on the tier of phosphorus to be treated, as a higher tier limit would require addition of a higher base dose and excursion dose.

Chemical dosing and costs can be reduced if longer averaging periods are permitted. With a longer averaging period, some of the TP excursions are offset by days when the influent and corresponding effluent TP concentrations are less than the average. Longer averaging periods allow some of the phosphorus "peaks" to be cancelled out by the phosphorus "lows".

For a monthly averaging period, ferric addition is required to treat all excursions, which only occur 8 percent of the time. The remaining 92 percent of the time, the ferric base dose is sufficient to treat the influent TP loads. For a seasonal averaging period, it was assumed that half of the excursions during peak phosphorus loading are cancelled out by lows that occur during the longer averaging period. The other half of the excursions must be treated with Chem P using ferric addition. This applies at a ratio of the number of days in the averaging period days divided by 365 days. For an annual averaging period it was also assumed that half of the excursions during peak phosphorus loading are cancelled out by lows that occur during the longer averaging period. The other half of the excursions must be treated with Chem P using ferric addition. This applies for all 365 days.

The following calculation methodology was used for Chem P dosing at different averaging periods:

1. **Monthly Averaging Period**

   For a monthly averaging period, which is the shortest and most stringent averaging period, chemicals must be used to treat all excursions. The equivalent average daily ferric dose for a monthly averaging period was estimated using the following formula:

   *Equivalent Average Day Ferric Dose (in gpd) = Base Dose * 92 percent + Excursion Dose * 8 percent.*

2. **3-Month Seasonal Averaging Period**

   Seasonal averaging periods were assumed to provide more time and tolerance for managing excursions than a monthly averaging period. It was assumed that half of the excursions during peak phosphorus loading are cancelled out by lows that occur during the longer averaging period. The other half of the excursions must be treated with Chem P using ferric addition. This applies at a ratio of the number of days in the averaging period days divided by 365 days. Thus, the equivalent average daily dose for a 3-month seasonal averaging period was estimated using the following formula:

   *Equivalent Average Ferric Dose (in gpd) = Base Dose * 92 percent + Excursion Dose * 8 percent * (0.5 * (90/365) + (275/365))*

3. **6-Month Seasonal Averaging Period**

   Similar to the 3-month seasonal averaging period, the Chem P requirements for the 6-month seasonal averaging period were calculated using:

   *Equivalent Average Ferric Dose (in gpd) = Base Dose * 92 percent + Excursion Dose * 8 percent * (0.5 * (180/365) + (180/365))*

4. Annual Seasonal Averaging Period

An annual averaging period provides for the most time and tolerance for excursions and is expected to require the least Chem P treatment. It was assumed that half of the excursions during peak phosphorus loading are cancelled out by lows that occur during the longer averaging period. The other half of the excursions must be treated with Chem P using ferric addition. This would apply for all the 365 days. The equivalent average dose for an annual averaging period was estimated by the following formula:

*Equivalent Average Ferric Dose (in gpd) = Base Dose * 92 percent + Excursion Dose * 8 percent (0.5)*

Chemical Quantities for Supplemental Treatment and Excursion Trimming

Table A.2.10 presents the equivalent average daily Chem P demand in gallons per day (gpd) for multiple aeration tank configurations and capacity scenarios based on monthly, seasonal (3 and 6 months), and annual averaging periods.

Table A.2.10 Equivalent Average Chem P Demand Requirements for Different Scenarios and Averaging Periods

Chemical Feed Requirements					
Aeration Tanks in Service	6	6	8	8	**10**
Settling Tanks in service	6	6	8	8	**10**
Anaerobic Zone Percentage (%)	22	11	22	11	**22**
Equivalent AADF (mgd)	36	40	41	45	**55**
Equivalent Average Ferric Dose (in gpd) for: Monthly Averaging Period					
Tier 1 (1.0 mg/L TP)	1	51	5	118	**9**
Tier 2 (0.5 mg/L TP)	29	82	37	153	**52**
Tier 3 (0.1 mg/L TP)	767	1,336	590	1,295	**704**
Equivalent Average Ferric Dose (in gpd) for: 3-Month Seasonal Averaging Period					
Tier 1 (1.0 mg/L TP)	1	45	4	103	**8**
Tier 2 (0.5 mg/L TP)	25	72	32	134	**45**
Tier 3 (0.1 mg/L TP)	751	1,312	571	1,261	**679**
Equivalent Average Ferric Dose (in gpd) for: 6-Month Seasonal Averaging Period					
Tier 1 (1.0 mg/L TP)	1	38	4	88	**7**
Tier 2 (0.5 mg/L TP)	22	62	27	115	**39**
Tier 3 (0.1 mg/L TP)	735	1,288	553	1,226	**654**
Equivalent Average Ferric Dose (in gpd) for: Annual Averaging Period					
Tier 1 (1mg/L TP)	0	26	2	59	**4**
Tier 2 (0.5 mg/L TP)	14	41	18	76	**26**
Tier 3 (0.1 mg/L TP)	704	1,241	516	1,158	**604**

Notes:
(1) The values for recommended configuration to achieve P removal at rated capacity are in **bold**.

As indicated in Table A.2.10, the Bio P performance is reduced and the corresponding Chem P demand is increased in scenarios where 11 percent anaerobic zone is used compared to 22 percent anaerobic zone. To achieve effluent TP levels of 0.1 mg/L, a significantly higher chemical dose is required due to the need for both daily chemical supplement, excursion trim chemical feed, and the higher Fe/P molar dose ratio required to achieve lower effluent TP limits.

As indicated in Table A.2.10, the equivalent average daily ferric dose requirements decrease when moving from a monthly averaging period to a seasonal averaging period to an annual averaging period.

Figure A.2.17 presents the equivalent average daily ferric demand to treat DAF rated capacity based on the three potential tier limits at different averaging periods. The annual ferric chloride cost was based on equivalent daily average ferric demand.

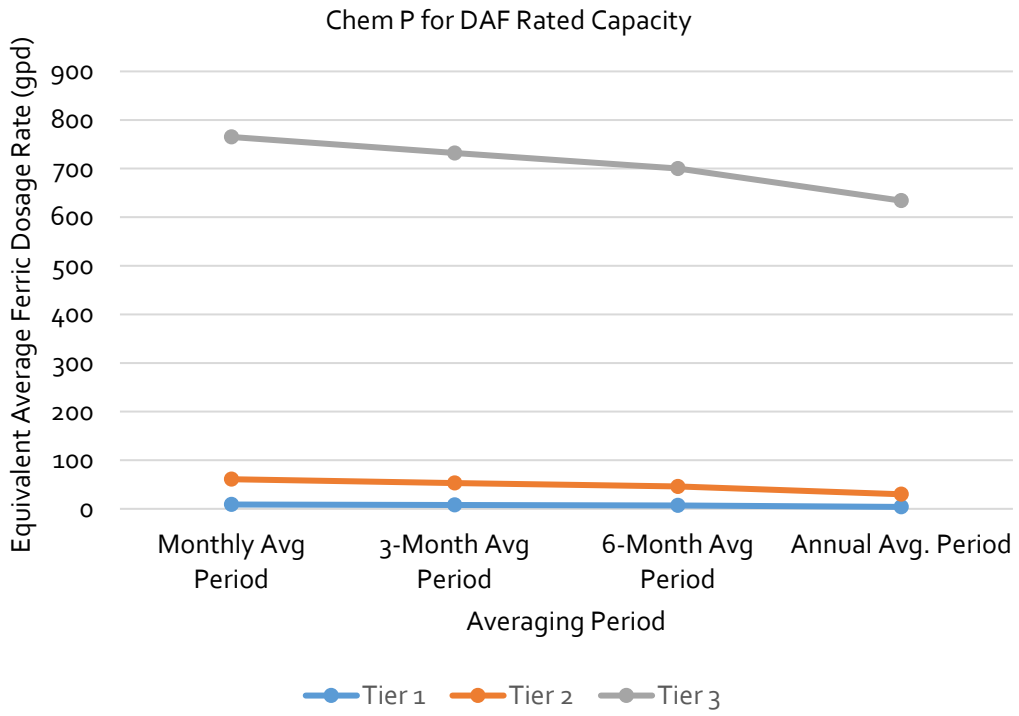

Figure A.2.17 Equivalent Average Daily Ferric Demand for DAF Rated Capacity to Meet Different Tier Limits at Different Averaging Periods with 22 Percent Anaerobic Zone Volume

Chem P System Modifications

Multiple chemical dosing points are recommended to provide the District with the flexibility to optimize Chem P. Ferric chloride piping will be routed through the Kirie WRP piping tunnel system to all chemical dose points. Approximately 8,035 linear feet of ferric distribution piping will be required. Figure A.2.18 shows the recommended dosing locations and general chemical feed pipe routing at Kirie WRP.

The recommended chemical dosing points are:

- The raw wastewater junction box upstream of the feed channels to aeration tanks in both Battery A and Battery B.
- The aeration tanks discharge channels to the settling tank distribution boxes in both Battery A and Battery B.
- The east and west tertiary filter feed at the filter building.

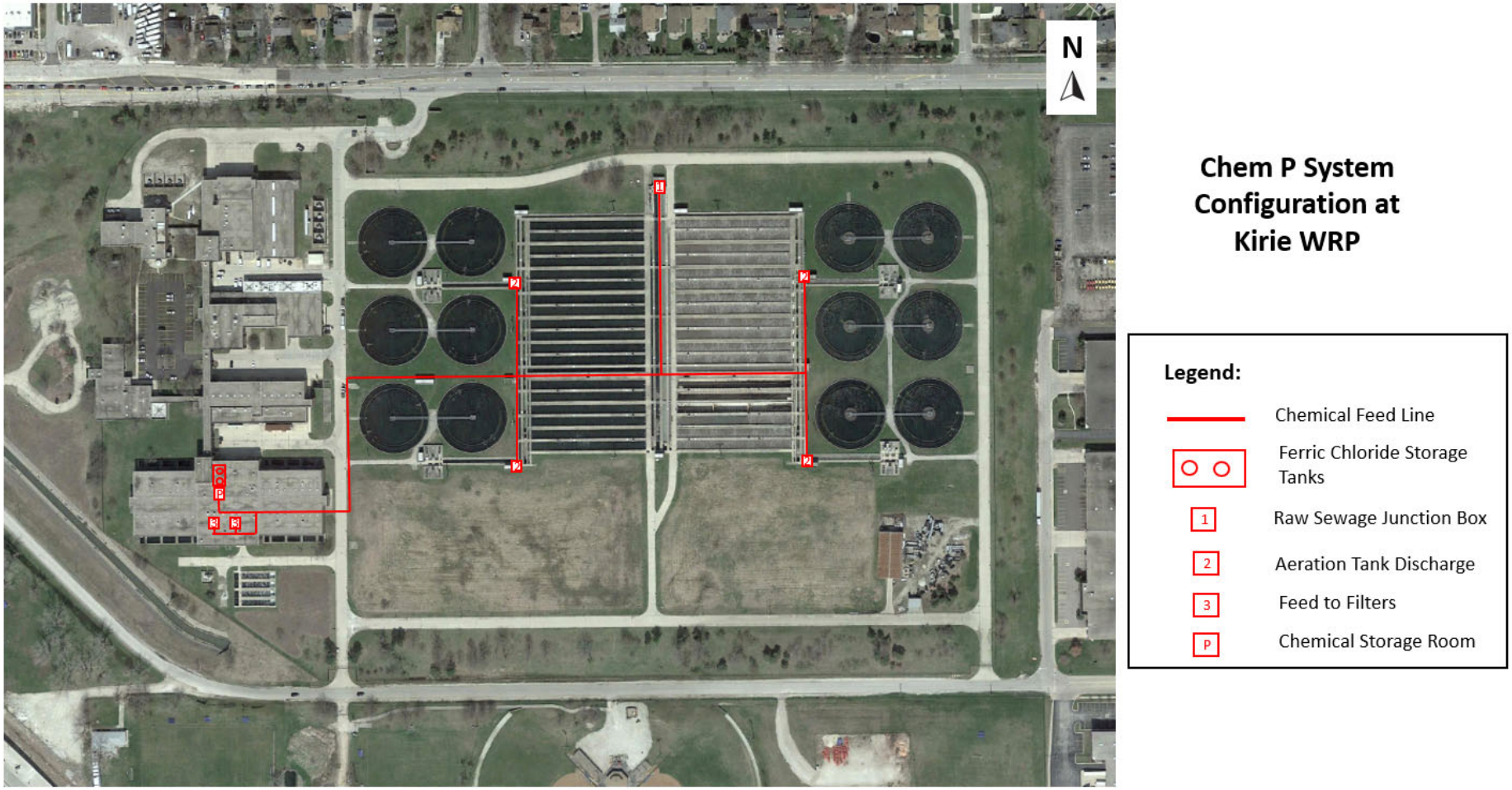

Figure A.2.18 Recommended Chem P System Configuration at the Kirie WRP

It is recommended that the chemical storage room in the filter building that currently houses hypochlorite storage tanks and feed pumps be modified and used for the bulk storage of ferric chloride and the associated chemical feed pumps. Figure A.2.19 presents a plan layout of the recommended chemical storage and containment area in the filter building.

Ferric chloride storage tanks are housed in a separate isolated room walled off from the hypochlorite tanks. Two 8,000 gallon, double-walled, fiberglass reinforced plastic tanks are recommended for ferric storage. Chemical storage tanks were sized to provide at least two weeks of chemical storage capacity at equivalent daily average ferric dose at the lowest effluent TP tier limit of 0.1 mg/L and rated capacity. Two 8,000 gallon storage tanks also allow the offloading of standard chemical delivery trucks while feeding chemical from either tank.

Chemical feed pumps are installed within the isolated ferric room alongside the hypochlorite tanks. Chemical feed tanks and pumps are placed inside of a common spill containment area. Six peristaltic metering pumps (five duty + one standby) feed ferric chloride to the five alternative dosage points. Ferric may be fed independently to one or more locations for optimal performance. Chemical feed pumps will be skid mounted and piped with calibration columns, pulsation dampeners, relief valves, pressure gauges, and fittings. The ferric feed pumps should be sized for peak ferric dose rates and include 25:1 turndown or replaceable heads to cover the required range of ferric feed.

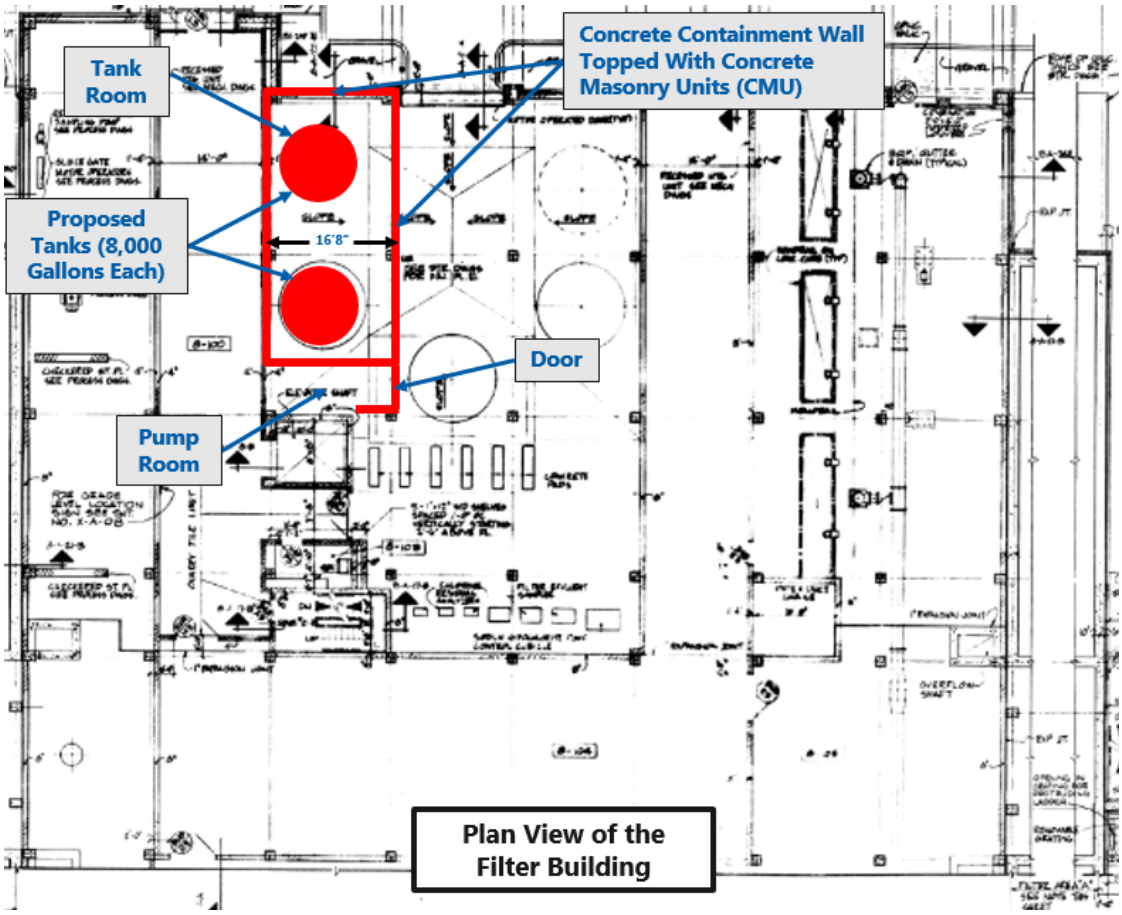

Figure A.2.19 Preliminary Plan Layout of Recommended Isolated Containment Area, Ferric Chloride Storage Tanks, and Chemical Feed Pumps in the Filter Building

A.2.5.3.5 Tertiary Filtration

The Kirie WRP currently operates Battery A settling tanks for clarification of mixed liquor from nitrification and Bio P. The Battery B settling tanks are used for dual clarification and additional polishing. The polished secondary effluent meets TSS effluent criteria of 5 mg/L without filtration. Therefore, the tertiary filters at the Kirie WRP are no longer in service, and the flow is bypassed directly to the disinfection/post-aeration facility.

As part of this Feasibility Study, it was assumed that tertiary filtration will be required if dual clarification and polishing in the Battery B settling tanks is not available. Dual clarification will not be fully available when the Battery B aeration tanks are operated for nitrification and Bio P at flows greater than the current 35.8 mgd. In addition, it is assumed that regardless of the use of Battery B settling tanks for dual clarification and polishing, effluent filtration will be required to meet Tier 3 numeric permit limits of 0.1 mg/L TP.

As part of this Feasibility Study, replacement of existing multi-media filters with cloth disc filters was assumed. As an alternative to constructing a new cloth disc filtration system, the existing multi-media filters could be rehabilitated. The capital cost for rehabilitation of the existing filters may be less than the cost of new cloth disc filters. Therefore, a planning level cost estimate for rehabilitation of existing filters was also generated for comparison purposes. Although rehabilitation of existing filters may save capital cost, the existing hydraulic profile may allow cloth filter operations without using the filter feed pumps. The life cycle cost savings afforded by avoiding filter feed pumping may offset the higher cost of cloth disc filters.

We recommend that, if effluent filtration is required for either Tier 3 P removal or higher than current flows, the District perform a more detailed life cycle analysis on capital cost, pumping, and chemical cost to determine the best approach to filtration. At the time of design, the selection of specific cloth filter manufacturers and development of filter configurations can be performed including confirmation of the filter hydraulics at rated and peak flows.

For sizing and cost estimating, the hydraulic loading rate for Tier 1 and Tier 2 effluent TP of 1.0 mg/L and 0.5 mg/L was assumed to be 5 gallons per minute per square foot (gpm/sf). For Tier 3 effluent TP of 0.1 mg/L, the hydraulic loading rate was assumed to be 4 gpm/sf. Reduced filtration rates at lower effluent TP concentrations is required due to the higher ferric dose associated with daily use of Chem P.

A.2.6 Summary of Future Treatment Phased Implementation Plan

The Kirie WRP has the capability to meet effluent TP of either 1.0 mg/L or 0.5 mg/L at current flows using the A/O Bio P process in Battery A, with chemical trim to manage excursions, and without effluent filtration. The Kirie WRP has the capability to meet effluent TP of 0.1 mg/L at current flows using the A/O Bio P process in Battery A, with chemical trim to provide supplemental P removal and to manage excursions, and with effluent filtration. Therefore, modification of the six Battery A aeration tanks and provisions for Chem P storage and feed systems is required with potential effluent filter replacement or rehab for Tier 3 compliance.

For future flows above the current 35.8 mgd, activation and modification of some Battery B aeration tanks will be required. For flows above the current 35.8 mgd where Battery B is activated, effluent filtration will be required for compliance with all effluent TP tiers.

The District can take a phased implementation approach to accommodate various potential effluent TP tiers at current flows without activating Battery B and a phased implementation approach to accommodate various potential effluent TP tiers at future flows up to the DAF rated capacity by activating Battery B.

This section presents a graphical summary of the anticipated phased implementation approach to accommodate additional capacity. The anticipated effluent TP performance with a various number of modified aeration tanks in service is presented. The supplemental and trim chemical dose projections are also presented. Planning level layouts for current and future capacity are presented in Section A.2.6.2.

A.2.6.1 Capacity Phasing, Bio P Performance, and Chem P Requirements for All Tier Limits with 22 Percent Anaerobic Zone

The process modeling results were plotted to help illustrate the capacity progression of phased aeration tank modifications, the corresponding Bio P performance, and the projected Chem P requirement for flows above 35.8 mgd.

Figure A.2.20 presents, on the secondary y-axis (orange dashed line), the number of aeration tanks required to accommodate increasing AADF capacity. The corresponding average day Bio P performance with 22 percent anaerobic volume is indicated on the primary y-axis (black solid line).

The number of aeration basins required for any AADF can be established by running vertically from the desired AADF on the x-axis to the orange dashed line, then horizontally over to the secondary y-axis. The Bio P performance at any AADF flow can be estimated by running horizontally from the number of aeration tanks on the secondary y-axis to the orange dashed line and then vertically to the black solid line.

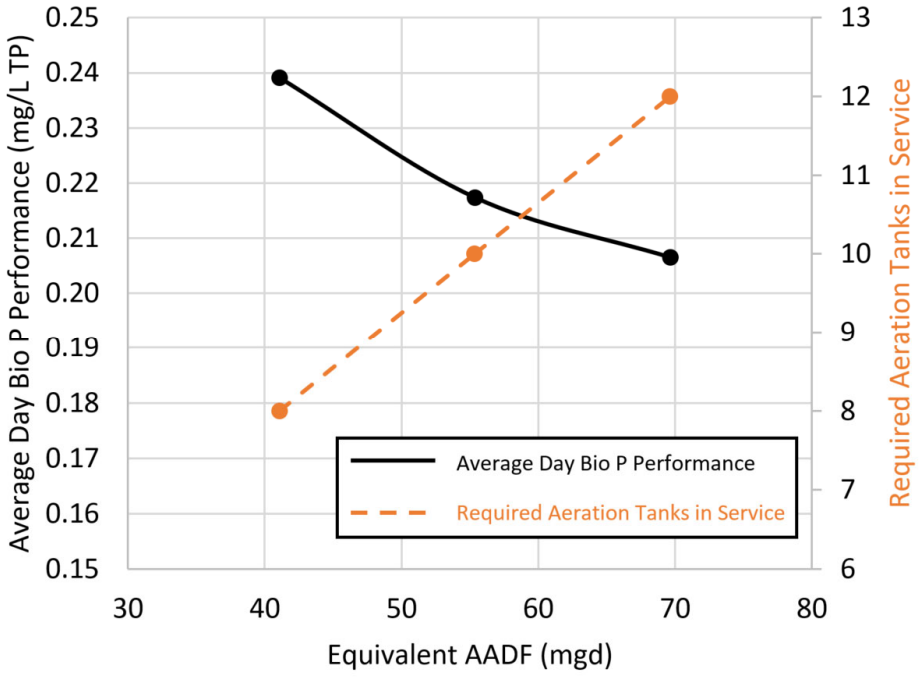

Figure A.2.20 Required Number of Aeration Tanks and Anticipated Bio P Performance with 22 Percent Anaerobic Zone

Figure A.2.21 presents the equivalent average daily ferric demand (gpd) for all the three effluent TP tier limits at any equivalent AADF. This ferric demand is based on the average day Bio P performance, the supplemental chemical dose required to reach Tier 3, and trim chemical dose required to manage excursions.

With 22 percent anaerobic zone and the appropriate number of aeration tanks in service the range of equivalent average daily ferric demand for each effluent TP tier is presented below:

- Tier 1 (1.0 mg/L TP): 5 gpd to 16 gpd.
- Tier 2 (0.5 mg/L TP): 37 gpd to 70 gpd.
- Tier 3 (0.1 mg/L TP): 590 gpd to 832 gpd.

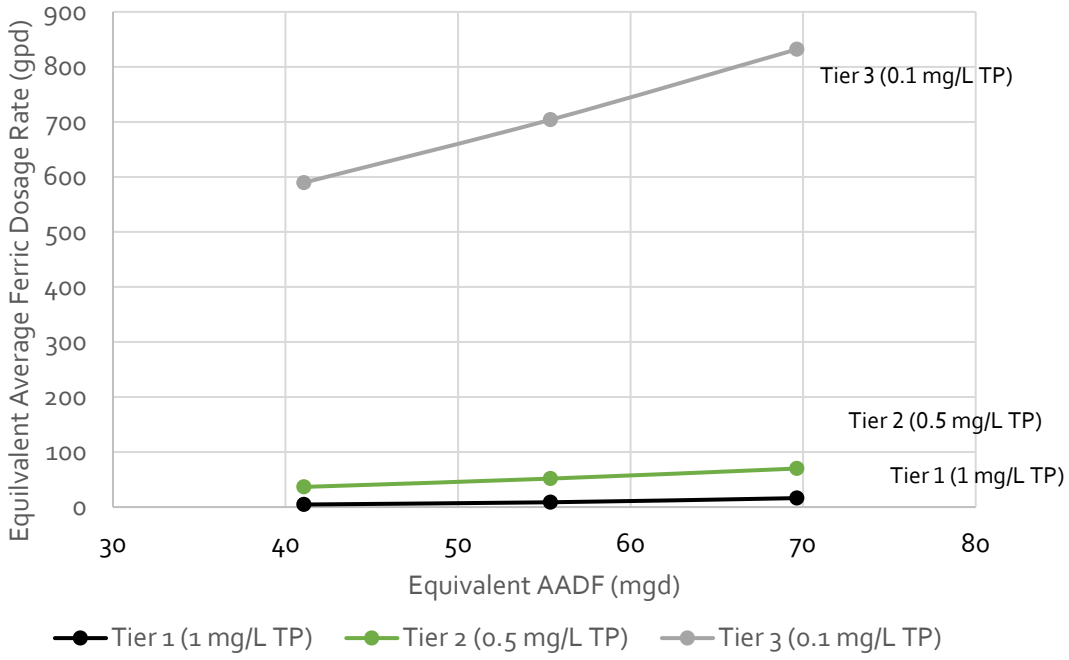

Figure A.2.21 Equivalent Average Daily Ferric Demand with 22 Percent Anaerobic Zone

A.2.6.2 Capacity Phasing, Bio P Performance, and Chem P Requirements for All Tier Limits with 11 Percent Anaerobic Zone

Figure A.2.22 presents, on the secondary y-axis (orange dashed line), the number of aeration tanks required to accommodate increasing AADF capacity. The corresponding average day Bio P performance with 11 percent anaerobic volume is indicated on the primary y-axis (black solid line).

The number of aeration basins required for any AADF can be established by running vertically from the desired AADF on the x-axis to the orange dashed line, then horizontally over to the secondary y-axis. The Bio P performance at any AADF flow can be estimated by running horizontally from the number of aeration tanks on the secondary y-axis to the orange dashed line and then vertically to the black solid line.

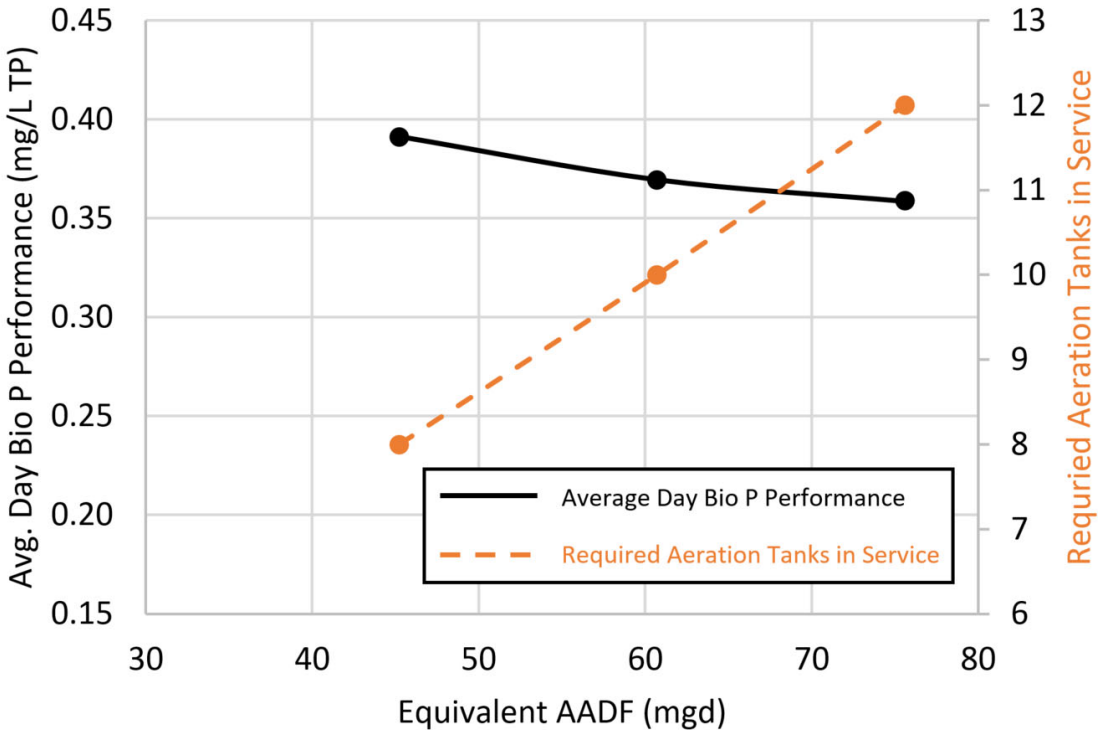

Figure A.2.22 Required Number of Aeration Tanks and Average Day Bio P Performance with 11 Percent Anaerobic Zone

Figure A.2.23 presents the equivalent average daily ferric demand (gpd) for all the three effluent TP tier limits at any equivalent AADF. This ferric dosage requirement is based on the average day Bio P performance, the supplemental chemical dose required to reach Tier 3, and trim chemical dose required to manage excursions.

With 11 percent anaerobic zone and the appropriate number of aeration tanks in service the range of equivalent average daily ferric demand for each effluent TP tier is presented below:

- Tier 1 (1.0 mg/L TP): 118 gpd to 232 gpd.
- Tier 2 (0.5 mg/L TP): 153 gpd to 291 gpd.
- Tier 3 (0.1 mg/L TP): 1,295 gpd to 2,009 gpd.

With 11 percent anaerobic zone volume, all tiers require significantly higher equivalent average daily ferric dose due to reduced Bio P performance.

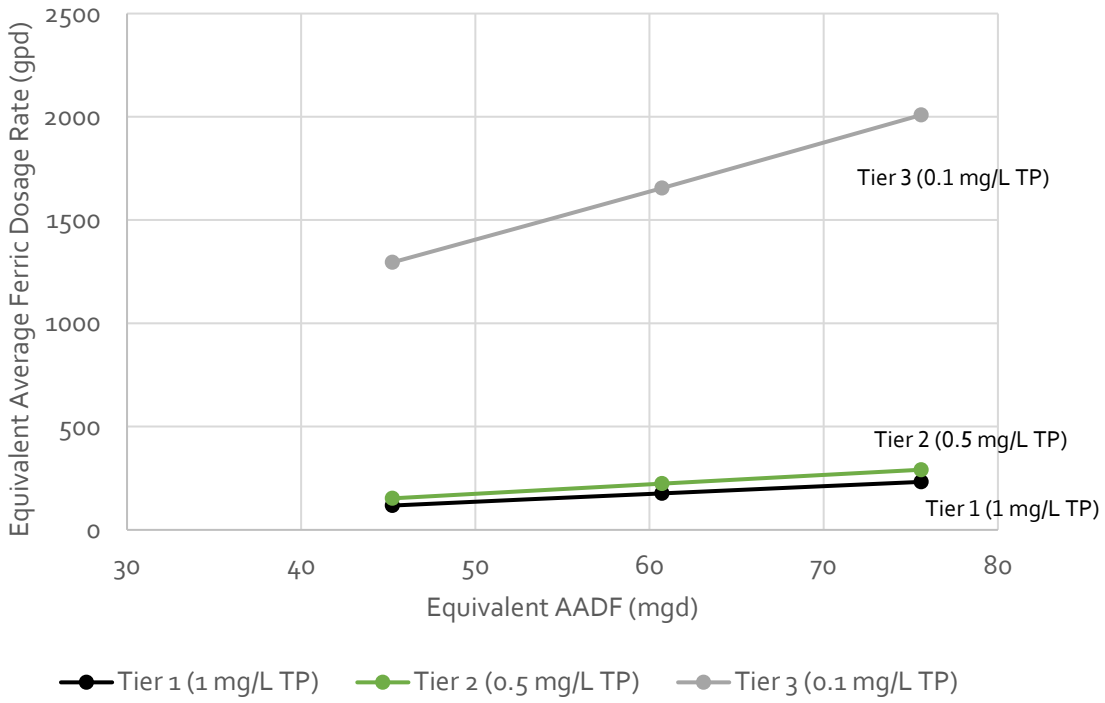

Figure A.2.23 Equivalent Average Daily Ferric Demand with 11 Percent Anaerobic Zone

A.2.6.3 Phased Implementation Layouts and Schedule

Planning level layouts were developed for:

1. **Existing Kirie WRP Operational Configuration:** To illustrate the current starting point with the existing operating facilities at Kirie WRP.
2. **Compliance with Tiered Effluent TP limits at Current Flows:** To illustrate the recommended modifications required for compliance with tiered effluent TP limits (1.0 mg/L, 0.5 mg/L, and 0.1 mg/L) at current flows (35.8 mgd).
3. **Compliance with Tiered Effluent TP limits at DAF Rated Capacity:** To illustrate the recommended modifications required for compliance with tiered effluent TP limits (1.0 mg/L, 0.5 mg/L, and 0.1 mg/L) at DAF rated capacity (52.0 mgd).

A.2.6.3.1 Existing Kirie WRP Operational Configuration

Figure A.2.24 presents the existing operational configuration at Kirie WRP. As illustrated in the figure, a single anaerobic zone is operating in the first pass of all six aeration tanks in Battery A. The anaerobic zones in aeration tanks 5 and 6 include large bubble mixers, while aeration tank 5 features temporary wood baffle walls. The anaerobic zones in tanks 1 through 4 are created by turning off aeration air and do not include temporary baffle walls. Mixing of the anaerobic zones is provided by aeration air bumping. All six aeration tanks in Battery B and the tertiary filters are currently not used for treatment.

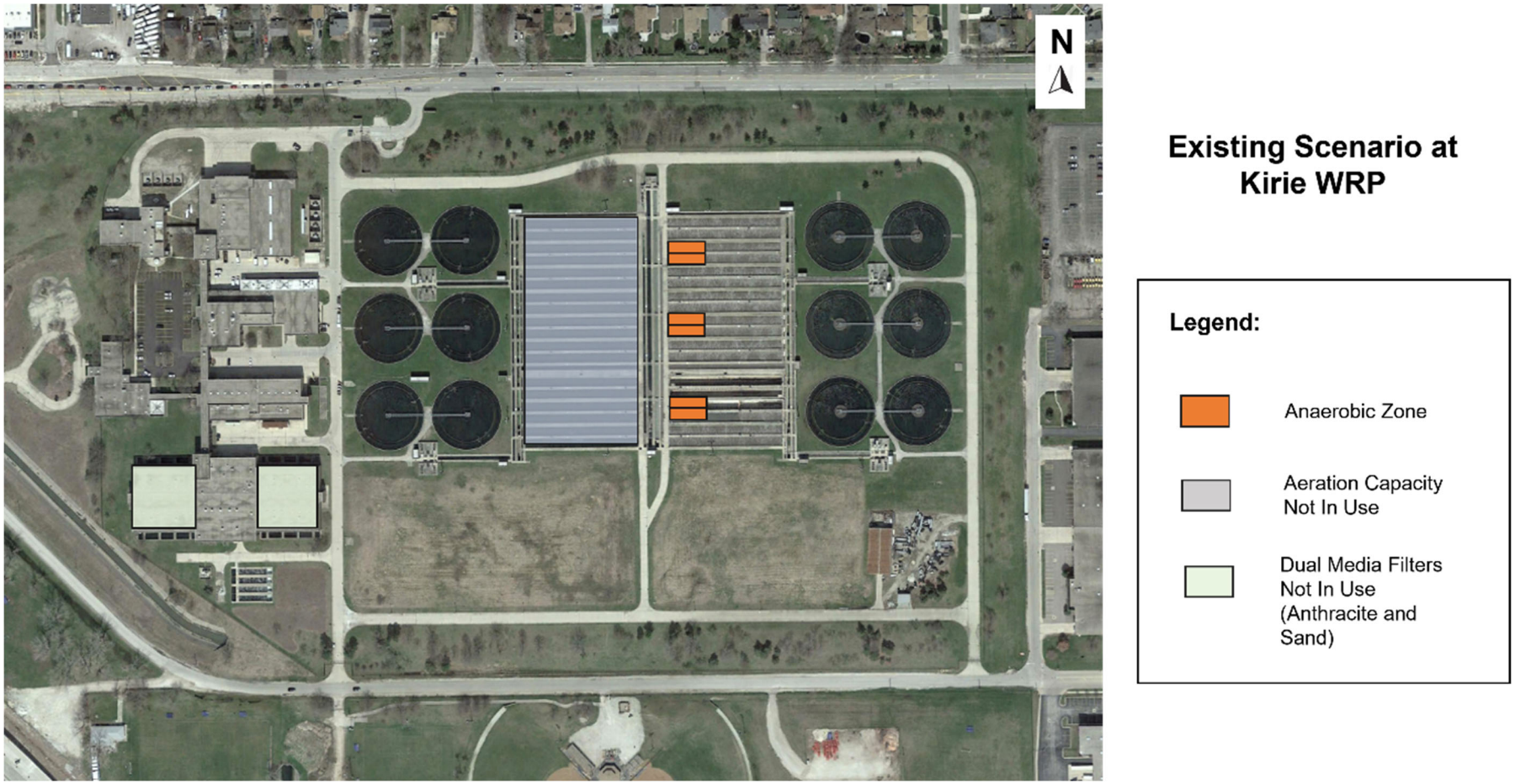

Figure A.2.24 Existing Operational Configuration at Kirie WRP

A.2.6.3.2 Compliance with Tiered Effluent TP limits at Current Flows

The recommended modifications to meet tiered effluent TP limits at current flows are described below.

Current Flows: Tier 1 and Tier 2

Figure A.2.25 presents the recommended modifications to meet Tier 1 (1.0 mg/L) and Tier 2 (0.5 mg/L) effluent TP limits at current flows. The recommended modifications are:

- Activation of six aeration tanks with 22 percent anaerobic zones.
- Installation of concrete baffle walls, large bubble mixers, membrane diffusers in the first pass swing and aerobic zones, and globe valves for first pass aeration control of each active aeration tank.
- Installation of Chem P system including storage tanks, feed pumps, and distribution piping.

The expected Bio P performance with six aeration tanks in service and 22 percent anaerobic zone is between 0.4 to 0.6 mg/L TP. This allows compliance with either a Tier 1 or Tier 2 limit.

At current flows, activation of aeration tanks in Battery B is not required to meet Tier 1 and Tier 2 effluent TP limits. A Chem P system is required irrespective of effluent TP tier limit to provide compliance during Bio P excursions associated with changing influent load and in-plant operating conditions. The ferric dose for excursions is anticipated to be higher with Tier 2 limits than Tier 1 limits.

To meet Tier 1 or Tier 2 limits at current flows, tertiary filters will not have to be activated as dual clarification using the Battery B settling tanks can produce compliant effluent TSS.

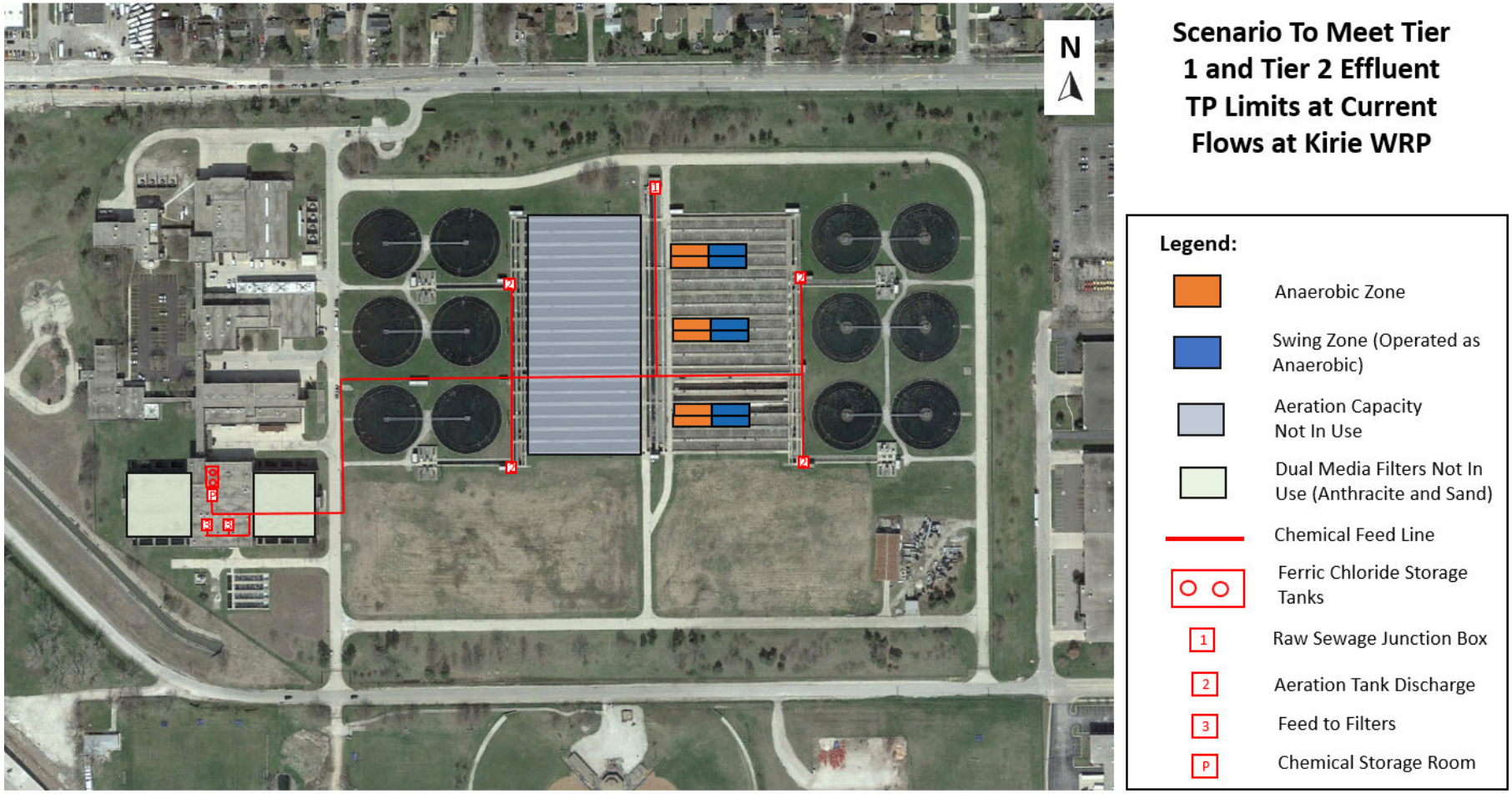

Figure A.2.25 Recommended Modifications for Compliance with Tier 1 and Tier 2 Effluent TP Limits at Current Flows

Current Flows: Tier 3

Figure A.2.26 presents the recommended modifications required to comply with a Tier 3 effluent TP limit (0.1 mg/L) at current flows. The recommended modifications are:

- Activation of six aeration tanks with 22 percent anaerobic zones.
- Installation of concrete baffle walls, large bubble mixers, membrane diffusers in the first pass swing and aerobic zones, and globe valves for first pass aeration control of each active aeration tank.
- Installation of Chem P system including storage tanks, feed pumps, and distribution piping.
- Activation of Tertiary Filtration.

The expected Bio P performance with six aeration tanks in service with 22 percent anaerobic zone is between 0.4 to 0.6 mg/L effluent TP. Therefore, Bio P alone will not meet the Tier 3 effluent TP limit. Activating additional aeration tanks in Battery B could improve Bio P performance but cannot provide reliable performance to 0.1 mg/L TP without effluent filtration. Activating additional aeration tanks in Battery B will discontinue the availability of dual clarification and require effluent filtration for TSS compliance. Therefore, it is recommended that Chem P be used to supplement the Bio P performance to meet Tier 3 limits.

Effluent filtration is required to meet low effluent TP limits at Tier 3 due to the need to remove the particulate P bound in TSS. The increased chemical dosage for Tier 3 will also potentially increase the particulate P bound in the solids. Thus, for the purpose of this Feasibility Study, it was assumed that dual clarification will not be sufficient to meet the effluent TP limit of Tier 3, and tertiary filtration must be activated.

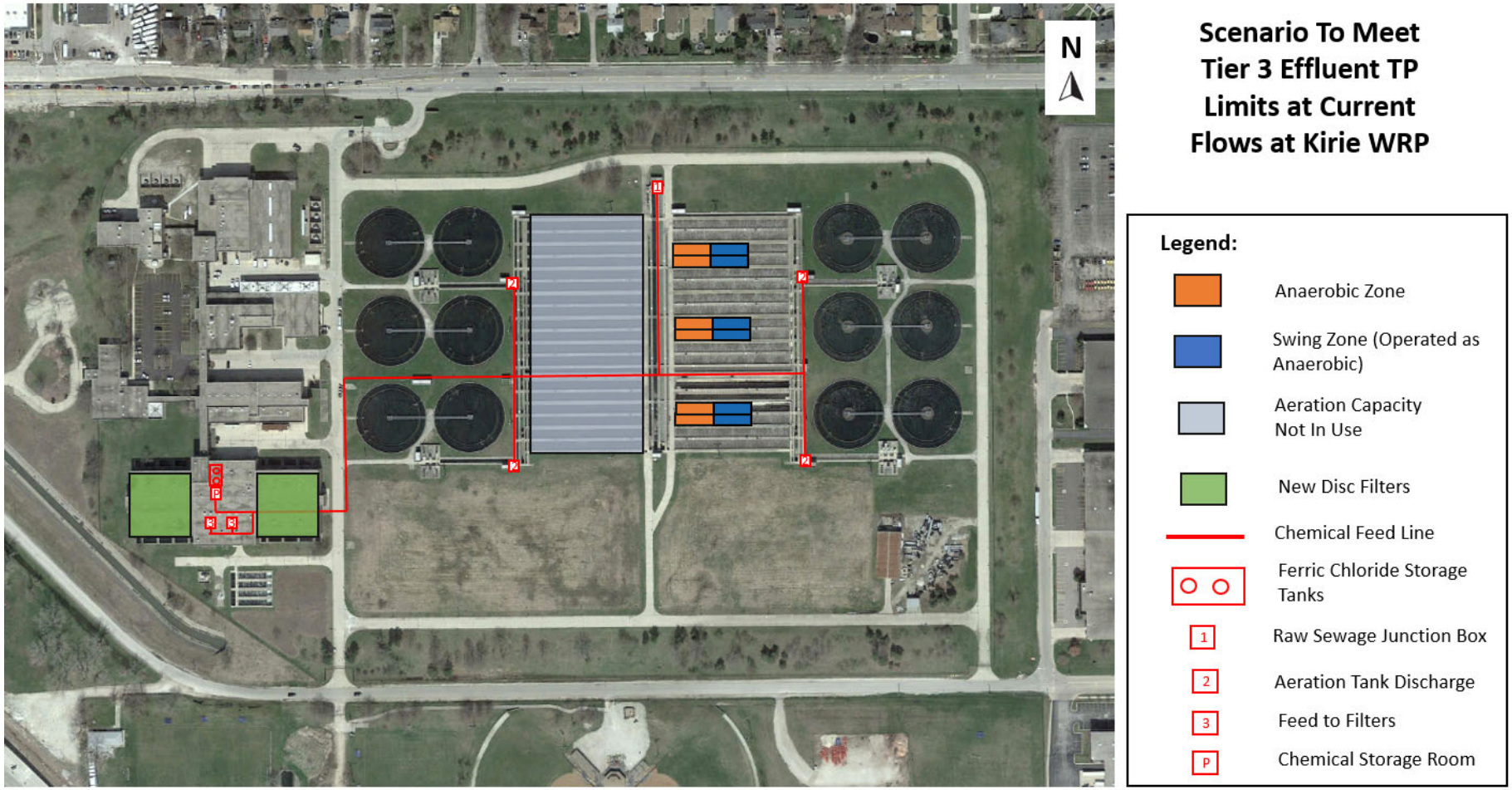

Figure A.2.26 Recommended Modifications for Compliance with Tier 3 Effluent TP Limits at Current Flows

A.2.6.3.3 Compliance with Tiered Effluent TP limits at DAF Rated Capacity

Figure A.2.27 presents the recommended modifications required to comply with all tiered effluent TP limits at DAF rated capacity. The recommended modifications are:

- Activation of ten aeration tanks with 22 percent anaerobic zones.
- Installation of concrete baffle walls, large bubble mixers, membrane diffusers in the first pass swing and aerobic zones, and globe valves for first pass aeration control of each active aeration tank.
- Installation of Chem P system including storage tanks, feed pumps, and distribution piping.
- Activation of Tertiary Filtration.

The only difference between the three tiers at DAF rated capacity is a higher ferric demand with lower effluent limits.

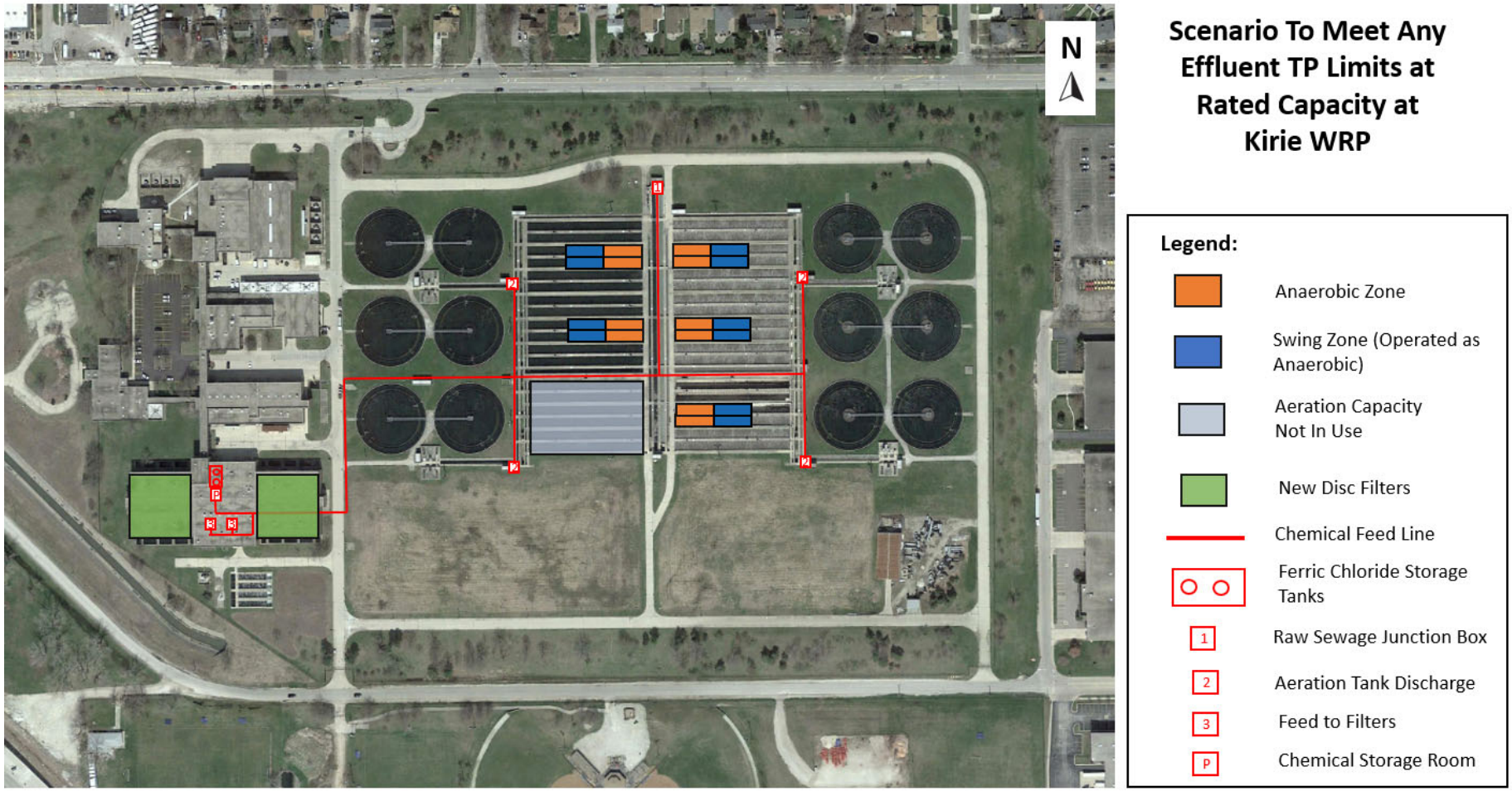

Figure A.2.27 Recommended Modifications for Compliance with All Tiered Effluent TP Limits at DAF Rated Capacity

A.2.6.3.4 Implementation Schedule Duration for Tier 1, Tier 2, and Tier 3 at Current Flows

A potential project implementation schedule and timeline for construction of facilities required to meet effluent TP limits of 1.0 mg/L, 0.5 mg/L, and 0.1 mg/L at current flows is presented in Table A.2.11. The total project implementation duration is expected to be approximately 63 months.

Table A.2.11 Project Implementation Schedule Duration for all Tiers at Current Flows

Project Implementation (Months)	
Prepare Request for Proposal (RFP)	3
Design Selection	6
Design	12
Bid and Award	6
Construction	30
Start-Up	6
Total (Months)	**63**

A.2.6.3.5 Implementation Schedule Duration for Tier 1, Tier 2, and Tier 3 at Rated Flows

A potential project implementation schedule and timeline for construction of facilities required to meet effluent TP limits of 1.0 mg/L, 0.5 mg/L, and 0.1 mg/L at rated flows is presented in Table A.2.12. The total project implementation duration is expected to be approximately 75 months.

Table A.2.12 Project Implementation Schedule Duration for all Tiers at Rated Flows

Project Implementation (Months)	
Prepare Request for Proposal (RFP)	3
Design Selection	6
Design	15
Bid and Award	6
Construction	36
Start-Up	9
Total (Months)	**75**

A.2.7 Evaluation of Potential Unintended Consequences of P Removal Implementation

Operational or process adjustments made in one area of the plant can lead to ramifications in other areas of the plant. These unintended consequences can occur when either Chem P or Bio P is implemented. The risks, side effects, and unintended consequences of Bio P can add capital and operating costs to the facility. It is recommended that all of the cost and O&M impacts of Bio P be considered before making the recommended capital improvements and operational changes. Some of the common unintended consequences associated with Bio P include:

- Biosolids handling impacts:
  - A reduction of dewatered cake solids percentage.
  - An increase in thickening and dewatering polymer use.
  - An increase in biosolids processing and disposal costs.
- An increase in formation of struvite or other scale causing compounds.
- An increase in power cost for zone mixing or other additional power demands.
- Potential generation of odors.
- Plant operational difficulties and additional O&M challenges.
- Increased process monitoring, laboratory analysis, and data management costs.

The unintended consequences identified above are noted to help improve the transition to Bio P operations.

A.2.7.1 Biosolids Handling Impacts

Implementation of Bio P at the Kirie WRP may lead to a minor increase in sludge production associated with additional PAO biomass in the MLSS. Additional sludge will also be generated due to the use of Chem P to meet the various effluent TP limits. The increase in sludge due to Bio P will remain the same across all effluent TP Tier limits, but the increase in sludge due to Chem P will depend on the quantity of ferric added at different effluent TP limits. The total increase in sludge for tiered effluent TP limits is estimated to be:

- Tier 1: 2.0 percent (Due to Bio P).
- Tier 2: 2.5 percent (2 percent due to Bio P and 0.5 percent due to Chem P).
- Tier 3: 7.0 percent (2 percent due to Bio P and 5 percent due to Chem P).

Other solids related impacts due to use of Chem P include increased mixed liquor concentration and reduced mixed liquor volatile suspended solids (VSS) due to chemical solids formation associated with chemical precipitation and reduced effluent alkalinity due to acidic chemical dosing.

Implementation of Bio P will change the sludge composition at Kirie WRP, which can affect dewaterability, cake content, and polymer usage. In general, the industry has noted a 3 to 5 percent reduction in cake solids percentage points when dewatering Bio P sludge as compared to non-Bio P sludge. At typical dewatered cake solids percentages of 25 percent, a 5 percentage point drop in cake dryness results in a 25 percent increase in cake volume for hauling, disposal, or reuse. In addition to the decrease in cake dryness and solids content, the polymer demand for thickening and dewatering also increases. In general, the industry has noted a 10 to 20 percent increase in polymer use when dewatering Bio P sludge as compared to non-Bio P sludge.

Biosolids produced at Kirie WRP are transferred to Egan WRP for processing and disposal or reuse. Therefore, impacts associated with solids handling due to the implementation of Bio P will occur at the Egan WRP. These impacts will be discussed as part of the Egan P removal Feasibility Study in TM B.2.

At higher flows there will also be additional solids generation with an associated cost related to biosolids transfer and pumping. This cost is not associated with P removal but rather the increased flows to the facility. The design of the future facilities to accommodate P removal and treatment at higher flows should include evaluation of existing infrastructure at both Kirie WRP and Egan WRP to verify sufficient capacity.

In order to provide adequate P reduction at the Egan WRP, recycled phosphorus must be sequestered. Therefore, P recovery will be considered at Egan WRP. Some of the P recovery costs at Egan WRP will be due to the P removal at the Kirie WRP. Because the physical facility and infrastructure for P recovery will be located at Egan WRP, all of the costs for P recovery have been allocated to Egan WRP.

A.2.7.2 Scale and Struvite Formation Potential

Potential compounds that cause scaling or precipitation in a Bio P process include brushite ($CaHPO_4$), newberyite ($MgHPO_4$), and struvite ($MgNH_4PO_4$). Of these compounds struvite (or magnesium ammonium phosphate) is the most prevalent when operating Bio P facilities that change the chemical ratios of ammonium and phosphate through biological conversion. Scaling at WRPs often occurs where high concentrations of nutrients are present or chemical changes including heat, pH, and pressure occur. Scaling and struvite formation in mainstream tanks or piping is less frequent as these conditions do not exist. However, scaling and struvite formation is more prevalent in solids handling systems and side-streams like centrate. In general, there is less risk of scaling or struvite formation with Bio P at the Kirie WRP because there are limited solids handling components, chemical changes in the process, and facility side-streams returned to the plant. Scaling or struvite formation is possible in the waste sludge pipeline from Kirie WRP to Egan WRP.

In general, with or without Bio P, struvite formation potential in the WAS sludge from the Kirie WRP is low because both liquid phosphate and ammonia concentrations are low as these nutrients are bound in the solids. However, it is possible that the biosolids from the Kirie WRP will decay in the sludge transfer pipe and release ammonia and soluble BOD. If the conditions in the pipeline become anaerobic, PAOs will release stored phosphorus which creates conditions for struvite formation or calcium phosphate scale. The probability of scale formation in the sludge transfer piping to the Egan WRP is dependent on the travel time, the anaerobic conditions, and the rate of decay to release ammonia.

The calibrated process model was used to estimate the release of nutrients in the pipeline and the potential for scale formation, without any consideration for the addition of metal salts used for phosphorus removal. At an average, continuous, waste sludge flow of 0.6 mgd, the estimated retention time in the 18-inch, 7-mile pipe from Kirie to Egan is approximately 1.6 days. Initial calcium and magnesium concentrations in the pipe are assumed to be equivalent to the effluent concentrations, which are routinely sampled at Kirie WRP. Simulations show that over a 1.6 day transit time nearly all polyphosphate is released under anaerobic conditions, however decay of the biosolids and ammonia release is limited. The mineral availability is also low. As such, the

scaling and formation potential for struvite, calcium phosphate, and newberyite in the transfer pipeline is low.

Ferric chloride will be used for Chem P to prevent effluent TP excursions and achieve compliance with Tier 3 effluent TP limits of 0.1 mg/L. Addition of ferric chloride increases the potential formation of vivianite scaling. Vivianite is a hydrated iron phosphate mineral usually materializing as deep blue to deep bluish green prismatic or flattened crystals.

Phosphorus release is expected under the anaerobic conditions experienced in the WAS transfer and will bind with residual ferric chloride present in the waste stream. The amount of residual ferric is expected to be higher with lower effluent TP limits due to the increased ferric dosing rate. Under these conditions vivianite formation could result in free floating crystals or scaling on the pipeline.

To reduce scale formation potential, we recommend ferric dosing be controlled to prevent excess residual ferric. The headloss through the pipeline can be monitored as an indicator of scale formation if headloss increases over time. Visual inspection of the pipeline should be conducted on a regular basis.

A.2.7.3 Impacts on Energy Neutrality Goals

Some facilities that implement Bio P experience higher power cost despite the anaerobic nature of the process. Higher power costs are primarily associated with four factors. Some of these factors are anticipated to result in additional power cost for implementation of Bio P at the Kirie WRP.

- Mixing of anaerobic zones.
- Pumping for Tertiary Filtration.
- Activation of additional unused aeration tanks.
- Power for chemical feed systems for ferric.

The Feasibility Study recommendations include anaerobic zone mixing using large bubble mixers. These mixers are not powered by electric motors but will require air compressors for compressed mixing air supply. At DAF rated capacity, with ten aeration tanks in service and 22 percent anaerobic zone, EnviroMix large bubble mixing system will require approximately 86 hp of continuous additional electrical load to the air compressors. At a unit power cost of $0.0663 per kilowatt hour (kWH), an increase in power cost of up to $37,000 per year is expected.

Activation of tertiary filtration at Kirie WRP will require pumping of secondary effluent into the filters. The motor hp required to pump secondary effluent will depend on the treated flow rate. At DAF rated capacity an estimated increase in power cost of up to $219,000 per year is expected. There will also be additional but lesser power costs for filter waste pumping.

P removal at future flows requires activation of the Battery B aeration tanks. However, activation of aeration tanks is required for capacity associated with flow increase and not P removal. Even if no P removal is considered at Kirie WRP, in order to accommodate for increased flows, Kirie WRP would have to move into Battery B to process the increased ammonia load and meet the nitrification requirements. This increased aeration power demand is driven by nitrification of increased flows and is not a cost factor associated with P removal.

The DO in the final pass of the aeration tanks is sometimes high. District staff has noted the potential impact in Bio P efficiency when the final pass DO is elevated. However, with the extended 22 percent anaerobic zones, little impact in Bio P performance under normal operating conditions is anticipated.

The Feasibility Study is based on compliance with numeric effluent standards that require a chemical feed system to supplement Bio P performance and prevent excursion violations. The additional power cost associated with chemical feed system is estimated at approximately $1,000 per year.

In summary, the existing Kirie WRP energy use and power cost profile is anticipated to increase by up to $257,000 per year with implementation of Bio P at DAF rated capacity. Over 85 percent of the cost increase is associated with filtration pumping.

A.2.7.4 Generation of Odors

Anaerobic conditions within a wastewater facility can result in odor generation. Odorous anaerobic conditions often occur where solids are held in anaerobic conditions long enough to break down carbons to shorter chain acidic compounds. This generally requires solids and hydraulic retention times in excess of 1 or more days.

In general, anaerobic zones within Bio P aeration tanks are sized to provide hydraulic retention times (HRTs) ranging from 30 to 60 minutes or less. As such, under normal operations, odor generation from anaerobic zones is not significant. However, if the anaerobic zone volume size is extended beyond a few hours to promote fermentation and VFA production noticeable odors can occur. If the mixing systems are used intermittently or do not provide adequate mixing to keep solids in suspension, pockets of settled solids can occur. Whereas pockets of settled solids can be beneficial for carbon fermentation and P release, additional odors are generated in pockets of scum or solids. Odorous gasses can escape from the surface of the anaerobic zones especially immediately after intermittent mixing systems are activated. In general, the conditions that lead to odor generation in Bio P anoxic zones are transient and can be mitigated through proper timing of the zone mixing and use of swing zones.

Based on the location of the Kirie WRP and distance to local neighbors, mitigation of odor emissions with Bio P anaerobic zone operations with covers, ventilation, and off gas scrubbing is not anticipated.

A.2.7.5 Minimizing Impacts of Recycle Streams

The presence of DO and nitrate (NO_3) in anaerobic zones of a Bio P process impact environmental conditions that support growth of PAOs and P release therefore reducing process efficiency. Process simulation modeling and demonstration testing indicates effective Bio P performance under the current raw wastewater feed, channel aeration, RAS rates, and temporary baffle wall configuration. District staff has reported a decrease in Bio P performance and efficiency when very high DO concentrations are measured in the final pass of the aeration tanks. For purposes of P removal and considering the recommendation for extended 22 percent anaerobic zones, significant operational adjustments or capital investments are not necessary to address the impact of recycle streams. However, best management practices to limit DO and nitrate return from RAS to the anaerobic zones are recommended. With the current discharge permit limit for DO being at least 6 mg/L and the availability of post aeration tanks at Kirie WRP, a balance needs to be maintained. And while the influent BOD_5:TP ratio at Kirie WRP is favorable

for Bio P, reducing the RAS rate as much as possible without compromising clarifier performance will reduce the amount of nitrate returned to the unaerated zones and improve Bio P performance.

Best management practices include:

- Management of aeration tank DO in the last pass to reduce oxygen concentration returned to the anaerobic zones in the RAS without impacting nitrification. Tapering the aeration and DO from the head to the tail of the aerated zone can allow adequate nitrification and limit last-pass DO.
- In the future if high DO in the aerated zones impacts the Bio P performance, the District may wish to consider reducing the DO setpoints in the aeration tanks and modifying the operation of the post-aeration facility to increase DO just prior to discharge.
- Design zone baffle walls to limit the amount of back mixing of high DO MLSS from aerated to anaerobic zones.
- Manage RAS rates to minimize unnecessary DO and nitrate return to the anaerobic zone.
- Avoid over aeration of wastewater feed channels and RAS return channels.
- Provide adequate instrumentation and control to evaluate the operating conditions and performance of the Bio P system.

A.2.7.6 Operational Difficulties and Challenges

Some facilities that implement Bio P experience operational challenges despite the similarities with nitrification and other BNR plant configurations. The District staff should be aware of the following potential operational difficulties and challenges that can result from full scale Bio P process operations:

- Over-optimization for P removal with Bio P has the potential for compromising other plant process performance goals. Optimization for P removal should be carried out in balance with other processes performance considerations.
- Recovery from upsets when optimizing for Bio P can be more challenging. It may become harder to mitigate foaming episodes, filament growth, and high sludge volume index (SVI) while operating for optimized Bio P.
- Competition from glycogen accumulating organisms (GAOs) must be managed. GAOs consume VFAs (inhibiting PAO growth), but do not uptake, store, and release phosphorus like the PAOs.
- PAOs uptake P under aerobic conditions and release P under anaerobic conditions. Operational caution must be taken to avoid "secondary P release" from phosphorus rich PAOs. Secondary P release can occur in channels, clarifiers, and piping and equipment having anaerobic conditions.
- Effluent TP is a combination of effluent soluble P (ortho-phosphate) and the P bound in the effluent TSS. If a plant upset episode occurs that increases effluent TSS, the effluent TP may also increase. Currently the Kirie WRP uses dual final clarifiers in series without filtration. Dual clarification results in low effluent TSS. If dual clarification is compromised and effluent TSS rises, it will impact P optimization.

- If calcium nitrate or other oxidizing compounds are added to the raw wastewater for odor and corrosion control, monitoring of the calcium nitrate dosage and effluent soluble P concentration may be required. These oxidizing agents can reduce the BOD_5 in the wastewater. Significant decrease in BOD_5 concentrations can decrease the BOD_5:TP ratio and the amount of carbon available for Bio P. The residual nitrate can also impact the P release efficiency in the anaerobic zones affecting Bio P process performance.
- Higher degree of process monitoring and control may be required to maintain the effectiveness of Bio P process, and avert potential plant upsets.
- For some facilities, additional data collection, laboratory analysis, and/or instrumentation control is required for improved operational control of Bio P. Online instrumentation to monitor ORP, sludge blanket levels may be desirable. Lab analysis and monitoring of data relating to VFAs, ortho-P at several places in the process including MLSS, clarified effluent, filtered effluent etc. may be important. Trending of P vs. other operating parameters such as DO, aerobic SRT, total SRT, MLSS concentration, and BOD_5:TP ratios can help support improved operations. Additional microscopic analysis may also be helpful for better process control.
- Additional monitoring of DO and management of setpoints may be warranted to optimize DO control. Management of DO concentrations in the last pass of aeration tanks may improve Bio P performance and efficiency.

A.2.7.7 Process Monitoring, Automation, and I&C System Improvements

Additional data monitoring and instrumentation can assist in improved Bio P control. If the District is required to meet numeric permit limits for effluent TP of 1.0 mg/L, 0.5 mg/L, or 0.1 mg/L, additional instrumentation such as ORP may be recommended to improve process monitoring and control.

A.2.7.7.1 Data Collection and Monitoring

The Kirie WRP staff currently collects sufficient data for plant operations. Continuing to collect the following information will help the District prepare for future Bio P system design and operations:

- Influent and effluent TP (Daily and 30 day moving average).
- Influent BOD_5 to TP ratios (Daily and 30 day moving average).
- Number of anaerobic zones in service.
- End of aeration tank DO vs. effluent TP.
- Aeration tank MLSS vs effluent TP.
- RAS rate vs. effluent TP.
- Anaerobic zone ORP vs. effluent TP.
- Anaerobic Zone ORP vs. end of aeration tank DO.

A.2.7.7.2 Instrumentation and Control Systems

Some agencies that operate Bio P facilities use online ORP meters to monitor the condition of the anaerobic zones. The anaerobic zone should operate in highly reducing conditions. The proper environment for phosphorus release in an anaerobic zone is indicated by a negative ORP value typically ranging from - 100 millivolt (mV) to - 250 mV. An ORP on the high side of the range can indicate inefficient P release due to nitrate or oxygen poisoning of the zone. It is

typically not necessary to monitor ORP in every anaerobic zone and every aeration tank where plant operations are generally consistent throughout.

A.2.8 Estimation of Capital, O&M, and Life Cycle Cost Estimates

A planning-level cost estimate was developed for the recommended improvements to meet tiered effluent TP limits at both current flows and DAF rated capacity. The planning level 4 cost estimate has an expected accuracy range of -30 percent to +50 percent[2] according to the American Association of Cost Engineers International (AACEI).

The following contingencies were applied:

- Estimating Contingency – 30 percent to cover the unknown elements associated with a planning level analysis.
- General Conditions – 10 percent to account for the field overhead costs that are incurred by the contractor, project initiation costs such as bonds and insurance, mobilization, demobilization, and the contractor's temporary facilities, and project close out costs such as testing, start-up, commissioning, and project site supervision.
- General Contractor Overhead – 10 percent to account for the cost of the contractor's home office operations, including the administration of subcontracts.
- General Contractor Profit – 10 percent.
- Construction Contingency – 5 percent to reflect the potential cost of work changes due to unforeseen conditions or other adjustments in the field.
- Engineering, Legal and Administration – 30 percent to account for the cost of District and consultant staff associated with the preliminary and final design of the improvements and the construction management and other administration costs.

The basis of the cost for the recommended improvements is listed below:

- **Zone Baffle Walls:** Installation of two concrete zone baffle walls in the first pass of each aeration tank. Cost for the removal of temporary baffle walls in aeration tanks 5 and 6 was also included. Note that the cost for the removal of the temporary baffle walls in aeration tank 6 have already been realized due to their premature removal resulting from failure. For current flows 12 new walls in 6 aeration tanks will be constructed. For DAF rated capacity 8 additional walls in 4 Battery B aeration tanks will be constructed.
- **Large Bubble Mixers:** Installation of large bubble mixing systems in the anaerobic zones and swing zones of all the aeration tanks in service. For current flows, 10 large bubble mixing zones will be installed across the 6 aeration tanks. The cost did not include the 2 large bubble mixing systems already installed in the two anaerobic zones of basin 5 and 6 under the Bio P testing program. For DAF rated capacity, 8 additional large bubble mixing zones will be installed in 4 Battery B aeration tanks.
- **1st Pass Aeration Diffusers:** Installation of membrane aeration diffusers in the swing zone and aerobic zone, in the first pass of each aeration tank. For current flows, 12 membrane diffuser zones will be installed in 6 aeration tanks. For DAF rated capacity, 8 additional membrane diffuser zones will be installed in 4 Battery B aeration tanks.

[2] American Association of Cost Engineers International Recommended Practices, No. 18R-97.

- **Globe Valves:** Installation of electrically actuated air supply control valves to each of the four aeration air drop legs serving the swing zones, in the first pass of each aeration tank. For current flows, 24 total actuated globe valves will be installed in 6 aeration tanks. For DAF rated capacity, 16 additional actuated globe valves will be installed in 4 Battery B aeration tanks.
- **Chemical Storage Area and Tanks:** Installation of two double-walled 8,000 gallons chemical storage tanks in a newly constructed chemical containment room inside the filter building. This cost will remain the same for both current flows and DAF rated capacity.
- **Chemical Piping:** Installation of double-walled, 2-inch PVC piping to connect the chemical dosage points to the chemical feed pumps. Flash mixing at each chemical dosing location was also included. This cost will remain the same for both current flows and DAF rated capacity.
- **Additional Bio P and Chem P Monitoring:** Incorporation of Bio P and Chem P processes will increase P monitoring costs in order to monitor and control the processes. These costs will remain the same for both current flows and rated capacity.
- **Chemical Feed Pumps:** For different tiered effluent TP limits the cost of the pump skids and the annual cost of ferric chloride varies. The capital cost of the chemical pumps and the annual cost of ferric chloride were calculated for each tier limit. The capital cost for both current and rated flows will remain the same while the O&M cost differs.
- **New Tertiary Filters:** For current flows, installation of new disc filters was included for the Tier 3 effluent TP limit. For DAF rated capacity, installation of new disc filters was included for all tier limits. The cost of tertiary filters for Tier 3 (0.1 mg/L) is higher than Tier 1 and Tier 2 because of the reduced hydraulic loading rates of the filters at an effluent TP of 0.1 mg/L.
- **Optional Rehabilitation of Existing Tertiary Filters:** The largest cost component to meet effluent TP at the Kirie WRP is new tertiary filters. The cost of new disc filters is anticipated to range from $42 million to $53 million. Rehabilitation of the existing dual media filters (anthracite and sand) was estimated at approximately $36 million. This cost estimate includes rehabilitation of filter building, filter boxes, mechanical pumping and piping, and HVAC. Further analysis of constructing new cloth disc filters versus rehabilitation of existing filters should be conducted before deciding on the final filter selection to meet TP limits.

Additional monitoring equipment, such as additional ORP probes, was not included in the cost estimates as the Kirie WRP currently has 10 probes. Additional P monitoring laboratory testing costs of $180/day for Bio P and Chem P processes was included. A quality control cost for receiving of ferric shipments of $55/per truck was included for testing the ferric strength and purity.

In order to put the cost estimates below in perspective, the estimated 2018 cost for collection and treatment of wastewater based on the approved 2018 Budget for Kirie WRP was $6,098,450, and for Egan WRP was $5,677,650.

A.2.8.1 Cost Estimate at Current Flows

Table A.2.13 presents the estimated capital improvements cost, annual O&M cost, estimated 20 year Net Present Value (NPV) of the O&M costs, and the total life cycle costs for each unit process component at current flows. The estimated capital improvement costs represent the total project cost including the material, labor, installation, and contingencies. The annual O&M cost consists of power, chemical, maintenance and replacement costs for major equipment. The total life cycle cost is the sum of the estimated capital improvements and the 20 year NPV of the O&M costs.

A detailed cost estimate for current flows is presented in Appendix A.2-C.

Table A.2.13 Estimated Cost Summary for Each Unit Process Component at Current Flows (as of September 2018)

Item No.	Description	Estimated Capital Improvements(1)	Estimated Annual O&M Cost	Estimated 20 Year O&M NPV	Total Life Cycle Cost(1)
1	Baffle Walls	$1,239,000	$0	$0	$1,239,000
2	Large Bubble Mixers	$1,152,000	$47,030	$940,603	$2,092,603
3	1st Pass Aeration Diffusers	$633,000	$25,368	$507,350	$1,140,350
4	Globe Valves	$364,000	$7,280	$145,600	$509,600
5	Chemical Storage Area and Tanks	$801,000	$0	$0	$801,000
6	Chemical Feed Piping	$1,814,000	$0	$0	$1,814,000
7	Additional Bio P and Chem P Monitoring	$0	$65,700	$1,314,000	$1,314,000
8a	Chemical Pumps and Dosage - Tier 1	$393,000	$9,370	$298,991	$691,991
8b	Chemical Pumps and Dosage - Tier 2	$473,000	$17,588	$460,359	$933,359
8c	Chemical Pumps and Dosage - Tier 3	$629,000	$217,670	$4,623,407	$5,252,407
9	Tertiary Filtration (Tier 3)	$52,657,000	$295,098	$5,901,967	$58,558,967

Notes:
(1) These costs include the following contingencies: Estimating Contingency (30%); General Conditions (10%); General Contractor Overhead (10%); General Contractor Profit (10%); Construction Contingency (5%); Engineering, Legal and Administration (30%).

Table A.2.14 presents a comparison of total costs for each tiered effluent TP limit at current flows.

Table A.2.14 Comparison of Total Costs for Each Tiered Effluent TP Limit at Current Flows (as of September 2018)

Item No.	Description	Estimated Capital Improvements(1)	Estimated Annual O&M Cost	Estimated 20 Year O&M NPV	Total Life Cycle Cost(1)
1	Total Costs for **Tier 1** Effluent TP Limit	$6,396,000	$154,747	$3,206,544	$9,602,544
2	Total Costs for **Tier 2** Effluent TP Limit	$6,476,000	$162,966	$3,367,912	$9,843,912
3	Total Costs for **Tier 3** Effluent TP Limit	$59,289,000	$658,146	$13,432,927	$72,721,927

Notes:
(1) These costs include the following contingencies: Estimating Contingency (30%); General Conditions (10%); General Contractor Overhead (10%); General Contractor Profit (10%); Construction Contingency (5%); Engineering, Legal and Administration (30%).

Figure A.2.28 presents the graphical comparison between the estimated costs for tiered effluent TP limits at current flows.

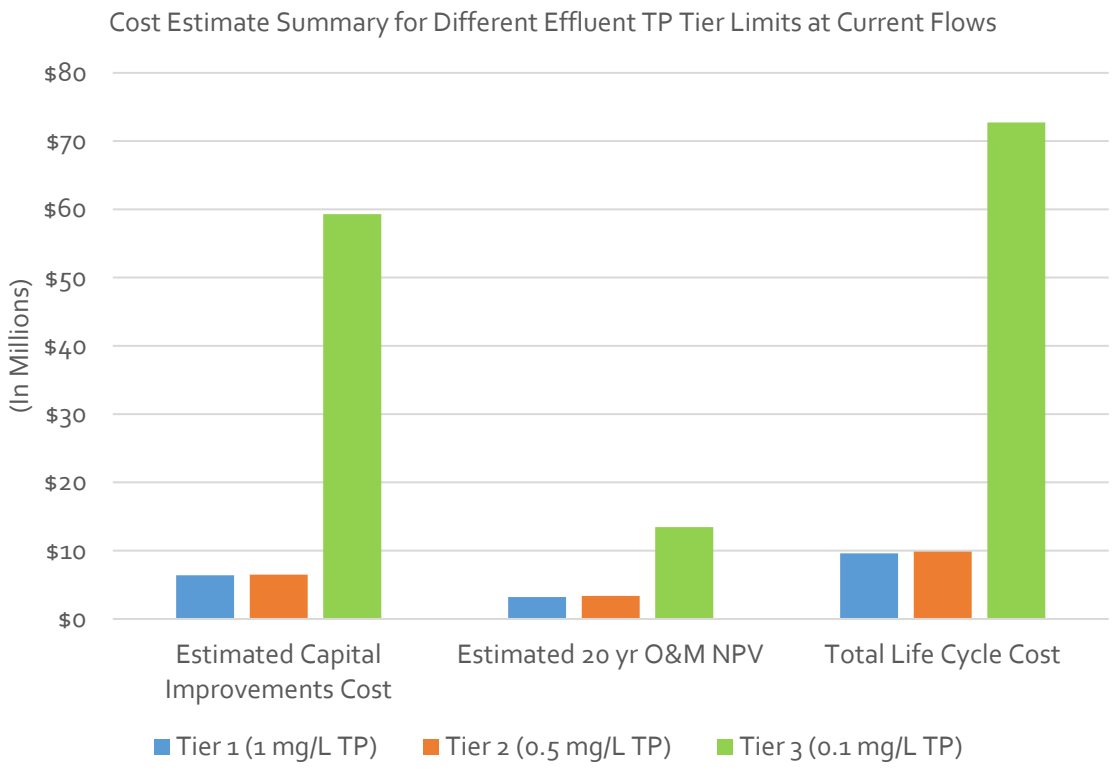

Figure A.2.28 Estimated Cost Summary for Tiered Effluent TP Limits at Current Flows (as of September 2018)

A.2.8.2 Cost Estimate at DAF Rated Capacity

Table A.2.15 presents the estimated capital improvements cost, annual O&M cost, estimated 20 year NPV of the O&M costs, and the total life cycle costs for each unit process component at DAF rated capacity.

Table A.2.15 Estimated Cost Summary for Each Unit Process Component at DAF Rated Capacity (as of September 2018)

Item No.	Description	Estimated Capital Improvements(1)	Estimated Annual O&M Cost	Estimated 20 Year O&M NPV	Total Life Cycle Cost(1)
1	Baffle Walls	$2,009,000	$0	$0	$2,009,000
2	Large Bubble Mixers	$2,031,000	$77,854	$1,557,086	$3,588,086
3	1st Pass Aeration Diffusers	$1,056,000	$38,813	$776,250	$1,832,250
4	Globe Valves	$605,000	$12,100	$242,000	$847,000
5	Chemical Storage Area and Tanks	$801,000	$0	$0	$801,000
6	Chemical Feed Piping	$1,814,000	$0	$0	$1,814,000
7	Additional Bio P and Chem P Monitoring	$0	$65,700	$1,314,000	$1,314,000
8a	Chemical Pumps and Dosage - Tier 1	$393,000	$11,472	$341,039	$734,039
8b	Chemical Pumps and Dosage - Tier 2	$473,000	$23,742	$583,447	$1,056,447
8c	Chemical Pumps and Dosage - Tier 3	$629,000	$200,839	$4,286,779	$4,915,779
9a, 9b	Tertiary Filtration (Tier 1 and Tier 2)	$42,128,000	$279,886	$5,597,722	$47,725,722
9b	Tertiary Filtration (Tier 3)	$52,657,000	$295,098	$5,901,967	$58,558,967

Notes:
(1) These costs include the following contingencies: Estimating Contingency (30%); General Conditions (10%); General Contractor Overhead (10%); General Contractor Profit (10%); Construction Contingency (5%); Engineering, Legal and Administration (30%).

Table A.2.16 presents the comparison of total costs for tiered effluent TP limits at DAF rated capacity.

Table A.2.16 Comparison of Total Costs for Tiered Effluent TP Limits at DAF Rated Capacity (as of September 2018)

Item No.	Description	Estimated Capital Improvements(1)	Estimated Annual O&M Cost	Estimated 20 year O&M NPV	Total Life Cycle Cost(1)
1	Total Cost for **Tier 1** Effluent TP Limit	$50,837,000	$485,825	$9,828,097	$60,665,097
2	Total Cost for **Tier 2** Effluent TP Limit	$50,917,000	$498,095	$10,070,505	$60,987,505
3	Total Cost for **Tier 3** Effluent TP Limit	$61,602,000	$690,404	$14,078,082	$75,680,082

Notes:
(1) These costs include the following contingencies: Estimating Contingency (30%); General Conditions (10%); General Contractor Overhead (10%); General Contractor Profit (10%); Construction Contingency (5%); Engineering, Legal and Administration (30%).

Figure A.2.29 presents the graphical comparison between the estimated costs for tiered effluent TP limits at DAF rated capacity.

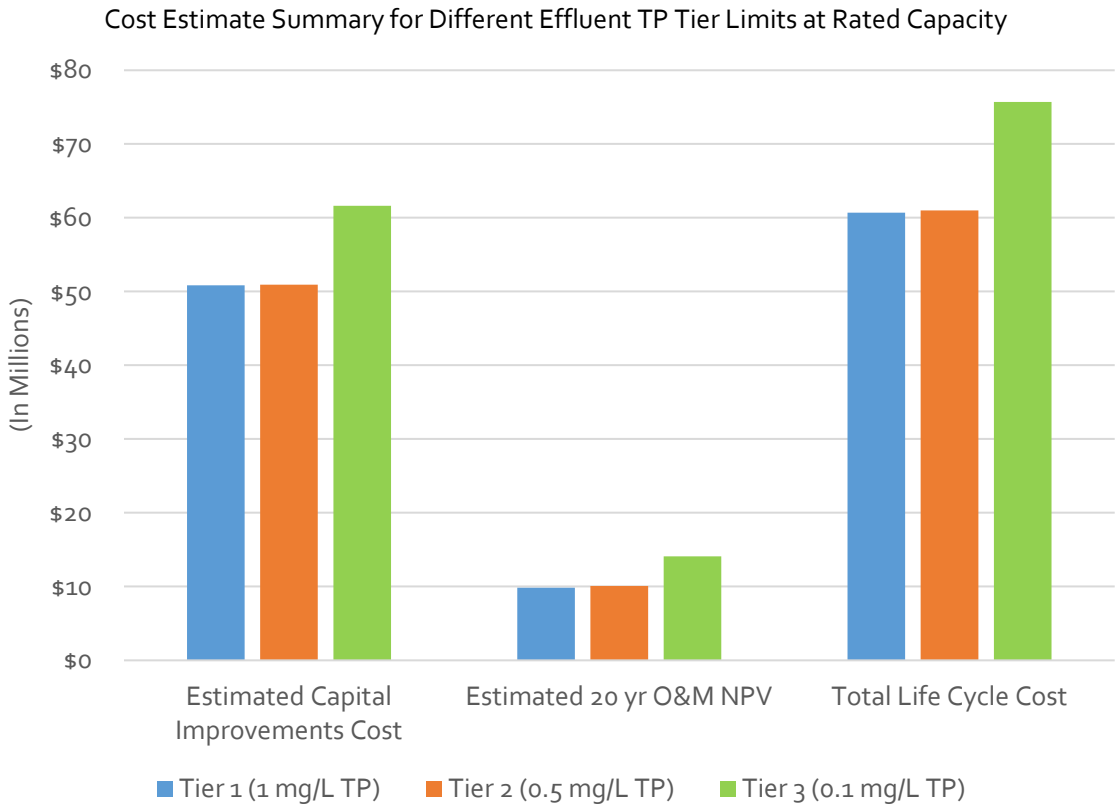

Figure A.2.29 Estimated Cost Summary for Tiered Effluent TP Limits at DAF Rated Capacity (as of September 2018)

A detailed cost estimate for DAF rated capacity is presented in Appendix A.2-D.

A.2.9 Summary of P Removal Feasibility Study Conclusions and Recommendations

The following summarizes the conclusions and recommendations of the P Feasibility Study for Kirie WRP:

- The A/O process is the simplest configuration to achieve complete nitrification and Bio P removal at Kirie WRP. The A/O process has been successfully used at Kirie WRP for Bio P testing and was also recommended as part of the Optimization Study.
- A modified A/O process with external RAS denitrification was evaluated for Bio P performance. The predicted improvement in Bio P performance was less than 0.1 mg/L TP. Therefore, a modified A/O process was not further considered as an option for enhanced Bio P removal at the Kirie WRP.
- The A/O process with external or internal dedicated anaerobic tanks in lieu of activating Battery B aeration tanks was evaluated. Due to limited hydraulic head, the use of internal or external anaerobic tanks was not feasible at the Kirie WRP.
- Construction of additional aeration and settling tanks south of Battery A in lieu of activating Battery B aeration tanks was not further considered as part of this Feasibility Study. New aeration and settling tanks are prohibitively expensive compared to rehabilitation and use of existing aeration tanks and cannot be justified.
- High-rate treatment processes such as BioMag, IFAS, ZeeLung were not evaluated as part of this Feasibility Study. These intensified processes are commonly more expensive than the A/O process. As the A/O process has shown good Bio P performance at the Kirie WRP and can meet anticipated future effluent TP criteria, the higher capital investments associated with intensified high-rate treatment processes was not warranted.
- At current flows, compliance with Tier 1 and Tier 2 effluent TP limits requires modification of six aeration tanks to provide 2/3rd volume of the first pass for anaerobic zone. Tertiary filtration will not be required as dual clarification provides compliant effluent TSS.
- At current flows, compliance with Tier 3 effluent TP limit of 0.1 mg/L requires modification of six aeration tanks to provide 2/3rd volume of the first pass for anaerobic zone. Tertiary filtration is required to remove particulate P bound in TSS.
- At DAF rated capacity, compliance with Tier 1, 2, and 3 effluent TP limits requires modification of ten aeration tanks to provide 2/3rd volume of the first pass for anaerobic zone. This includes use of 6 aeration tanks in Battery A and 4 aeration tanks in Battery B. Tertiary filtration is required for all effluent TP Tier limits as dual clarification will be discontinued.
- Chem P is recommended for both current and future flows and all tiered effluent TP limits in order to supplement Bio P and provide protection against TP excursions. The only difference between the three effluent TP tier limits is a higher chemical demand as effluent requirements become more stringent and averaging periods become shorter.

- Unintended consequences and operational challenges associated with implementation of Bio P may occur at the Kirie WRP. These include biosolids handling impacts, potential scale formation, increased energy costs, plant operational difficulties, and additional O&M challenges. Based on several years of operations under a Bio P test mode, these consequences and challenges are not anticipated to be significant. However, the District's M&O staff should be aware of potential impacts of operating the Kirie WRP as a Bio P process and manage those as necessary for success. Some of the impacts of Bio P operations may be transferred to the Egan WRP through the combined solids handling systems. With P removal at increased flows in the future, solids handling processes and sludge transmission via pipeline should be evaluated in more detail.
- Cost estimates to meet the tiered effluent TP limits at both current flows and rated capacity were generated, assuming a monthly averaging period.

Appendix A.2-A

KIRIE WRP NPDES PERMIT NO. IL0047741

NPDES Permit No. IL0047741

Illinois Environmental Protection Agency

Division of Water Pollution Control

1021 North Grand Avenue East

Post Office Box 19276

Springfield, Illinois 62794-9276

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

Modified (NPDES) Permit

Expiration Date: July 31, 2026

Issue Date: July 28, 2021
Effective Date: August 1, 2021
Modification Date: September 10, 2021
2nd Modification Date: April 07, 2022

Name and Address of Permittee:

Metropolitan Water Reclamation District of Greater Chicago
100 East Erie Street
Chicago, Illinois 60611

Facility Name and Address:

MWRDGC - James Kirie WRP
701 West Oakton Street
Des Plaines, Illinois 60018
(Cook County)

Receiving Waters: Higgins Creek

In compliance with the provisions of the Illinois Environmental Protection Act, Title 35 of the Ill. Adm. Code, Subtitle C, Chapter I, and the Clean Water Act (CWA), the above named Permittee is hereby authorized to discharge at the above location to the above named receiving stream in accordance with the Effluent Limitations, Monitoring, and Reporting requirements; Special Conditions and Standard Conditions attached herein.

Permittee is not authorized to discharge after the above expiration date. In order to receive authorization to discharge beyond the expiration date, the Permittee shall submit the proper application as required by the Illinois Environmental Protection Agency (IEPA) not later than 180 days prior to the expiration date.

Darin E. LeCrone, P.E.
Manager, Permit Section
Division of Water Pollution Control

DEL:JAR:21092201

 Modification Date: April 07, 2022

NPDES Permit No. IL0047741

Effluent Limitations, Monitoring, and Reporting

FINAL

Discharge Number(s) and Name(s): 001 WRP Main Outfall

Load limits computed based on a design average flow (DAF) of 52 MGD.

From the modification date of this Permit until the expiration date, the effluent of the above discharge(s) shall be monitored and limited at all times as follows, providing monthly average flows are 52 MGD or less. For monthly average flows greater than 52 MGD see page 4.

Parameter	LOAD LIMITS lbs/day DAF Monthly Average	Weekly Average	Daily Maximum	CONCENTRATION LIMITS MG/L Monthly Average	Weekly Average	Daily Maximum	Sample Frequency	Sample Type
Flow (MGD)							Continuous	
$CBOD_5$*' ***	1735		8674	4		20	3 Days/Week	Composite
Suspended Solids***	2168		10408	5		24	3 Days/Week	Composite
pH	Shall be in the range of 6 to 9 Standard Units						5 Days/Week	Grab
Fecal Coliform**	Monthly geometric mean shall not exceed 200 per 100 mL, nor shall more than 10% of the samples during the month exceed 400 per 100 mL; 605,702 million coliform per day. (May through October)						5 Days/Week	Grab
Chlorine Residual**						0.038	5 Days/Week	Grab
Ammonia Nitrogen: (as N)								
March-May/Sept.-Oct.	911	2255	3383	2.1	5.2	7.8	5 Days/Week	Composite
June-August	694	1735	4814	1.6	4.0	11.1	5 Days/Week	Composite
Nov.-Feb.	1735	----	3643	4.0	----	8.4	5 Days/Week	Composite
Chloride	Monitor Only						1 Day/Week	Composite
Total Nitrogen (as N)	Monitor Only						1 Day/Week	Composite
Total Phosphorus (as P)****	434			1.0			5 Days/Week	Composite
TOC	Report						*	Composite
Dissolved Phosphorus	Monitor Only						1 Day/Month	Composite
Nitrate/Nitrite	Monitor Only						1 Day/Month	Composite
Total Kjeldahl Nitrogen	Monitor Only						1 Day/Month	Composite
Alkalinity	Monitor Only						1 Day/Month	Grab
Specific Conductivity	Monitor Only						1 Day/Month	Grab
Temperature	Monitor Only						1 Day/Month	Single Reading
				Monthly Average not less than	Weekly Average not less than	Daily Minimum		
Dissolved Oxygen								
March - July				N/A	6.0	5.0	5 Days/Week	Grab
August - February				5.5	4.0	3.5	5 Days/Week	Grab

*Carbonaceous BOD_5 ($CBOD_5$) or total organic carbon (TOC) may be measured to comply with $CBOD_5$. Testing shall be in accordance with 40 CFR 136. If TOC is measured, TOC shall be sampled 3 days per week and reported on the DMR as a monthly average and daily maximum. The TOC results shall be converted to $CBOD_5$ using the equation, Log $CBOD_5$ = Log TOC*1.60-1.14, and reported on the DMR as $CBOD_5$.

**See Special Conditions 8 and 29. During those months in which no chlorine is used, the Permittee is required to report on DMRs "No Chlorine Used".

***BOD_5 and Suspended Solids (85% removal required): In accordance with 40 CFR 133, the 30-day average percent removal shall not be less than 85 percent. The percent removal need not be reported to the IEPA on DMRs but influent and effluent data must be used for this calculation and available, as required elsewhere in this Permit, for IEPA inspection and review. For measuring compliance with

this requirement, 5 mg/L shall be added to the effluent $CBOD_5$ concentration to determine the effluent BOD_5 concentration, BOD_5 may be measured directly, or TOC may be measured and converted to BOD_5 using the equation Log BOD_5 = Log TOC*1.67-1.12. Percent removal is a percentage expression of the removal efficiency across a treatment plant for a given pollutant parameter, as determined from the 30-day average values of the raw wastewater influent concentrations to the facility and the 30-day average values of the effluent pollutant concentrations for a given time period.
****See Special Condition 20.

Flow shall be reported on the Discharge Monitoring Report (DMR) as monthly average and daily maximum.
Fecal Coliform shall be reported on the DMR as a monthly geometric mean and as a percentage of samples exceeding 400 per 100 mL.
pH shall be reported on the DMR as minimum and maximum value.
Chlorine Residual shall be reported on DMR as daily maximum value.
Dissolved oxygen shall be reported on the DMR as a minimum value.
Total Nitrogen shall be reported on the DMR as a monthly average and daily maximum value. Total Nitrogen is the sum total of Total Kjeldahl Nitrogen, Nitrate, and Nitrite.
Total Phosphorus shall be reported on the DMR as a monthly average and daily maximum value.
Chloride shall be monitored 1 day per week from December through April and reported on the DMR as a monthly average and daily maximum value.

NPDES Permit No. IL0047741

Effluent Limitations, Monitoring, and Reporting

FINAL

Discharge Number(s) and Name(s): 001 WRP Main Outfall

Load limits computed based on a design average flow (DAF) of 52 MGD (design maximum flow (DMF) of 110 MGD).

From the modification date of this Permit until the expiration date, the effluent of the above discharge(s) shall be monitored and limited at all times as follows, providing monthly average flows are greater than 52 MGD.

	LOAD LIMITS lbs/day DAF (DMF)*			CONCENTRATION LIMITS MG/L				
Parameter	Monthly Average	Weekly Average	Daily Maximum	Monthly Average	Weekly Average	Daily Maximum	Sample Frequency	Sample Type
Flow (MGD)							Continuous	
$CBOD_5$**' ****	4337 (9174)		8674 (18348)	10		20	3 Days/Week	Composite
Suspended Solids****	5204 (11009)		10408 (22018)	12		24	3 Days/Week	Composite
pH	Shall be in the range of 6 to 9 Standard Units						5 Days/Week	Grab
Fecal Coliform***	Monthly geometric mean shall not exceed 200 per 100 mL, nor shall more than 10% of the samples during the month exceed 400 per 100 mL; 605,702 million coliform per day (832,841 million coliform per day). (May through October)						5 Days/Week	Grab
Chlorine Residual***						0.038	5 Days/Week	Grab
Ammonia Nitrogen: (as N)								
March-May/Sept.-Oct.	911 (1927)	2255 (4771)	3383 (7156)	2.1	5.2	7.8	5 Days/Week	Composite
June-August	694 (1468)	1735 (3670)	4814 (10183)	1.6	4.0	11.1	5 Days/Week	Composite
Nov.-Feb.	1735 (3670)	----	3643 (7706)	4.0	----	8.4	5 Days/Week	Composite
Chloride	Monitor Only						1 Day/Week	Composite
Total Nitrogen (as N)	Monitor Only						1 Day/Week	Composite
Total Phosphorus (as P)*****	434 (917)			1.0			5 Days/Week	Composite
TOC	Report						**	Composite
Dissolved Phosphorus							1 Day/Month	Composite
Nitrate/Nitrite							1 Day/Month	Composite
Total Kjeldahl Nitrogen							1 Day/Month	Composite
Alkalinity							1 Day/Month	Grab
Specific Conductivity							1 Day/Month	Grab
Temperature							1 Day/Month	Single Reading
				Monthly Average not less than	Weekly Average not less than	Daily Minimum		
Dissolved Oxygen				N/A	6.0	5.0	5 Days/Week	Grab
March - July				5.5	4.0	3.5	5 Days/Week	Grab
August - February								

*Load limits based on design maximum flow shall apply only when flow exceeds design average flow.

**Carbonaceous BOD_5 ($CBOD_5$) or total organic carbon (TOC) may be measured to comply with $CBOD_5$. Testing shall be in accordance with 40 CFR 136. If TOC is measured, TOC shall be sampled 3 days per week and reported on the DMR as a monthly average and daily maximum. The TOC results shall be converted to $CBOD_5$ using the equation, Log $CBOD_5$ = Log TOC*1.60-1.14, and reported on the DMR as $CBOD_5$.

***See Special Conditions 8 and 29. During those months in which no chlorine is used, the Permittee is required to report on DMRs "No Chlorine Used".

****BOD_5 and Suspended Solids (85% removal required): In accordance with 40 CFR 133, the 30-day average percent removal shall not be less than 85 percent. The percent removal need not be reported to the IEPA on DMRs but influent and effluent data must be

used for this calculation and available, as required elsewhere in this Permit, for IEPA inspection and review. For measuring compliance with this requirement, 5 mg/L shall be added to the effluent $CBOD_5$ concentration to determine the effluent BOD_5 concentration, BOD_5 may be measured directly, or TOC may be measured and converted to BOD_5 using the equation Log BOD_5 = Log TOC*1.67-1.12. Percent removal is a percentage expression of the removal efficiency across a treatment plant for a given pollutant parameter, as determined from the 30-day average values of the raw wastewater influent concentrations to the facility and the 30-day average values of the effluent
pollutant concentrations for a given time period.
*****See Special Condition 20.

Flow shall be reported on the Discharge Monitoring Report (DMR) as monthly average and daily maximum.
Fecal Coliform shall be reported on the DMR as a monthly geometric mean and as a percentage of samples exceeding 400 per 100 mL.
pH shall be reported on the DMR as minimum and maximum value.
Chlorine Residual shall be reported on DMR as daily maximum value.
Dissolved oxygen shall be reported on the DMR as a minimum value.
Total Nitrogen shall be reported on the DMR as a monthly average and daily maximum value. Total Nitrogen is the sum total of Total Kjeldahl Nitrogen, Nitrate, and Nitrite.
Total Phosphorus shall be reported on the DMR as a monthly average and daily maximum value.
Chloride shall be monitored 1 day per week from December through April and reported on the DMR as a monthly average and daily maximum value.

NPDES Permit No. IL0047741

Effluent Limitations, Monitoring, and Reporting

FINAL

Discharge Number(s) and Name(s): 111 CSO at Central Road

From the modification date of this Permit until the expiration date, the effluent of the above discharge(s) shall be monitored and limited at all times as follows:

Parameter		CONCENTRATION LIMITS mg/L Monthly Average	Daily Maximum	Sample Frequency*	Sample Type
Total Flow (MG)	See Below			Daily	
BOD_5**		Report		Daily When Discharging	Grab
Suspended Solids		Report		Daily When Discharging	Grab
Fecal Coliform		Report	Report	Daily When Discharging	Grab
TOC		Report	Report	**	Grab

Occurrence date of discharge(s) shall be reported as the Discharge Monitoring Report (DMR), with estimation of discharge duration.

Report the number of days of discharge in the comments section of the DMR.

BOD_5 and Suspended Solids shall be reported on the DMR as a monthly average concentration.

Fecal Coliform shall be reported on the DMR as a monthly geometric mean and daily maximum value.

*If the CSO duration is too short to allow for sampling logistics, then specify so on the DMR.

**BOD_5 or total organic carbon (TOC) may be measured to comply with BOD_5. Testing shall be in accordance with 40 CFR 136. If TOC is measured, the results shall be converted to BOD_5 using the equation, Log BOD_5 = Log TOC*1.67-1.12, and reported on the DMR as BOD_5. The TOC data shall also be reported on the DMR as a monthly average and sampled daily when discharging if used to comply with BOD_5.

NPDES Permit No. IL0047741

Influent Monitoring, and Reporting

The influent to the plant shall be monitored as follows:

Parameter	Sample Frequency	Sample Type
Flow (MGD)	Continuous	
BOD_5*	3 days/week	Composite
Suspended Solids	3 days/week	Composite
Total Phosphorus (as P)	5 days/week	Composite
Total Nitrogen (as N)	1 day/week	Composite
TOC	*	Composite

Influent samples shall be taken at a point representative of the influent.

Flow (MGD) shall be reported on the Discharge Monitoring Report (DMR) as monthly average and daily maximum.

BOD_5 and Suspended Solids shall be reported on the DMR as a monthly average concentration.

Total Phosphorus shall be reported on the DMR as a monthly average and daily maximum value.

Total Nitrogen shall be reported on the DMR as a monthly average and daily maximum value. Total Nitrogen is the sum total of Total Kjeldahl Nitrogen, Nitrate, and Nitrite.

*BOD_5 or total organic carbon (TOC) may be measured to comply with BOD_5. Testing shall be in accordance with 40 CFR 136. If TOC is measured, the results shall be converted to BOD_5 using the equation, Log BOD_5 = Log TOC*1.67-1.12, and reported on the DMR as BOD_5. The TOC data shall also be reported on the DMR as a monthly average and sampled 3 days per week if used to comply with BOD_5.

Special Conditions

SPECIAL CONDITION 1. This Permit may be modified to include different final effluent limitations or requirements which are consistent with applicable laws and regulations. The IEPA will public notice the permit modification.

SPECIAL CONDITION 2. The use or operation of this facility shall be by or under the supervision of a Certified Class 1 operator.

SPECIAL CONDITION 3. The IEPA may request in writing submittal of operational information in a specified form and at a required frequency at any time during the effective period of this Permit.

SPECIAL CONDITION 4. The IEPA may request more frequent monitoring by permit modification pursuant to 40 CFR § 122.63 and Without Public Notice.

SPECIAL CONDITION 5. The effluent, alone or in combination with other sources, shall not cause a violation of any applicable water quality standard outlined in 35 Ill. Adm. Code 302.

SPECIAL CONDITION 6. Samples taken in compliance with the effluent monitoring requirements shall be taken at a point representative of the discharge, but prior to entry into the receiving stream.

SPECIAL CONDITION 7. This Permit may be modified to include requirements for the Permittee on a continuing basis to evaluate and detail its efforts to effectively control sources of infiltration and inflow into the sewer system and to submit reports to the IEPA if necessary.

SPECIAL CONDITION 8. Fecal Coliform limits for Discharge Number 001 are effective May thru October. Sampling of Fecal Coliform is only required during this time period.

The total residual chlorine limit is applicable at all times. If the Permittee is chlorinating for any purpose during the months of November through April, sampling is required on a daily grab basis. Sampling frequency for the months of May through October shall be as indicated on effluent limitations, monitoring and reporting page of this Permit.

SPECIAL CONDITION 9.

A. Publicly Owned Treatment Works (POTW) Pretreatment Program General Provisions

1. The Permittee shall implement and enforce its approved Pretreatment Program which was approved on June 19, 1985 and all approved subsequent modifications thereto. The Permittee shall maintain legal authority adequate to fully implement the Pretreatment Program in compliance with Federal (40 CFR 403), State, and local laws and regulations. All definitions in this section unless specifically otherwise defined in this section, are those definitions listed in 40 CFR 403.3. USEPA Region 5 is the Approval Authority for the administration of pretreatment programs in Illinois. The Permittee shall:

   a. Develop and implement procedures to ensure compliance with the requirements of a pretreatment program as specified in 40 CFR 403.8 (f)(2).

   b. Carry out independent inspection and monitoring procedures at least once per year, which will determine whether each significant industrial user (SIU) is in compliance with applicable pretreatment standards;

   c. Evaluate whether each SIU needs a slug control plan or other action to control slug discharges. If needed, the SIU slug control plan shall include the items specified in 40 CFR 403.8(f)(2)(vi). For IUs identified as significant prior to November 14, 2005, this evaluation must have been conducted at least once by October 14, 2006; additional SIUs must be evaluated within 1 year of being designated an SIU;

   d. Update its inventory of Industrial Users (IUs) at least annually and as needed to ensure that all SIUs are properly identified, characterized, and categorized;

   e. Receive and review self monitoring and other IU reports to determine compliance with all pretreatment standards and requirements, and obtain appropriate remedies for noncompliance by any IU with any pretreatment standard and/or requirement;

   f. Investigate instances of noncompliance, collect and analyze samples, and compile other information with sufficient care as to produce evidence admissible in enforcement proceedings, including judicial action;

   g. Require development, as necessary, of compliance schedules by each industrial user to meet applicable pretreatment standards; and,

   h. Maintain an adequate revenue structure and staffing level for continued operation of the Pretreatment Program.

2. The Permittee shall issue/reissue permits or equivalent control mechanisms to all SIUs prior to expiration of existing permits or prior to commencement of discharge in the case of new discharges. The permits at a minimum shall include the elements listed in 40 CFR § 403.8(f)(1)(iii)(B).

3. The Permittee shall develop, maintain, and enforce, as necessary, local limits to implement the general and specific prohibitions in 40 CFR § 403.5 which prohibit the introduction of any pollutants which cause pass through or interference and the introduction of specific pollutants to the waste treatment system from any source of nondomestic discharge.

4. In addition to the general limitations expressed in Paragraph 3 above, applicable pretreatment standards must be met by all industrial users of the POTW. These limitations include specific standards for certain industrial categories as determined by Section 307(b) and (c) of the Clean Water Act, State limits, or local limits, whichever are more stringent.

Special Conditions

5. The USEPA and IEPA individually retain the right to take legal action against any industrial user and/or the POTW for those cases where an industrial user has failed to meet an applicable pretreatment standard by the deadline date regardless of whether or not such failure has resulted in a permit violation.

6. The Permittee shall establish agreements with all contributing jurisdictions, as necessary, to enable it to fulfill its requirements with respect to all IUs discharging to its system.

7. Unless already completed, the Permittee shall within six (6) months of the effective date of this Permit submit to USEPA and IEPA a proposal to modify and update its approved Pretreatment Program to incorporate Federal revisions to the general pretreatment regulations. The proposal shall include all changes to the approved program and the sewer use ordinance which are necessary to incorporate the revisions of the Pretreatment Streamlining Rule (which became effective on November 14, 2005), which are considered required changes, as described in the Pretreatment Streamlining Rule Fact Sheet 2.0: Required changes, available at:

   https://www.epa.gov/sites/production/files/2015-10/documents/pretreatment_streamlining_required_changes.pdf. This includes any necessary revisions to the Permittee's Enforcement Response Plan (ERP).

   a. The permittee will review and modify, as appropriate, its existing industrial pretreatment program to minimize combined sewer overflow impacts related to discharges to the collection system from non-domestic users. This review shall include: (1) An inventory of nondomestic discharges to the combined sewers system, focusing on those discharges with the greatest potential to impact CSOs (2) Assessment of the impact of these discharges on CSOs, and (3) Evaluation of feasible modifications to the pretreatment program to minimize CSO impacts, including the prohibition of batch discharges during wet weather events.

   b. The Permittee shall maintain all current pollution prevention (P2) activities with the Illinois Waste Management and Research Center (WMRC)/ University of Illinois Sustainable Technology Center (ISTC). Reports on pollution prevention activities shall be included in the annual pretreatment report submitted to the Agency.

8. The Permittee submitted a technical re-evaluation dated December 29, 2014 and an amended version dated August 31, 2017 which were approved by USEPA on December 18, 2017. The Permittee may revise the technical re-evaluation of its local limitations consistent with U.S. EPA's Local Limits Development Guidance (July 2004) and shall submit any proposed revisions to its local limits to IEPA and U.S. EPA Region 5 for review and approval. U.S. EPA Region 5 will request Permittee to submit the evaluation and any proposed revisions to its local limits on the spreadsheet "Region 5 Pretreatment Limit Spreadsheet Illinois/Indiana" found at: *https://www.epa.gov/npdes-permits/illinois-npdes-permits*. To demonstrate technical justification for new local industrial user limits or justification for retaining existing limits, the following information must be submitted to U.S. EPA:

   a. Total plant flow
   b. Domestic/commercial pollutant contributions for pollutants of concern
   c. Industrial pollutant contributions and flows
   d. Current POTW pollutant loadings, including loadings of conventional pollutants
   e. Actual treatment plant removal efficiencies, as a decimal (primary, secondary, across the wastewater treatment plant)
   f. Safety factor to be applied
   g. Identification of applicable criteria:
      i. NPDES permit conditions
         •Specific NPDES effluent limitations
         •Water-quality criteria
         •Whole effluent toxicity requirements
         •Criteria and other conditions for sludge disposal
      ii. Biological process inhibition
         •Nitrification
         •Sludge digester
      iii. Collection system problems
   h. The Permittee's sludge disposal methods (land application, surface disposal, incineration, landfill)
   i. Sludge flow to digester
   j. Sludge flow to disposal
   k. % solids in sludge to disposal, not as a decimal
   l. % solids in sludge to digester, not as a decimal
   m. Plant removal efficiencies for conventional pollutants
   n. If revised industrial user discharge limits are proposed, the method of allocating available pollutants loads to industrial users
   o. A comparison of maximum allowable headworks loadings based on all applicable criteria listed in g, above
   p. Pollutants that have caused:
      i. Violations or operational problems at the POTW, including conventional pollutants
      ii. Fires and explosions
      iii. Corrosion
      iv. Flow obstructions
      v. Increased temperature in the sewer system

vi. Toxic gases, vapors or fumes that caused acute worker health and safety problems
vii. Toxicity found through Whole Effluent Toxicity testing
viii. Inhibition

q. Pollutants designated as "monitoring only" in the NPDES permit
r. Supporting data, assumptions, and methodologies used in establishing the information a through q above

9. Modifications of your Pretreatment Program shall be submitted in accordance with 40 CFR § 403.18, which established conditions for substantial and non-substantial modifications. All requests should be sent in electronic format to r5npdes@epa.gov, Attention: NPDES Program Branch.

B. Reporting and Records Requirements

1. The Permittee shall provide an annual report briefly describing the permittee's pretreatment program activities over the previous calendar year. Permittees who operate multiple plants may provide a single report providing all plant-specific reporting requirements are met. Such report shall be submitted electronically no later than June 30th of each year to R5pretreatment@epa.gov with "IL0047741 Annual Report" as the subject of the email the and shall be in the format set forth in IEPA's POTW Pretreatment Report Package which contains information regarding:

   a. An updated listing of the Permittee's significant industrial users, indicating additions and deletions from the previous year, along with brief explanations for deletions. The list shall specify which categorical Pretreatment standards, if any, are applicable to each Industrial User.

   b. A descriptive summary of the compliance activities including numbers of any major enforcement actions, (i.e., administrative orders, penalties, civil actions, etc.), and the outcome of those actions. This includes an assessment of the compliance status of the Permittee's industrial users and the effectiveness of the Permittee's Pretreatment Program in meeting its needs and objectives.

   c. A description of all substantive changes made to the Permittee's Pretreatment Program. Changes which are "substantial modifications" as described in 40 CFR § 403.18(c) must receive prior approval from the USEPA.

   d. Results of sampling and analysis of POTW influent, effluent, and sludge.

   e. A summary of the findings from the priority pollutants sampling. As sufficient data becomes available the IEPA may modify this Permit to incorporate additional requirements relating to the evaluation, establishment, and enforcement of local limits for organic pollutants. Any permit modification is subject to formal due process procedures pursuant to State and Federal law and regulation. Upon a determination that an organic pollutant is present that causes interference or pass through, the Permittee shall establish local limits as required by 40 CFR § 403.5(c).

2. The Permittee shall maintain all pretreatment data and records for a minimum of three (3) years. This period shall be extended during the course of unresolved litigation or when requested by the IEPA or the Regional Administrator of USEPA. Records shall be available to USEPA and the IEPA upon request.

3. The Permittee shall establish public participation requirements of 40 CFR 25 in implementation of its Pretreatment Program. The Permittee shall at least annually, publish the names of all IU's which were in significant noncompliance (SNC), as defined by 40 CFR § 403.8(f)(2)(viii), in a newspaper of general circulation that provides meaningful public notice within the jurisdictions served by the Permittee or based on any more restrictive definition of SNC that the POTW may be using.

4. The Permittee shall provide written notification to the USEPA, Region 5, 77 West Jackson Blvd., Chicago, Illinois 60604, Attention: NPDES Programs Branch and to the Deputy Counsel for the Division of Water Pollution Control, IEPA, 1021 North Grand Avenue East, P.O. Box 19276, Springfield, Illinois 62794-9276 within five (5) days of receiving notice that any Industrial User of its sewage treatment plant is appealing to the Circuit Court any condition imposed by the Permittee in any permit issued to the Industrial User by Permittee. A copy of the Industrial User's appeal and all other pleadings filed by all parties shall be mailed to the Deputy Counsel within five (5) days of the pleadings being filed in Circuit Court.

C. Monitoring Requirements

1. The Permittee shall monitor its influent, effluent and sludge and report concentrations of the following parameters on Discharge Monitoring Report (DMR) electronic forms due August 25th, unless otherwise specified by the IEPA, and include them in its annual report. Influent and effluent samples shall be taken at weekly intervals at the indicated reporting limit or better and consist of a 24-hour composite unless otherwise specified below. Sludge samples shall be taken of final sludge on a monthly basis and consist of a grab sample reported on a dry weight basis.

STORET CODE	PARAMETER	Minimum reporting limit
01097	Antimony	0.07 mg/L
01002	Arsenic	0.05 mg/L
01007	Barium	0.5 mg/L
01012	Beryllium	0.005 mg/L
01027	Cadmium	0.001 mg/L
01032	Chromium (hex) (grab not to exceed 24 hours)*	0.01 mg/L

01034	Chromium (total)	0.05 mg/L
01042	Copper	0.005 mg/L
00720	Cyanide (total) (grab)****	5.0 µg/L
00722	Cyanide* (grab) (available ***** or amenable to chlorination)****	5.0 µg/L
00951	Fluoride*	0.1 mg/L
01045	Iron (total)	0.5 mg/L
01046	Iron (Dissolved)*	0.5 mg/L
01051	Lead	0.05 mg/L
01055	Manganese	0.5 mg/L
71900	Mercury (effluent grab)***	1.0 ng/L**
01067	Nickel	0.005 mg/L
00556	Oil (hexane soluble or equivalent) (Grab Sample only)*	5.0 mg/L
32730	Phenols (grab)	0.005 mg/L
01147	Selenium	0.005 mg/L
01077	Silver (total)	0.003 mg/L
01059	Thallium	0.3 mg/L
01092	Zinc	0.025 mg/L

* Influent and effluent only
**Minimum reporting limit of 1 ng/L = 1 part per trillion when utilizing Method 1631E and 1 µg/L = 1 part per billion when utilizing Method 3112 and SW-846.
***Utilize USEPA Method 1631E and the digestion procedure described in Section 11.1.1.2 of 1631E, other approved methods may be used for influent (composite) and sludge.
****Analysis for cyanide (available or amenable to chlorination) is only required if cyanide (total) is detected at or more than the minimum reporting limit.
*****USEPA Method OIA-1677 or Standard Method SM 4500-CN G, effective 12 months from the effective date of this permit.

The minimum reporting limit for each parameter is specified by Illinois EPA as the regulatory authority.

The minimum reporting limit for each parameter shall be greater than or equal to the lowest calibration standard and within the acceptable calibration range of the instrument.

The minimum reporting limit is the value below which data are to be reported as non-detects.

The statistically-derived laboratory method detection limit for each parameter shall be less than the minimum reporting limit required for that parameter.

All sample containers, chemical and thermal preservation, holding times, analyses, method detection limit determinations and quality assurance/quality control requirements shall be in accordance with 40 CFR Part 136.

Unless otherwise indicated, concentrations refer to the total amount of the constituent present in all phases, whether solid, suspended or dissolved, elemental or combined including all oxidation states. Where constituents are commonly measured as other than total, the phase is so indicated.

2. The Permittee shall conduct an analysis for the one hundred and ten (110) organic priority pollutants identified in 40 CFR 122 Appendix D, Table II as amended. This monitoring shall be done annually and reported on monitoring report forms provided by the IEPA and shall consist of the following:

   a. The influent and effluent shall be sampled and analyzed for the one hundred and ten (110) organic priority pollutants. The sampling shall be done during a day when industrial discharges are expected to be occurring at normal to maximum levels.

      Samples for the analysis of acid and base/neutral extractable compounds, pesticides, and PCBs shall be 24-hour composites.

      Six (6) grab samples shall be collected each monitoring day to be analyzed for volatile organic compounds. A single analysis for volatile pollutants (Method 624.1) may be run for each monitoring day by compositing equal volumes of each grab sample in the laboratory right before the analysis and loading the composite sample vial in the automated purge and trap system.

      Wastewater samples must be handled, prepared, and analyzed by gas chromatograph/electro capture detector in accordance with USEPA Method 608.3 and GC/MS in accordance with USEPA Methods 624.1 and 625.1 of 40 CFR 136 as amended.

   b. The sludge shall be sampled and analyzed for the one hundred and ten (110) organic priority pollutants. A sludge sample shall be collected concurrent with a wastewater sample and taken as final sludge.

      Sampling and analysis shall conform to USEPA Methods 608.3, 624.1 and 625.1 unless an alternate method has been approved by IEPA.

   c. Sample collection, preservation and storage shall conform to approved USEPA procedures and requirements.

3. In addition, the Permittee shall monitor any new toxic substances as defined by the Clean Water Act, as amended, following notification by the IEPA or USEPA.

4. Permittee shall report any noncompliance with effluent or water quality standards in accordance with Standard Condition 12(f) of this Permit.

5. Analytical detection limits shall be in accordance with 40 CFR 136. Minimum detection limits for sludge analyses shall be in accordance with 40 CFR 503.

D. Pretreatment Reporting

USEPA Region 5 is the Approval Authority for administering the pretreatment program in Illinois. All requests for modification of pretreatment program elements should be submitted in redline/strikeout format and must be sent to USEPA at r5npdes@epa.gov.

Permittee shall upon notice from USEPA, modify any pretreatment program element found to be inconsistent with 40 CFR 403.

E. The Permittee shall report names of all significant contributing industries annually to both IEPA and USEPA. The report shall include the flow and the Standard Industrial Classification and/or North American Industrial Classification systems for each major contributing industry and be submitted with the annual report required in Special Condition 9. The Permittee shall furnish industrial waste data for any specific industrial group that IEPA or USEPA requests, where such requests are reasonable in scope. Otherwise, at the request of IEPA or USEPA the Permittee shall provide access to files and guidance to IEPA or USEPA personnel for reviewing data related to industrial users.

F. To the extent different requirements are imposed by the Permittee's approved pretreatment program and this Permit, the stricter requirements shall be applicable.

SPECIAL CONDITION 10. During January of each year the Permittee shall submit annual fiscal data regarding sewerage system operations to the Illinois Environmental Protection Agency/Division of Water Pollution Control/Compliance Assurance Section. The Permittee may use any fiscal year period provided the period ends within twelve (12) months of the submission date.

Submission shall be electronically on forms provided by IEPA titled "Fiscal Report Form For NPDES Permittees" to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 10" as the subject of the email. Forms are available on the following webpage: *https://www2.illinois.gov/epa/topics/forms/water-forms/Pages/wastewater-compliance.aspx*.

SPECIAL CONDITION 11. The Permittee shall conduct biomonitoring of the effluent from Discharge Number(s) 001.Biomonitoring

A. Acute Toxicity - Standard definitive acute toxicity tests shall be run on at least two trophic levels of aquatic species (fish, invertebrate) representative of the aquatic community of the receiving stream. Testing must be consistent with Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (Fifth Ed.) EPA/821-R-02-012. Unless substitute tests are pre-approved; the following tests are required:

1. Fish 96-hour static LC_{50} Bioassay using fathead minnows (*Pimephales promelas*).

2. Invertebrate 48-hour static LC_{50} Bioassay using *Ceriodaphnia*.

B. Testing Frequency - The above tests shall be conducted using 24-hour composite samples unless otherwise authorized by the IEPA. Sample collection and testing must be conducted in the 18th, 15th, 12th, and 9th month prior to the expiration date of this Permit. When possible, bioassay sample collection should coincide with sample collection for metals analysis or other parameters that may contribute to effluent toxicity.

C. Reporting - Results shall be reported according to EPA/821-R-02-012, Section 12, Report Preparation, and shall be and submitted electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 11" as the subject of the email within one week of receipt from the laboratory. Reports are due to the IEPA no later than the 16th, 13th, 10th, and 7th month prior to the expiration date of this Permit.

D. Toxicity – Should a bioassay result in toxicity to >20% of organisms tested in the 100% effluent treatment, the IEPA may require, upon notification, six (6) additional rounds of monthly testing on the affected organism(s) to be initiated within 30 days of the toxic bioassay. Results shall be submitted to IEPA within one (1) week of becoming available to the Permittee. Should any of the additional bioassays result in toxicity to ≥50% of organisms tested in the 100% effluent treatments, the Permittee must contact the IEPA within one (1) day of the results becoming available to the Permittee and begin the toxicity identification and reduction evaluation process as outlined below.

E. Toxicity Identification and Reduction Evaluation - Should any of the additional bioassays result in toxicity to ≥50% of organisms tested in the 100% effluent treatment, the Permittee must contact the IEPA within one (1) day of the results becoming available to the Permittee and begin the toxicity identification evaluation process in accordance with Methods for Aquatic Toxicity Identification Evaluations, EPA/600/6-91/003. The IEPA may also require, upon notification, that the Permittee prepare a plan for toxicity reduction evaluation to be developed in accordance with Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants, EPA/833B-99/002, which shall include an evaluation to determine which chemicals have a potential for being discharged in the plant wastewater, a monitoring program to determine their presence or absence and to identify other compounds which are not being removed by treatment, and other measures as appropriate. The Permittee shall submit to the IEPA its plan for toxicity reduction evaluation within ninety (90) days following notification by the IEPA. The Permittee shall implement the plan within ninety (90) days or other such date as contained in a notification letter received from the IEPA.

Special Conditions

The IEPA may modify this Permit during its term to incorporate additional requirements or limitations based on the results of the biomonitoring. In addition, after review of the monitoring results, the IEPA may modify this Permit to include numerical limitations for specific toxic pollutants. Modifications under this condition shall follow public notice and opportunity for hearing.

SPECIAL CONDITION 12. Discharge Number 002 is an emergency high level overflow located in the influent pump station that would discharge overland directly to Higgins Creek, if activated. Discharges from this outfall are prohibited. The Permittee shall maintain continuous electronic monitors capable of detecting all discharges from each prohibited discharge outfall (wet well bubbler data) or shall inspect each listed prohibited discharge outfall listed above within 24 hours of receiving 0.25 inches of precipitation or greater within a 24 hour period as recorded at the nearest national Weather Service Reporting Station. Permittee shall utilize chalk or block devices or other discharge confirming devices approved by the Agency to enhance visual monitoring. These prohibited discharges, if they occur, are subject to conditions A-E listed below.

A Definitions

"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 discharge. Severe property damage does not mean economic loss caused by delays in production.

B Notice

1 Anticipated discharge. If the Permittee knows in advance of the need for a prohibited discharge from Discharge Number 002, it shall submit prior notice, if possible at least ten days before the date of the discharge.

2 Unanticipated discharge. The Permittee shall submit notice of an unanticipated discharge as required in Standard Condition 12(f) of this Permit (24-hour notice).

C Limitation on IEPA enforcement discretion. The IEPA may take enforcement action against a Permittee for prohibited discharges from Discharge Number 002, unless:

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

2 There was no feasible alternative to the discharge, 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 back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a discharge which occurred during normal periods of equipment downtime or preventive maintenance; and

3 The Permittee submitted notices as required under Standard Condition 12(f) of this Permit.

D Emergency discharges when discharging, shall be monitored daily by grab sample for BOD_5, Suspended Solids and Fecal Coliform. The Permittee shall submit the monitoring results on Discharge Monitoring Report forms using one such form for each month in which discharging occurs. The Permittee shall specify the number of discharges per month that occur and shall report this number in the quantity daily maximum column. The Permittee shall report the highest concentration value of BOD_5, Suspended Solids and Fecal Coliform discharged in the concentration daily maximum column. BOD_5 or total organic carbon (TOC) may be measured to comply with BOD_5. Testing shall be in accordance with 40 CFR 136. If TOC is measured, the results shall be converted to BOD_5 using the equation, Log BOD_5 = Log TOC*1.67-1.12, and reported on the DMR as BOD_5. The TOC data shall also be reported on the DMR as a daily maximum and sampled daily when discharging if used to comply with BOD_5.

E The above limitations on enforcement discretion apply only with respect to IEPA. They do not serve as a limitation on the ability of any other governmental agency or person to bring an enforcement action in accordance with the Federal Clean Water Act.

SPECIAL CONDITION 13. For the duration of this Permit, the Permittee shall determine the quantity of sludge produced by the treatment facility in dry tons or gallons with average percent total solids analysis. The Permittee shall maintain adequate records of the quantities of sludge produced and have said records available for IEPA inspection. The Permittee shall submit to the IEPA, at a minimum, a semi-annual summary report of the quantities of sludge generated and disposed of, in units of dry tons or gallons (average total percent solids) by different disposal methods including but not limited to application on farmland, application on reclamation land, landfilling, public distribution, dedicated land disposal, sod farms, storage lagoons or any other specified disposal method. Said reports shall be submitted to the IEPA by January 31 and July 31 of each year reporting the preceding January thru June and July thru December interval of sludge disposal operations.

Duty to Mitigate. The Permittee shall take all reasonable steps to minimize any sludge use or disposal in violation of this Permit.

Sludge monitoring must be conducted according to test procedures approved under 40 CFR 136 unless otherwise specified in 40 CFR 503, unless other test procedures have been specified in this Permit.

Planned Changes. The Permittee shall give notice to the IEPA on the semi-annual report of any changes in sludge use and disposal.

The Permittee shall retain records of all sludge monitoring, and reports required by the Sludge Permit as referenced in Standard Condition 25 for a period of at least five (5) years from the date of this Permit.

If the Permittee monitors any pollutant more frequently than required by the Sludge Permit, the results of this monitoring shall be included in the reporting of data submitted to the IEPA.

The Permittee shall comply with existing federal and state regulations governing sewage sludge use or disposal.

Special Conditions

The Permittee shall comply with standards for sewage sludge use or disposal established under section 405(d) of the CWA within the time provided in the regulations that establish the standards for sewage sludge use or disposal even if the permit has not been modified to incorporate the requirement.

The Permittee shall ensure that the applicable requirements in 40 CFR Part 503 are met when the sewage sludge is applied to the land, placed on a surface disposal site, or fired in a sewage sludge incinerator.

Monitoring reports for sludge shall be reported on the form titled "Sludge Management Reports" and submitted electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 13" as the subject of the email. Forms are available on the following webpage: *https://www2.illinois.gov/epa/topics/forms/water-forms/Pages/wastewater-compliance.aspx.*

SPECIAL CONDITION 14.

AUTHORIZATION OF
COMBINED SEWER AND TREATMENT PLANT DISCHARGES

The IEPA has determined that at least a portion of the collection system consists of combined sewers. References to the collection system and the sewer system refer only to those parts of the system which are owned and operated by the Permittee unless otherwise indicated. The Permittee is authorized to discharge from the overflow/bypass listed below provided the diversion structure is located on a combined sewer and the following terms and conditions are met:

Discharge Number	Location	Receiving Water
111	Central Road	Weller's Creek

A. CSO Monitoring, Reporting and Notification Requirements

1. The Permittee shall monitor the frequency of discharge (number of discharges per month) and estimate the duration (in hours) of each discharge from each outfall listed in this Special Condition. Estimates of storm duration and total rainfall shall be provided for each storm event in which a CSO occurred.

Start Date	Rainfall Duration (hrs.)	Rainfall Amount (in.)	CSO Outfall #	Outfall Description	Estimated Duration of CSO Discharge (hrs.)	Estimated Volume of CSO Discharge (MG)

For frequency reporting, all discharges from the same storm, or occurring within 24 hours, shall be reported as one. The date that a discharge commences shall be recorded for each outfall. Results shall be reported on the "NPDES CSO Discharge Monitoring Report Form" or other approved format* and submitted electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 14.A" as the subject of the email by the 15th of February, May, August, and November for the previous quarter, (October – December, January – March, April – June, and July – September). Forms are available on the following webpage: *https://www2.illinois.gov/epa/topics/forms/water-forms/Pages/wastewater-compliance.aspx*. In addition to the above required information, these reports shall include estimates of the pounds of BOD discharged, pounds of suspended solids discharged through CSO's on, or scheduled to be connected to the legs of TARP tributary to the James C. Kirie Water Reclamation Plant. The report shall also include estimates of the pounds of BOD, pounds of suspended solids, and volume of combined sewage treated at the James C. Kirie Water Reclamation Plant. *Requires written approval from IEPA.

B. CSO Treatment Requirements

1. All combined sewer overflows and treatment plant bypasses shall be given sufficient treatment to prevent pollution and the violation of applicable water quality standards. Sufficient treatment shall consist of the following:

   a. All dry weather flows and the first flush of storm flows shall be transported to the main STP and shall meet all applicable effluent standards and the effluent limitations required for the main STP outfall. Additional flows, but not less than ten times the average dry weather flow for the design year, shall receive the equivalent of primary treatment and disinfection with adequate retention time; and,

   b. Any additional treatment, necessary to comply with applicable water quality standards and the federal Clean Water Act, including any amendments made by the Wet Weather Water Quality Act of 2000.

2. All CSO discharges authorized by this Permit shall be treated, in whole or in part, to the extent necessary to prevent accumulations of sludge deposits, floating debris and solids in accordance with 35 Ill. Adm. Code 302.203 and to prevent depression of oxygen levels below the applicable water quality standards.

3. Overflows during dry weather are prohibited. Dry weather overflows, if discovered, shall be reported to the IEPA pursuant to Standard Condition 12(f) of this Permit (24 hour notice).

4. The collection system shall be operated to optimize transport of wastewater flows and to minimize CSO discharges.

5. The treatment system shall be operated to maximize treatment of wastewater flows.

C. Pollution Prevention Activities

1. The Permittee's Pollution Prevention activities are identified in Special Condition 9, Part A.7.

D. Nine Minimum Controls

1. The Permittee shall comply with the nine minimum controls contained in the National CSO Control Policy published in the Federal Register on April 19, 1994. The nine minimum controls are:

   a. Proper operation and maintenance programs for the sewer system and the CSOs;

   b. Maximum use of the collection system for storage;

   c. Review and modification of pretreatment requirements to assure CSO impacts are minimized;

   d. Maximization of flow to the POTW for treatment;

   e. Prohibition of CSOs during dry weather;

   f. Control of solids and floatable materials in CSOs;

   g. Pollution prevention programs which focus on source control activities;

   h. Public notification to ensure that citizens receive adequate information regarding CSO occurrences and CSO impacts; and,

   i. Monitoring to characterize impacts and efficiency of CSO controls.

   Any previously-prepared CSO pollution prevention plan (PPP) for this collection system shall be reviewed, and revised if necessary, by the Permittee to address the items contained in Chapter 8 of the U.S. EPA guidance document, Combined Sewer Overflows, Guidance For Nine Minimum Controls, and any items contained in previously-sent review documents from the IEPA concerning the PPP. Combined Sewer Overflows, Guidance For Nine Minimum Controls is available on line at *http://www.epa.gov/npdes/pubs/owm0030.pdf*. The PPP (or revised PPP) shall be presented to the general public at a public information meeting conducted by the Permittee annually during the term of this Permit. The Permittee shall submit documentation that the pollution prevention plan complies with the requirements of this Permit and that the public information meeting was held. Such documentation shall be submitted electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 14.D" as the subject of the email and posted to the permittees website within twelve (12) months of the effective date of this Permit and shall include a summary of all significant issues raised by the public, the Permittee's response to each issue, and a completed "CSO Pollution Prevention Plan Certification". Forms are available on the following webpage: *https://www2.illinois.gov/epa/topics/forms/water-forms/Pages/wastewater-permits.aspx*. Following the public meeting, the Permittee shall implement the pollution prevention plan and shall maintain a current pollution prevention plan, updated to reflect system modifications, on file at the sewage treatment works or other acceptable location and made available to the public. The pollution prevention plan revisions shall be submitted electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 14.D" as the subject of the email and posted to the permittees website one (1) month from the revision date.

E. Sensitive Area Considerations

1. Pursuant to Section II.C.3 of the federal CSO Control Policy of 1994, sensitive areas are any water likely to be impacted by a CSO discharge which meet one or more of the following criteria: (1) designated as an Outstanding National Resource Water; (2) found to contain shellfish beds; (3) found to contain threatened or endangered aquatic species or their habitat; (4) used for primary contact recreation; (5) National Marine Sanctuaries; or, (6) within the protection area for a drinking water intake structure.

   Within one (1) month of the effective date of this Permit, the Permittee shall submit electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 14.E" as the subject of the email and post to the permittees website documentation indicating which of the outfalls listed in this Special Condition either do, or do not discharge to sensitive areas. Such documentation shall include information regarding the use of the receiving water for primary contact activities (swimming, water skiing, jet skiing, etc.). If the Permittee believes that it is not possible for primary contact recreation to occur in the areas impacted or potentially impacted by the CSOs listed in this Special Condition, then justification as to why primary contact recreation is not possible shall be submitted. Adequate justification shall include, but is not limited to: (1) inadequate water depth; (2) presence of physical obstacles sufficient to prevent access to or for primary contact recreation; and, (3) uses of adjacent land sufficient to discourage primary contact activities. The IEPA will make a determination based on this documentation and other information available to the IEPA. Evidence of existing use of waterway for primary contact recreation activities will likely negate such potential "no-use" justifications.

   Should the IEPA conclude that any of the CSOs listed in this Special Condition discharge to a sensitive area, the IEPA will notify the Permittee in writing. Within three (3) months of the date of notification, or such other date contained in the notification letter, the Permittee shall submit two (2) copies of either a schedule to relocate, control, or treat discharges from these outfalls. If none of these options are possible, the Permittee shall submit adequate justification as to why these options are not possible. Such justification shall be in accordance with Section II.C.3 of the National CSO Control Policy.

F. Operational and Maintenance Plans

1. The Permittee shall implement measures to reduce, to the greatest extent practicable, the total loading of pollutants and

floatables entering the receiving stream to ensure that the Permittee ultimately achieves compliance with water quality standards. These measures shall include, but not be limited to developing and implementing a CSO O & M plan, tailored to the permittee's collection and waste treatment systems, which shall include mechanisms and specific procedures where applicable to ensure:

a. Collection system inspection on a scheduled basis;

b. Sewer, catch basin, and regulator cleaning and maintenance on a scheduled basis;

c. Inspections are made and preventive maintenance is performed on all pump/lift stations;

d. Collection system replacement, where necessary;

e. Detection and elimination of illegal connections;

f. Detection, prevention, and elimination of dry weather overflows;

g. The collection system is operated to maximize storage capacity and the combined sewer portions of the collection system are operated to delay storm entry into the system; and,

h. The treatment and collection systems are operated to maximize treatment.

The IEPA received a CSO operational and maintenance plan "CSO O&M plan" dated July 20, 2018 prepared for this sewerage system. The Permittee shall fully implement the plan and review and revise, if needed, the CSO O&M plan to reflect system changes. The CSO O&M plan shall be presented to the general public at a public information meeting conducted by the Permittee within nine (9) months of the effective date of this Permit or within nine (9) months of the CSO system being modified. The Permittee shall submit documentation that the CSO O&M plan complies with the requirements of this Permit and that the public information meeting was held. Such documentation shall be submitted electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 14.F" as the subject of the email and posted to the permittees website within twelve (12) months of the effective date of this Permit or within three (3) months of the public meeting and shall include a summary of all significant issues raised by the public, the Permittee's response to each issue, and a completed "CSO Operational Plan Checklist and Certification". Forms are available on the following webpage: *https://www2.illinois.gov/epa/topics/forms/water-forms/Pages/wastewater-permits.aspx*. Following the public meeting, the Permittee shall maintain a current CSO O&M plan, updated to reflect system modifications, on file at the sewage treatment works or other acceptable location and made available to the public. The CSO O&M plan and all updates shall be submitted electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 14.F" as the subject of the email and posted to the permittees website one (1) month from the revision date.

G. Sewer Use Ordinances

1.

a. The Permittee shall implement and enforce all conditions and requirements of the Infiltration/Inflow Control Program (IICP) contained in Article 8 of the Watershed Management Ordinance. The steps used to implement the IICP shall be included in the CSO O&M plan contained in Paragraph F of this Special Condition.

b. The Permittee shall report to the IEPA's Compliance Assurance Section on an annual basis the progress obtained in the satellite entities' efforts to meet the following goals: 1) Prevention of water pollution; 2) Elimination of basement sewage backups and adverse surcharging conditions that cause health hazards and financial losses; 3) Minimization of extraneous flows transported to the Permittee's facilities. Also included in this report shall be the results of the District's efforts to reduce and effectively control sources of infiltration and inflow. The report shall be submitted by November 15th of each year and shall include the most recent October 1 through September 30 time period.

c. In the event that local sewer system owners have excessive I/I (any wet weather flows exceeding 150 gpcpd 24-hour average with peak flow not to exceed 100 gpcpd times an allowable peaking factor in accordance with the Illinois Recommended Standards for Sewage Works) in their separate sewer systems that cause or contribute to basement back-ups and/or sanitary sewer overflows, the Permittee shall require that the local sewer system owner implement measures in addition to those required under the IICP in an effort to reduce the excessive I/I. Such additional remedies may include sewer system evaluation studies, sewer rehabilitation or replacement, inflow source removal, and restrictions on the issuance of additional sewer connection permits. A summary of such additional measures shall be included with the IICP Report.

H. Compliance with Water Quality Standards

1.

a. Pursuant to Section 301 of the federal Clean Water Act and 40 CFR § 122.4, discharges from the outfalls listed in this Special Condition shall not cause or contribute to violations of applicable water quality standards or cause use impairment in the receiving waters. The Permittee, no later than March 31st of each year, shall submitted electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 14.H.1.a" as the subject of the email and posted to the permittees website documentation of water quality data for the waterway systems within its jurisdiction for the previous calendar year. The Permittee shall also work with the IEPA and Municipalities with CSO outfall structures connected to

TARP, or planned to be connected to TARP, to develop and implement a plan to assess, and if necessary, abate, impacts from CSO discharges.

b. The Permittee completed post construction water quality monitoring for the Kirie TARP in 2011.

c. Should the results of the water quality monitoring plan, or if information becomes available that causes IEPA to conclude that the discharges from any of the CSOs (treated or untreated) authorized to discharge under this Permit are causing or contributing to violations of water quality standards or are causing use impairment in the receiving water(s) (and so do not comply with the provisions of Paragraph H.1.a, above), the Permittee shall revise and submit electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 14.H.1.c" as the subject of the email and post to the permittees website a CSO Long-Term Control Plan (LTCP) that includes measures for assuring that the discharges from the CSOs (treated or untreated) authorized in this Permit comply with the provisions of Paragraph G.1.a above. The LTCP shall include a schedule for implementation and provisions for re-evaluating compliance with applicable standards and regulations after complete implementation.

If IEPA notifies the Permittee in writing that it has concluded that discharges from any of the CSOs are causing or contributing to violations of water quality standards or are causing use impairment in the receiving waters, then the Permittee shall revise and submit electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 14.H.1.c" as the subject of the email and post to the permittees website the revised LTCP within twelve (12) months of receiving the IEPA written notice. The revised LTCP shall include measures necessary for assuring that the discharges from the CSOs (treated or untreated) authorized in this Permit comply with the provisions of Paragraph H.1.a above.

Following submittal of the revised LTCP, the Permittee shall respond to any initial IEPA review letter in writing within ninety (90) days of the date of such a review letter, and within thirty (30) days of any subsequent review letter(s), if any. The Permittee may be required to implement the LTCP, or another remedy for addressing CSOs, through an enforcement action, permit modification or other enforceable mechanism.

2. A public notification program in accordance with Section II.B.8 of the federal CSO Control Policy of 1994 shall be developed employing a process that actively informs the affected public. The program shall include at a minimum public notification of CSO occurrences and CSO impacts, with consideration given to including mass media and/or Internet notification. The Permittee shall post and maintain signs in waters likely to be impacted by CSO discharges at the point of discharge and at points where these waters are used for primary contact recreation. The sign's message should be visible from both shoreline and water vessel approach (if appropriate), respectively. Provisions shall be made to include modifications of the program when necessary and notification to any additional member of the affected public. The program shall be presented to the general public at a public information meeting conducted by the Permittee. The Permittee shall conduct the public information meeting providing a summary and status of the CSO control program annually during the term of this Permit. The Permittee shall submit documentation that the public information meeting was held, shall submit a summary of all significant issues raised by the public and the Permittee's response to each issue and shall identify any modifications to the program as a result of the public information meeting electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 14.H.2" as the subject of the email within 60 days of holding the public meeting. The Permittee shall submit copies of the public notification program electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 14.H.2" as the subject of the email within 30 days of development or revision. The most recent CSO Public Notification Plan was dated December 2009.

3. If any of the CSO discharge points listed in this Special Condition are eliminated, or if additional CSO discharge points, not listed in this Special Condition, are discovered, the Permittee shall notify the IEPA in writing within one (1) month of the respective outfall elimination or discovery. Such notification shall be in the form of a request for the appropriate modification of this NPDES Permit.

I. Summary of Compliance Dates in this CSO Special Condition

1. The following summarizes the dates that submittals contained in this Special Condition are due at the IEPA:

IICP Report, and CSO Monitoring Data Report (Paragraphs A.1 and G.1)	Every November 15th
Water Quality Data (Paragraph H.1)	Every March 31st
Elimination of a CSO or Discovery of Additional CSO locations (Paragraph H.3)	1 month from discovery or elimination
Documentation of CSO locations (Paragraph E.1, Sensitive Areas)	6 months from effective date of this Permit
Conduct OMP Information Meeting (Paragraph F.1) **No Submittal Due with this Milestone**	9 months from the effective date of the Permit
Submit OMP Certification (Paragraphs F.1)	12 months from the effective date of this Permit
Submit Pollution Prevention Report (Paragraph C.1)	Every June 30th
Conduct PN Public Information Meeting (Paragraph H.2) **No Submittal Due with this Milestone**	Annually
Submit PN Information Meeting Summary (Paragraph H.2)	60 days after the public meeting

J. Reopening and Modifying this Permit

1. The IEPA may initiate a modification for this Permit at any time to include requirements and compliance dates which have been submitted in writing by the Permittee and approved by the IEPA, or other requirements and dates which are necessary to carry the provisions of the Illinois Environmental Protection Act, the Clean Water Act, or regulations promulgated under those Acts. Public Notice of such modifications and opportunity for public hearing shall be provided.

SPECIAL CONDITION 15. The Permittee shall record monitoring results on Discharge Monitoring Report (DMR) electronic forms using one such form for each outfall each month.

In the event that an outfall does not discharge during a monthly reporting period, the DMR Form shall be submitted with no discharge indicated.

The Permittee is required to submit electronic DMRs (NetDMRs) instead of mailing paper DMRs to the IEPA unless a waiver has been granted by the Agency. More information, including registration information for the NetDMR program, can be obtained on the IEPA website, https:www2.illinois.gov/epa/topics/water-quality/surface-water/netdmr/pages/quick-answer-guide.aspx.

The completed Discharge Monitoring Report forms shall be submitted to IEPA no later than the 25th day of the following month, unless otherwise specified by the permitting authority.

Permittees that have been granted a waiver shall mail Discharge Monitoring Reports with an original signature to the IEPA at the following address:

Illinois Environmental Protection Agency
Division of Water Pollution Control
Attention: Compliance Assurance Section, Mail Code # 19
1021 North Grand Avenue East
Post Office Box 19276
Springfield, Illinois 62794-9276

SPECIAL CONDITION 16. This Permit contains provisions implementing the federal Combined Sewer Overflow (CSO) Control Policy (published in the Federal Register on April 19, 1994). The Permit contains the elements of the Nine Minimum Controls. Authorization is provided in this Permit for discharge from one CSO into Weller's Creek. This CSO will discharge only when precipitation events, including snow melt, cause the available capacity in TARP to be exceeded.

SPECIAL CONDITION 17. The provisions of 40 CFR Section 122.41 (m) & (n) are incorporated herein by reference.

SPECIAL CONDTION 18. The Permittee shall work towards the goals of achieving no discharges from sanitary sewer overflows or basement back-ups and ensuring that overflows or back-ups, when they do occur do not cause or contribute to violations of applicable standards or cause impairment in any adjacent receiving water. Overflows from sanitary sewers are expressly prohibited by this permit and by 35 Ill. Adm. Code 306.304. As part of the process to ultimately achieve compliance through the elimination of and mitigating the adverse impacts of any such overflows if they do occur, the Permittee shall (A) identify and report to IEPA all SSOs that do occur, and (B) update the existing Capacity, Management, Operations, and Maintenance (CMOM) plan at least annually and maintain it at the facility for review during Agency Field Operations Section inspections. The CMOM shall be submitted electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 18" as the subject of the email and posted to the permittees website by March 31 of each year. The Permittee shall modify the Plan to incorporate any comments that it receives from IEPA and shall implement the modified plan as soon as possible. The Permittee should work as appropriate, in consultation with affected authorities at the local, county, and/or state level to develop the plan components involving third party notification of overflow events. The Permittee may be required to construct additional sewage transport and/or treatment facilities in future permits or other enforceable documents should the implemented CMOM plan indicate that the Permittee's facilities are not capable of conveying and treating the flow for which they are designed.

The CMOM plan shall include the following elements:

A. Measures and Activities:

1. A complete map and system inventory for the collection system owned and operated by the Permittee;
2. Organizational structure; budgeting; training of personnel; legal authorities; schedules for maintenance, sewer system cleaning, and preventative rehabilitation; checklists, and mechanisms to ensure that preventative maintenance is performed on equipment owned and operated by the Permittee;
3. Documentation of unplanned maintenance;
4. An assessment of the capacity of the collection and treatment system owned and operated by the Permittee at critical junctions and immediately upstream of locations where overflows and backups occur or are likely to occur; use flow monitoring and/or sewer hydraulic modeling, as necessary;
5. Identification and prioritization of structural deficiencies in the system owned and operated by the Permittee. Include preventative maintenance programs to prevent and/or eliminate collection system blockages from roots or grease, and prevent corrosion or negative effects of hydrogen sulfide which may be generated within collection system;
6. Operational control, including documented system control procedures, scheduled inspections and testing, list of scheduled frequency of cleaning (and televising as necessary) of sewers;

7. The Permittee shall develop and implement an Asset Management strategy to ensure the long-term sustainability of the collection system. Asset Management shall be used to assist the Permittee in making decisions on when it is most appropriate to repair, replace or rehabilitate particular assets and develop long-term funding strategies; and
8. Asset Management shall include but is not limited to the following elements:
   a. Asset Inventory and State of the Asset;
   b. Level of Service;
   c. Critical Asset Identification;
   d. Life Cycle Cost; and
   e. Long-Term Funding Strategy.

B. Design and Performance Provisions:

1. Monitor the effectiveness of CMOM;
2. Upgrade the elements of the CMOM plan as necessary; and
3. Maintain a summary of CMOM activities.

C. Overflow Response Plan:

1. Know where overflows and back-ups within the facilities owned and operated by the Permittee occur;
2. Respond to each overflow or back-up to determine additional actions such as clean up; and
3. Locations where basement back-ups and/or sanitary sewer overflows occur shall be evaluated as soon as practicable for excessive inflow/infiltration, obstructions or other causes of overflows or back-ups as set forth in the System Evaluation Plan.
4. Identify the root cause of the overflow or basement backup, and document to files;
5. Identify actions or remediation efforts to reduce risk of reoccurrence of these overflows or basement backups in the future, and document to files.

D. System Evaluation Plan:

1. Summary of existing SSO and Excessive I/I areas in the system and sources of contribution;
2. Evaluate plans to reduce I/I and eliminate SSOs;
3. Evaluate the effectiveness and performance in efforts to reduce excessive I/I in the collection system;
4. Special provisions for Pump Stations and force mains and other unique system components; and
5. Construction plans and schedules for correction.

E. Reporting and Monitoring Requirements:

1. Program for SSO detection and reporting; and
2. Program for tracking and reporting basement back-ups, including general public complaints.

F. Third Party Notice Plan:

1. Describes how, under various overflow scenarios, the public, as well as other entities, would be notified of overflows within the Permittee's system that may endanger public health, safety or welfare;
2. Identifies overflows within the Permittee's system that would be reported, giving consideration to various types of events including events with potential widespread impacts;
3. Identifies who shall receive the notification;
4. Identifies the specific information that would be reported including actions that will be taken to respond to the overflow;
5. Includes a description of the lines of communication; and
6. Includes the identities and contact information of responsible POTW officials and local, county, and/or state level officials.

For additional information concerning USEPA CMOM guidance and Asset Management please refer to the following web site addresses. http://www.epa.gov/npdes/pubs/cmom_guide_for_collection_systems.pdf and http://water.epa.gov/type/watersheds/wastewater/upload/guide_smallsystems_assetmanagement_bestpratices.pdf

SPECIAL CONDITION 19. This Permit may be modified to include alternative or additional final effluent limitations pursuant to an approved Total Maximum Daily Load (TMDL) Study, an approved Nutrient Assessment Reduction Plan, or an approved trading program.

SPECIAL CONDITION 20. A phosphorus monthly average concentration effluent limitation of 1.0 mg/L and associated loading limitations shall become effective five (5) years from the effective date of this permit. In order to achieve a phosphorus effluent limit of 1.0 mg/L, the Permittee shall submit progress reports in compliance with the following schedule:

A. Assess Key Process Parameters for System Design; Initiate Design Selection	6 months from effective date of this Permit
B. Interim Report on System Design and Selection	12 months from effective date of this Permit
C. Interim Report on System Design and Selection	18 months from effective date of this Permit
D. Complete System Design; Initiate Bid and Award	24 months from effective date of this Permit
E. Commence Construction of Selected System;	27 months from effective date of this Permit
F. Interim Report on Construction Activities and Progress	30 months from effective date of this Permit

G.	Second Interim Report on Construction Activities and Progress	36 months from effective date of this Permit
H.	Third Interim Report on Construction Activities and Progress	42 months from effective date of this Permit
I.	Fourth Interim Report on Construction Activities and Progress	48 months from effective date of this Permit
J.	Complete Construction; Begin Optimization of Phosphorus Removal	54 months from effective date of this Permit
K.	Achieve Compliance with Final Phosphorus Effluent Limitations	60 months from effective date of this Permit

In addition, the IEPA may initiate a modification of the schedule set forth in this permit at any time, to include other dates which are necessary to carry out the provisions of the Environmental Protection Act, the Federal Clean Water Act or regulations promulgated under those Acts or compliance dates which have been submitted in writing by the Permittee and approved by the IEPA. Public Notice of such modifications and opportunity for public hearing shall be provided consistent with 40 CFR 122.63.

The Permittee shall submit a report for each number item in the compliance schedule, indicating, a) the date the item was completed, or b) that the item was not completed. All reports shall be submitted electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 20" as the subject of the email

SPECIAL CONDITION 21: The Permittee shall participate in the Lower Des Plaines Watershed Group (LDWG). The Permittee shall work with other watershed members of the LDWG to determine the most cost effective means to remove dissolved oxygen (DO) and offensive condition impairments in the Lower Des Plaines Watershed to the extent feasible. The Permittee shall participate in the LDWG for the completion of the Bioassessment Monitoring Program Plan of the Lower Des Plaines Watershed Bioassessment Quality Assurance Project Plan dated July 27, 2018 (hereinafter the Plan) which will include biological, chemical and physical monitoring of the Lower Des Plaines River Watershed.

A. The LDWG will conduct the following activities in accordance with the Plan during the term of this permit:
   1. Conduct stream monitoring in Lower Mainstem Des Plaines River in 2018;
   2. Conduct stream monitoring in Upper Mainstem and tributaries of the Des Plaines River in 2019;
   3. Conduct stream monitoring in Hickory Creek Watershed in 2020;
   4. Conduct stream monitoring in remaining tributaries of the Des Plaines River in 2021; and
   5. Assess stream monitoring and develop recommendations for future stream monitoring in 2022.

B. The Permittee shall submit an annual progress report on the activities identified in (A) above to the Agency by March 31 of each year. The Permittee may work cooperatively with the LDWG to prepare a single annual progress report that is common among LDWG members.

C. In its application for renewal of this permit, the Permittee shall consider and incorporate recommended LDWG activities listed in any annual progress report or Nutrient Assessment Reduction Plan that the Permittee will implement during the next permit term.

SPECIAL CONDITION 22: The Permittee shall monitor the wastewater effluent for Total Phosphorus, Dissolved Phosphorus, Nitrate/Nitrite, Total Kjeldahl Nitrogen (TKN), Ammonia, Total Nitrogen (calculated), Alkalinity, Specific Conductivity, Chloride and Temperature at least once a month beginning on the effective date of this permit. The Permittee shall monitor the wastewater influent for Total Phosphorus at least once a month. The results shall be submitted on electronic Discharge Monitoring Report Forms (NetDMRs) to IEPA unless otherwise specified by the IEPA.

SPECIAL CONDITION 23: The Permittee shall, within 18 months of the effective date of this permit, prepare and submit electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 23" as the subject of the email and post to the permittees website a Phosphorus Removal Feasibility Study (PRFS) that identifies the method, timeframe, and costs of reducing phosphorus levels in its discharge to a level consistently meeting a potential future effluent limit of 0.5 mg/L and 0.1 mg/L. The study shall evaluate the construction and O & M costs of the application of this limit on a monthly, seasonal and annual average basis. The feasibility report shall also be shared with the Lower Des Plaines Watershed Group. Previously submitted feasibility studies that did not include an alternative effluent limit of 0.5 mg/L and 0.1 mg/L may be amended to identify supplemental treatment technologies necessary to achieve 0.5 mg/L and 0.1 mg/L.

SPECIAL CONDITION 24: The Permittee shall develop and submit to the Agency a Phosphorus Discharge Optimization Plan within 18 months of the effective date of this permit. The plan shall include a schedule for the implementation of these optimization measures. Annual progress reports on the optimization of the existing treatment facilities shall be submitted electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 24" as the subject of the email and post to the permittees website by March 31 of each year beginning 12 months from the effective date of the permit. In developing the plan, the Permittee shall evaluate a range of measures for reducing phosphorus discharges from the treatment plant, including possible source reduction measures, operational improvements, and minor facility modifications that will optimize reductions in phosphorus discharges from the wastewater treatment facility. The Permittee's evaluation shall include, but not be limited to, an evaluation of the following optimization measures:

A. WWTF influent reduction measures.
   1. Evaluate the phosphorus reduction potential of users.
   2. Determine which sources have the greatest opportunity for reducing phosphorus (i.e., industrial, commercial, institutional, municipal and others).
      a. Determine whether known sources (i.e., restaurant and food preparation) can adopt phosphorus minimization and water conservation plans.
      b. Evaluate implementation of local limits on influent sources of excessive phosphorus.

B. WWTF effluent reduction measures.
   1. Reduce phosphorus discharges by optimizing existing treatment processes.
      a. Adjust the solids retention time for either nitrification, denitrification, or biological phosphorus removal.
      b. Adjust aeration rates to reduce dissolved oxygen and promote simultaneous nitrification-denitrification.
      c. Add baffles to existing units to improve microorganism conditions by creating divided anaerobic, anoxic, and aerobic zones.
      d. Change aeration settings in plug flow basins by turning off air or mixers at the inlet side of the basin system.
      e. Minimize impact on recycle streams by improving aeration within holding tanks.
      f. Reconfigure flow through existing basins to enhance biological nutrient removal.
      g. Increase volatile fatty acids for biological phosphorus removal.

SPECIAL CONDITION 25:

A. Subject to paragraph (B) below, an effluent limit of 0.5 mg/L Total Phosphorus 12 month rolling geometric mean (calculated monthly) basis (hereinafter "the Limit"), shall be met by the Permittee by January 1, 2030, unless the Permittee demonstrates that meeting such Limit is not technologically or economically feasible in one of the following manners:
   1. the Limit is not technologically feasible through the use of biological phosphorus removal (BPR) process(es) at the treatment facility; or
   2. the Limit would result in substantial and widespread economic or social impact. Substantial and widespread economic impacts must be demonstrated using applicable USEPA guidance, including but not limited to any of the following documents:
      a. Interim Economic Guidance for Water Quality Standards, March 1995, EPA-823-95-002;
      b. Combined Sewer Overflows – Guidance for Financial Capability Assessment and Schedule Development, February 1997, EPA-832—97-004;
      c. Financial Capability Assessment Framework for Municipal Clean Water Act Requirements, November 24, 2014; and
      d. any additional USEPA guidance on affordability issues that revises, supplements or replaces those USEPA guidance documents; or
   3. the Limit can only be met by chemical addition for phosphorus removal at the treatment facility in addition to those processes currently contemplated; or
   4. the Limit is demonstrated not to be feasible by January 1, 2030, but is feasible within a longer timeline, then the Limit shall be met as soon feasible and approved by the Agency; or
   5. the Limit is demonstrated not to be achievable, then an effluent limit that is achievable by the Permittee (along with associated timeline) will apply instead, except that the effluent limit shall not exceed 0.6 mg/L Total Phosphorus 12 month rolling geometric mean (calculated monthly).

B. The Limit shall be met by the Permittee by January 1, 2030, except in the following circumstances:
   1. If the Permittee develops a written plan, preliminary engineering report, facility plan or project plan no later than January 1, 2025, to rebuild or replace the secondary treatment process(es) of the treatment facility, the Limit shall be met by December 31, 2035; or
   2. If the Permittee decides to construct/operate biological nutrient removal (BNR) process(es), incorporating nitrogen reduction, the Limit shall be met by December 31, 2035; or
   3. If the Permittee decides to use chemical addition for phosphorus removal instead of BPR, the Limit and the effluent limit of 1.0 mg/L Total Phosphorus monthly average shall be met by December 31, 2025; or
   4. If the Permittee has already installed chemical addition for phosphorus removal instead of BPR, and has a 1.0 mg/L Total Phosphorus monthly average effluent limit in its permit, or the Permittee is planning to install chemical addition with an IEPA construction permit that is issued on or before July 31, 2018, the 1.0 mg/L Total Phosphorus monthly average effluent limit (and associated compliance schedule) shall apply, and the Limit shall not be applicable; or
   5. The NARP determines that a limit lower than the Limit is necessary and attainable. The lower limit and timeline identified in the NARP shall apply to the Permittee; or
   6. If the Permittee participates in a watershed group that is developing a NARP for an impairment related to phosphorus or a risk eutrophication, and IEPA determines that the group has the financial and structural capability to develop the NARP by the deadline specified in the NARP provisions below.

C. The Permittee shall identify and provide adequate justification of any exception identified in paragraph (A) or circumstance identified in paragraph (B), regarding meeting the Limit. The justification shall be submitted to the Agency at the time of renewal of this permit or by December 31, 2023, whichever date is first. Any justification or demonstration performed by the Permittee pursuant to paragraph (A) or circumstance pursuant to paragraph (B) must be reviewed and approved by the Agency. The Agency will renew or modify the NPDES permit as necessary. No date deadline modification or effluent limitation modification for any of the exceptions or circumstances specified in paragraphs (A) or (B) will be effective until it is included in a modified or reissued NPDES permit.

D. For purposes of this permit, the following definitions are used:
   1. BPR (Biological Phosphorus Removal) is defined herein as treatment processes which do not require use of supplemental treatment processes at the treatment facilities before or after the biological system, such as but not limited to, chemical addition, carbon supplementation, fermentation, or filtration. The installation of a back-up chemical phosphorus removal system is allowable and does not invalidate the status of a WRP's BPR removal system or change the compliance date of January 1, 2030. The use of filtration or additional equipment to meet other effluent limits is not prohibited, but those processes will not be considered part of the BPR process for purposes of this permit, and
   2. BNR (Biological Nutrient Removal) is defined herein as treatment processes used for nitrogen and phosphorus removal from wastewater before it is discharged. BNR treatment processes, as defined herein, do not require use of supplemental treatment

processes at the treatment facilities before or after the biological system, such as but not limited to, chemical addition, carbon supplementation, fermentation or filtration. The use of filtration or additional equipment to meet other effluent limits is not prohibited, but those processes will not be considered part of the BNR process for purposes of this permit.

E. The 0.5 mg/L Total Phosphorus 12 month rolling geometric mean (calculated monthly) effluent limit applies to the effluent from the treatment plant.

SPECIAL CONDITION 26: The Agency has determined that the Permittee's treatment plant effluent is located upstream of a waterbody or stream segment that has been determined to have a phosphorus related impairment. This determination was made upon reviewing available information concerning the characteristics of the relevant waterbody/segment and the relevant facility (such as quantity of discharge flow and nutrient load relative to the stream flow).

A phosphorus related impairment means that the downstream waterbody or segment is listed by the Agency as impaired due to dissolved oxygen and/or offensive condition (algae and/or aquatic plant growth) impairments that is related to excessive phosphorus levels.

The Permittee shall develop, or be a part of a watershed group that develops, a Nutrient Assessment Reduction Plan (NARP) that will meet the following requirements:

A. The NARP shall be developed and submitted to the Agency by December 31, 2024. This requirement can be accomplished by the Permittee, by participation in an existing watershed group or by creating a new group. The NARP shall be supported by data and sound scientific rationale.
B. The Permittee shall cooperate with and work with other stakeholders in the watershed to determine the most cost-effective means to address the phosphorus related impairment. If other stakeholders in the watershed will not cooperate in developing the NARP, the Permittee shall develop its own NARP for submittal to the Agency to comply with this condition.
C. In determining the target levels of various parameters necessary to address the phosphorus related impairment, the NARP shall either utilize the recommendations by the Nutrient Science Advisory Committee or develop its own watershed-specific target levels.
D. The NARP shall identify phosphorus input reductions by point source discharges and non-point source discharges in addition to other measures necessary to remove phosphorus related impairments in the watershed. The NARP may determine, based on an assessment of relevant data, that the watershed does not have an impairment related to phosphorus, in which case phosphorus input reductions or other measures would not be necessary. Alternatively, the NARP could determine that phosphorus input reductions from point sources are not necessary, or that phosphorus input reductions from both point and nonpoint sources are necessary, or that phosphorus input reductions are not necessary and that other measures, besides phosphorus input reductions, are necessary.
E. The NARP shall include a schedule for the implementation of the phosphorus input reductions by point sources, non-point sources and other measures necessary to remove phosphorus related impairments. The NARP schedule shall be implemented as soon as possible, and shall identify specific timelines applicable to the Permittee.
F. The NARP can include provisions for water quality trading to address the phosphorus related impairments in the watershed. Phosphorus/Nutrient trading cannot result in violations of water quality standards or applicable antidegradation requirements.
G. The Permittee shall request modification of the permit within 90 days after the NARP has been completed to include necessary phosphorus input reductions identified within the NARP. The Agency will modify the NPDES permit, if necessary.
H. If the Permittee does not develop or assist in developing the NARP, and such a NARP is developed for the watershed, the Permittee will become subject to effluent limitations necessary to address the phosphorus related impairments. The Agency shall calculate these effluent limits by using the NARP and any applicable data. If no NARP has been developed, the effluent limits shall be determined for the Permittee on a case-by-case basis, so as to ensure that the Permittee's discharge will not cause or contribute to violations of the dissolved oxygen or narrative water quality standards.

SPECIAL CONDITION 27: The equations to convert TOC to $CBOD_5$ and BOD_5 must be revalidated prior to the expiration date of the permit, and a request to continue TOC measurement must be submitted with the NPDES renewal application including all data and other necessary information to support your request.

SPECIAL CONDITION 28: The Permittee shall develop, and submit for approval, a sewershed Chloride Reduction Plan with the objective of decreasing chloride loading within MWRDGC's James Kirie WRP combined sewer service area within 9 months of the effective date of this Permit. The plan shall include, but not be limited to; an inventory of the chloride concentration of the sewershed, prioritization of the sewershed, and BMPs to be implemented. The plan shall be implemented upon Agency approval. The Permittee may develop this Program cooperatively with NPDES Permittees and the Lower Des Plaines Watershed Group (LDWG) to decrease public agency chloride application rates used for winter road safety. The Permittee shall submit electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 28" as the subject of the email an annual report on the annual implementation of the Program identifying the practices deployed, chloride application rates, and estimated reductions achieved compared to a baseline condition. The report shall be provided to the Agency by March 31 of each year reflecting the Chloride Abatement Program performance for the preceding year (example: 2020-21 winter season report shall be submitted no later than March 31, 2022). The Permittee may work cooperatively with the LDWG to prepare a single annual progress report that is common among permittees within MWRDGC's James Kirie WRP combined sewer service area.

SPECIAL CONDITION 29: Schedule for Chlorine Residual Effluent Limitations

Compliance is required with the 0.038 mg/L daily maximum chlorine residual effluent limit two years (2) years from the effective date of this Permit. From the effective date of this Permit until compliance with the 0.038 mg/L daily maximum chlorine residual effluent limit is achieved, the 0.05 mg/L daily maximum chlorine residual effluent limit applies.

Special Conditions

The Permittee shall achieve compliance with the final effluent limitations as specified in this Permit for Discharge Number(s) 001 by completion of the effluent limit described above in accordance with the following compliance schedule:

ITEM	COMPLETION DATE
A. Interim progress report	6 months from the effective date of this Permit
B. Procurement of equipment	12 months from the effective date of this Permit
C. Achieve compliance with the 0.038 mg/L daily maximum chlorine residual effluent limit	24 months from the effective date of this Permit

This Permit may be modified, with Public Notice, to include revised compliance dates set out in this Permit.

In addition, the IEPA may initiate a modification of the compliance schedule set out in this Permit at any time, to include other dates which are necessary to carry out the provisions of the Illinois Environmental Protection Act, the Federal Clean Water Act or regulations promulgated under those Acts. Public Notice of such modification and opportunity for public hearing shall be provided.

Reporting

The Permittee shall submit electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0047741 Special Condition 29" as the subject of the email a report no later than fourteen (14) days following the completion dates indicated for each lettered item in the compliance schedule, indicating, a) the date the item was completed, or b) that the item was not completed.

Standard Conditions

Definitions

Act means the Illinois Environmental Protection Act, 415 ILCS 5 as Amended.

Agency means the Illinois Environmental Protection Agency.

Board means the Illinois Pollution Control Board.

Clean Water Act (formerly referred to as the Federal Water Pollution Control Act) means Pub. L 92-500, as amended. 33 U.S.C. 1251 et seq.

NPDES (National Pollutant Discharge Elimination System) means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 402, 318 and 405 of the Clean Water Act.

USEPA means the United States Environmental Protection Agency.

Daily Discharge means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurements, the "daily discharge" is calculated as the average measurement of the pollutant over the day.

Maximum Daily Discharge Limitation (daily maximum) means the highest allowable daily discharge.

Average Monthly Discharge Limitation (30 day average) means the highest allowable average of daily discharges over a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month.

Average Weekly Discharge Limitation (7 day average) means the highest allowable average of daily discharges over a calendar week, calculated as the sum of all daily discharges measured during a calendar week divided by the number of daily discharges measured during that week.

Best Management Practices (BMPs) means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the State. BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Aliquot means a sample of specified volume used to make up a total composite sample.

Grab Sample means an individual sample of at least 100 milliliters collected at a randomly-selected time over a period not exceeding 15 minutes.

24-Hour Composite Sample means a combination of at least 8 sample aliquots of at least 100 milliliters, collected at periodic intervals during the operating hours of a facility over a 24-hour period.

8-Hour Composite Sample means a combination of at least 3 sample aliquots of at least 100 milliliters, collected at periodic intervals during the operating hours of a facility over an 8-hour period.

Flow Proportional Composite Sample means a combination of sample aliquots of at least 100 milliliters collected at periodic intervals such that either the time interval between each aliquot or the volume of each aliquot is proportional to either the stream flow at the time of sampling or the total stream flow since the collection of the previous aliquot.

(1) **Duty to comply**. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action, permit termination, revocation and reissuance, modification, or for denial of a permit renewal application. The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if the permit has not yet been modified to incorporate the requirements.

(2) **Duty to reapply**. If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. If the permittee submits a proper application as required by the Agency no later than 180 days prior to the expiration date, this permit shall continue in full force and effect until the final Agency decision on the application has been made.

(3) **Need to halt or reduce activity not a defense**. 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.

(4) **Duty to mitigate**. The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

(5) **Proper operation and maintenance**. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up, or auxiliary facilities, or similar systems only when necessary to achieve compliance with the conditions of the permit.

(6) **Permit actions**. This permit may be modified, revoked and reissued, or terminated for cause by the Agency pursuant to 40 CFR 122.62 and 40 CFR 122.63. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

(7) **Property rights**. This permit does not convey any property rights of any sort, or any exclusive privilege.

(8) **Duty to provide information**. The permittee shall furnish to the Agency within a reasonable time, any information which the Agency may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with the permit. The permittee shall also furnish to the Agency upon request, copies of records required to be kept by this permit.

(9) **Inspection and entry**. The permittee shall allow an authorized representative of the Agency or USEPA (including an authorized contractor acting as a representative of the Agency or USEPA), upon the presentation of credentials and other documents as may be required by law, to:

(a) Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;
(b) Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

(c) Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

(d) Sample or monitor at reasonable times, for the purpose of assuring permit compliance, or as otherwise authorized by the Act, any substances or parameters at any location.

(10) **Monitoring and records.**

(a) Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

(b) The permittee shall retain records of all monitoring information, including all calibration and maintenance records, and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of this permit, measurement, report or application. Records related to the permittee's sewage sludge use and disposal activities shall be retained for a period of at least five years (or longer as required by 40 CFR Part 503). This period may be extended by request of the Agency or USEPA at any time.

(c) Records of monitoring information shall include:

(1) The date, exact place, and time of sampling or measurements;
(2) The individual(s) who performed the sampling or measurements;
(3) The date(s) analyses were performed;
(4) The individual(s) who performed the analyses;
(5) The analytical techniques or methods used; and
(6) The results of such analyses.

(d) Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit. Where no test procedure under 40 CFR Part 136 has been approved, the permittee must submit to the Agency a test method for approval. The permittee shall calibrate and perform maintenance procedures on all monitoring and analytical instrumentation at intervals to ensure accuracy of measurements.

(11) **Signatory requirement.** All applications, reports or information submitted to the Agency shall be signed and certified.

(a) **Application.** All permit applications shall be signed as follows:
(1) For a corporation: by a principal executive officer of at least the level of vice president or a person or position having overall responsibility for environmental matters for the corporation:
(2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or
(3) For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official.

(b) **Reports.** All reports required by permits, or other information requested by the Agency shall be signed by a person described in paragraph (a) or by a duly authorized representative of that person. A person is a duly authorized representative only if:
(1) The authorization is made in writing by a person described in paragraph (a); and
(2) The authorization specifies either an individual or a position responsible for the overall operation of the facility, from which the discharge originates, such as a plant manager, superintendent or person of equivalent responsibility; and
(3) The written authorization is submitted to the Agency.

(c) **Changes of Authorization.** If an authorization under (b) is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of (b) must be submitted to the Agency prior to or together with any reports, information, or applications to be signed by an authorized representative.

(d) **Certification.** Any person signing a document under paragraph (a) or (b) of this section shall make the following certification:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

(12) **Reporting requirements.**

(a) **Planned changes.** The permittee shall give notice to the Agency as soon as possible of any planned physical alterations or additions to the permitted facility.
Notice is required when:
(1) The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source pursuant to 40 CFR 122.29(b); or
(2) The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements pursuant to 40 CFR 122.42(a)(1).
(3) The alteration or addition results in a significant change in the permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan.

(b) **Anticipated noncompliance.** The permittee shall give advance notice to the Agency of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

(c) **Transfers.** This permit is not transferable to any person except after notice to the Agency.

(d) **Compliance schedules.** Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date.

(e) **Monitoring reports.** Monitoring results shall be reported at the intervals specified elsewhere in this permit.
(1) Monitoring results must be reported on a Discharge Monitoring Report (DMR).
(2) If the permittee monitors any pollutant more frequently than required by the permit, using test procedures

approved under 40 CFR 136 or as specified in the permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR.

(3) Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Agency in the permit.

(f) **Twenty-four hour reporting.** The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24-hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and time; and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance. The following shall be included as information which must be reported within 24-hours:

(1) Any unanticipated bypass which exceeds any effluent limitation in the permit.

(2) Any upset which exceeds any effluent limitation in the permit.

(3) Violation of a maximum daily discharge limitation for any of the pollutants listed by the Agency in the permit or any pollutant which may endanger health or the environment.

The Agency may waive the written report on a case-by-case basis if the oral report has been received within 24-hours.

(g) **Other noncompliance.** The permittee shall report all instances of noncompliance not reported under paragraphs (12)(d), (e), or (f), at the time monitoring reports are submitted. The reports shall contain the information listed in paragraph (12)(f).

(h) **Other information.** Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application, or in any report to the Agency, it shall promptly submit such facts or information.

(13) **Bypass.**

(a) 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.

(b) 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 assure efficient operation. These bypasses are not subject to the provisions of paragraphs (13)(c) and (13)(d).

(c) Notice.

(1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of the bypass.

(2) Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in paragraph (12)(f) (24-hour notice).

(d) Prohibition of bypass.

(1) Bypass is prohibited, and the Agency may take enforcement action against a permittee for bypass, unless:

(i) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(ii) 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 back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

(iii) The permittee submitted notices as required under paragraph (13)(c).

(2) The Agency may approve an anticipated bypass, after considering its adverse effects, if the Agency determines that it will meet the three conditions listed above in paragraph (13)(d)(1).

(14) **Upset.**

(a) Definition. Upset means 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. 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.

(b) Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of paragraph (14)(c) are met. 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.

(c) Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

(1) An upset occurred and that the permittee can identify the cause(s) of the upset;

(2) The permitted facility was at the time being properly operated; and

(3) The permittee submitted notice of the upset as required in paragraph (12)(f)(2) (24-hour notice).

(4) The permittee complied with any remedial measures required under paragraph (4).

(d) Burden of proof. In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

(15) **Transfer of permits.** Permits may be transferred by modification or automatic transfer as described below:

(a) Transfers by modification. Except as provided in paragraph (b), a permit may be transferred by the permittee to a new owner or operator only if the permit has been modified or revoked and reissued pursuant to 40 CFR 122.62 (b) (2), or a minor modification made pursuant to 40 CFR 122.63 (d), to identify the new permittee and

incorporate such other requirements as may be necessary under the Clean Water Act.

(b) Automatic transfers. As an alternative to transfers under paragraph (a), any NPDES permit may be automatically transferred to a new permittee if:

(1) The current permittee notifies the Agency at least 30 days in advance of the proposed transfer date;

(2) The notice includes a written agreement between the existing and new permittees containing a specified date for transfer of permit responsibility, coverage and liability between the existing and new permittees; and

(3) The Agency does not notify the existing permittee and the proposed new permittee of its intent to modify or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement.

(16) All manufacturing, commercial, mining, and silvicultural dischargers must notify the Agency as soon as they know or have reason to believe:

(a) That any activity has occurred or will occur which would result in the discharge of any toxic pollutant identified under Section 307 of the Clean Water Act which is not limited in the permit, if that discharge will exceed the highest of the following notification levels:

(1) One hundred micrograms per liter (100 ug/l);

(2) Two hundred micrograms per liter (200 ug/l) for acrolein and acrylonitrile; five hundred micrograms per liter (500 ug/l) for 2,4-dinitrophenol and for 2-methyl-4,6 dinitrophenol; and one milligram per liter (1 mg/l) for antimony.

(3) Five (5) times the maximum concentration value reported for that pollutant in the NPDES permit application; or

(4) The level established by the Agency in this permit.

(b) That they have begun or expect to begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant which was not reported in the NPDES permit application.

(17) All Publicly Owned Treatment Works (POTWs) must provide adequate notice to the Agency of the following:

(a) Any new introduction of pollutants into that POTW from an indirect discharge which would be subject to Sections 301 or 306 of the Clean Water Act if it were directly discharging those pollutants; and

(b) Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.

(c) For purposes of this paragraph, adequate notice shall include information on (i) the quality and quantity of effluent introduced into the POTW, and (ii) any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

(18) If the permit is issued to a publicly owned or publicly regulated treatment works, the permittee shall require any industrial user of such treatment works to comply with federal requirements concerning:

(a) User charges pursuant to Section 204 (b) of the Clean Water Act, and applicable regulations appearing in 40 CFR 35;

(b) Toxic pollutant effluent standards and pretreatment standards pursuant to Section 307 of the Clean Water Act; and

(c) Inspection, monitoring and entry pursuant to Section 308 of the Clean Water Act.

(19) If an applicable standard or limitation is promulgated under Section 301(b)(2)(C) and (D), 304(b)(2), or 307(a)(2) and that effluent standard or limitation is more stringent than any effluent limitation in the permit, or controls a pollutant not limited in the permit, the permit shall be promptly modified or revoked, and reissued to conform to that effluent standard or limitation.

(20) Any authorization to construct issued to the permittee pursuant to 35 Ill. Adm. Code 309.154 is hereby incorporated by reference as a condition of this permit.

(21) The permittee shall not make any false statement, representation or certification in any application, record, report, plan or other document submitted to the Agency or the USEPA, or required to be maintained under this permit.

(22) The Clean Water Act provides that any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Clean Water Act is subject to a civil penalty not to exceed $25,000 per day of such violation. Any person who willfully or negligently violates permit conditions implementing Sections 301, 302, 306, 307, 308, 318 or 405 of the Clean Water Act is subject to a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than one year, or both.

Additional penalties for violating these sections of the Clean Water Act are identified in 40 CFR 122.41(a)(2) and (3).

(23) The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000, or by imprisonment for not more than 2 years, or both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment is a fine of not more than $20,000 per day of violation, or by imprisonment of not more than 4 years, or both.

(24) The Clean Water 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 non-compliance 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.

(25) Collected screening, slurries, sludges, and other solids shall be disposed of in such a manner as to prevent entry of those wastes (or runoff from the wastes) into waters of the State. The proper authorization for such disposal shall be obtained from the Agency and is incorporated as part hereof by reference.

(26) In case of conflict between these standard conditions and any other condition(s) included in this permit, the other condition(s) shall govern.

(27) The permittee shall comply with, in addition to the requirements of the permit, all applicable provisions of 35 Ill. Adm. Code, Subtitle C, Subtitle D, Subtitle E, and all applicable orders of the Board or any court with jurisdiction.

(28) The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit is held invalid, the remaining provisions of this permit shall continue in full force and effect.

(Rev. 7-9-2010 bah)

Attachment H

Standard Conditions

Definitions

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Maximum Daily Discharge Limitation (daily maximum) means the highest allowable daily discharge.

Average Monthly Discharge Limitation (30 day average) means the highest allowable average of daily discharges over a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month.

Average Weekly Discharge Limitation (7 day average) means the highest allowable average of daily discharges over a calendar week, calculated as the sum of all daily discharges measured during a calendar week divided by the number of daily discharges measured during that week.

Best Management Practices (BMPs) means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the State. BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Aliquot means a sample of specified volume used to make up a total composite sample.

Grab Sample means an individual sample of at least 100 milliliters collected at a randomly-selected time over a period not exceeding 15 minutes.

24-Hour Composite Sample means a combination of at least 8 sample aliquots of at least 100 milliliters, collected at periodic intervals during the operating hours of a facility over a 24-hour period.

8-Hour Composite Sample means a combination of at least 3 sample aliquots of at least 100 milliliters, collected at periodic intervals during the operating hours of a facility over an 8-hour period.

Flow Proportional Composite Sample means a combination of sample aliquots of at least 100 milliliters collected at periodic intervals such that either the time interval between each aliquot or the volume of each aliquot is proportional to either the stream flow at the time of sampling or the total stream flow since the collection of the previous aliquot.

(1) **Duty to comply**. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action, permit termination, revocation and reissuance, modification, or for denial of a permit renewal application. The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if the permit has not yet been modified to incorporate the requirements.

(2) **Duty to reapply**. If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. If the permittee submits a proper application as required by the Agency no later than 180 days prior to the expiration date, this permit shall continue in full force and effect until the final Agency decision on the application has been made.

(3) **Need to halt or reduce activity not a defense**. 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.

(4) **Duty to mitigate**. The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

(5) **Proper operation and maintenance**. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up, or auxiliary facilities, or similar systems only when necessary to achieve compliance with the conditions of the permit.

(6) **Permit actions**. This permit may be modified, revoked and reissued, or terminated for cause by the Agency pursuant to 40 CFR 122.62 and 40 CFR 122.63. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

(7) **Property rights**. This permit does not convey any property rights of any sort, or any exclusive privilege.

(8) **Duty to provide information**. The permittee shall furnish to the Agency within a reasonable time, any information which the Agency may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with the permit. The permittee shall also furnish to the Agency upon request, copies of records required to be kept by this permit.

(9) **Inspection and entry**. The permittee shall allow an authorized representative of the Agency or USEPA (including an authorized contractor acting as a representative of the Agency or USEPA), upon the presentation of credentials and other documents as may be required by law, to:

(a) Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records

must be kept under the conditions of this permit;
(b) Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;
(c) Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and
(d) Sample or monitor at reasonable times, for the purpose of assuring permit compliance, or as otherwise authorized by the Act, any substances or parameters at any location.

(10) **Monitoring and records**.
(a) Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.
(b) The permittee shall retain records of all monitoring information, including all calibration and maintenance records, and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of this permit, measurement, report or application. Records related to the permittee's sewage sludge use and disposal activities shall be retained for a period of at least five years (or longer as required by 40 CFR Part 503). This period may be extended by request of the Agency or USEPA at any time.
(c) Records of monitoring information shall include:
(1) The date, exact place, and time of sampling or measurements;
(2) The individual(s) who performed the sampling or measurements;
(3) The date(s) analyses were performed;
(4) The individual(s) who performed the analyses;
(5) The analytical techniques or methods used; and
(6) The results of such analyses.
(d) Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit. Where no test procedure under 40 CFR Part 136 has been approved, the permittee must submit to the Agency a test method for approval. The permittee shall calibrate and perform maintenance procedures on all monitoring and analytical instrumentation at intervals to ensure accuracy of measurements.

(11) **Signatory requirement**. All applications, reports or information submitted to the Agency shall be signed and certified.
(a) **Application**. All permit applications shall be signed as follows:
(1) For a corporation: by a principal executive officer of at least the level of vice president or a person or position having overall responsibility for environmental matters for the corporation:
(2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or
(3) For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official.
(b) **Reports**. All reports required by permits, or other information requested by the Agency shall be signed by a person described in paragraph (a) or by a duly authorized representative of that person. A person is a duly authorized representative only if:
(1) The authorization is made in writing by a person described in paragraph (a); and
(2) The authorization specifies either an individual or a position responsible for the overall operation of the facility, from which the discharge originates, such as a plant manager, superintendent or person of equivalent responsibility; and
(3) The written authorization is submitted to the Agency.
(c) **Changes of Authorization**. If an authorization under (b) is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of (b) must be submitted to the Agency prior to or together with any reports, information, or applications to be signed by an authorized representative.
(d) **Certification**. Any person signing a document under paragraph (a) or (b) of this section shall make the following certification:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

(12) **Reporting requirements**.
(a) **Planned changes**. The permittee shall give notice to the Agency as soon as possible of any planned physical alterations or additions to the permitted facility.
Notice is required when:
(1) The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source pursuant to 40 CFR 122.29 (b); or
(2) The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements pursuant to 40 CFR 122.42 (a)(1).
(3) The alteration or addition results in a significant change in the permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan.
(b) **Anticipated noncompliance**. The permittee shall give advance notice to the Agency of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.
(c) **Transfers**. This permit is not transferable to any person except after notice to the Agency.
(d) **Compliance schedules**. Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date.
(e) **Monitoring reports**. Monitoring results shall be reported at the intervals specified elsewhere in this permit.
(1) Monitoring results must be reported on a Discharge Monitoring Report (DMR).

(2) If the permittee monitors any pollutant more frequently than required by the permit, using test procedures approved under 40 CFR 136 or as specified in the permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR.

(3) Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Agency in the permit.

(f) **Twenty-four hour reporting**. The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24-hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and time; and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance. The following shall be included as information which must be reported within 24-hours:

(1) Any unanticipated bypass which exceeds any effluent limitation in the permit.

(2) Any upset which exceeds any effluent limitation in the permit.

(3) Violation of a maximum daily discharge limitation for any of the pollutants listed by the Agency in the permit or any pollutant which may endanger health or the environment.

The Agency may waive the written report on a case-by-case basis if the oral report has been received within 24-hours.

(g) **Other noncompliance**. The permittee shall report all instances of noncompliance not reported under paragraphs (12) (d), (e), or (f), at the time monitoring reports are submitted. The reports shall contain the information listed in paragraph (12) (f).

(h) **Other information**. Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application, or in any report to the Agency, it shall promptly submit such facts or information.

(13) **Bypass**.

(a) 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.

(b) 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 assure efficient operation. These bypasses are not subject to the provisions of paragraphs (13)(c) and (13)(d).

(c) Notice.

(1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of the bypass.

(2) Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in paragraph (12)(f) (24-hour notice).

(d) Prohibition of bypass.

(1) Bypass is prohibited, and the Agency may take enforcement action against a permittee for bypass, unless:

(i) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(ii) 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 back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

(iii) The permittee submitted notices as required under paragraph (13)(c).

(2) The Agency may approve an anticipated bypass, after considering its adverse effects, if the Agency determines that it will meet the three conditions listed above in paragraph (13)(d)(1).

(14) **Upset**.

(a) Definition. Upset means 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. 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.

(b) Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of paragraph (14)(c) are met. 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.

(c) Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

(1) An upset occurred and that the permittee can identify the cause(s) of the upset;

(2) The permitted facility was at the time being properly operated; and

(3) The permittee submitted notice of the upset as required in paragraph (12)(f)(2) (24-hour notice).

(4) The permittee complied with any remedial measures required under paragraph (4).

(d) Burden of proof. In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

(15) **Transfer of permits.** Permits may be transferred by modification or automatic transfer as described below:
  (a) Transfers by modification. Except as provided in paragraph (b), a permit may be transferred by the permittee to a new owner or operator only if the permit has been modified or revoked and reissued pursuant to 40 CFR 122.62 (b) (2), or a minor modification made pursuant to 40 CFR 122.63 (d), to identify the new permittee and incorporate such other requirements as may be necessary under the Clean Water Act.
  (b) Automatic transfers. As an alternative to transfers under paragraph (a), any NPDES permit may be automatically transferred to a new permittee if:
    (1) The current permittee notifies the Agency at least 30 days in advance of the proposed transfer date;
    (2) The notice includes a written agreement between the existing and new permittees containing a specified date for transfer of permit responsibility, coverage and liability between the existing and new permittees; and
    (3) The Agency does not notify the existing permittee and the proposed new permittee of its intent to modify or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement.

(16) All manufacturing, commercial, mining, and silvicultural dischargers must notify the Agency as soon as they know or have reason to believe:
  (a) That any activity has occurred or will occur which would result in the discharge of any toxic pollutant identified under Section 307 of the Clean Water Act which is not limited in the permit, if that discharge will exceed the highest of the following notification levels:
    (1) One hundred micrograms per liter (100 ug/l);
    (2) Two hundred micrograms per liter (200 ug/l) for acrolein and acrylonitrile; five hundred micrograms per liter (500 ug/l) for 2,4-dinitrophenol and for 2-methyl-4,6 dinitrophenol; and one milligram per liter (1 mg/l) for antimony.
    (3) Five (5) times the maximum concentration value reported for that pollutant in the NPDES permit application; or
    (4) The level established by the Agency in this permit.
  (b) That they have begun or expect to begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant which was not reported in the NPDES permit application.

(17) All Publicly Owned Treatment Works (POTWs) must provide adequate notice to the Agency of the following:
  (a) Any new introduction of pollutants into that POTW from an indirect discharge which would be subject to Sections 301 or 306 of the Clean Water Act if it were directly discharging those pollutants; and
  (b) Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.
  (c) For purposes of this paragraph, adequate notice shall include information on (i) the quality and quantity of effluent introduced into the POTW, and (ii) any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

(18) If the permit is issued to a publicly owned or publicly regulated treatment works, the permittee shall require any industrial user of such treatment works to comply with federal requirements concerning:
  (a) User charges pursuant to Section 204 (b) of the Clean Water Act, and applicable regulations appearing in 40 CFR 35;
  (b) Toxic pollutant effluent standards and pretreatment standards pursuant to Section 307 of the Clean Water Act; and
  (c) Inspection, monitoring and entry pursuant to Section 308 of the Clean Water Act.

(19) If an applicable standard or limitation is promulgated under Section 301(b)(2)(C) and (D), 304(b)(2), or 307(a)(2) and that effluent standard or limitation is more stringent than any effluent limitation in the permit, or controls a pollutant not limited in the permit, the permit shall be promptly modified or revoked, and reissued to conform to that effluent standard or limitation.

(20) Any authorization to construct issued to the permittee pursuant to 35 Ill. Adm. Code 309.154 is hereby incorporated by reference as a condition of this permit.

(21) The permittee shall not make any false statement, representation or certification in any application, record, report, plan or other document submitted to the Agency or the USEPA, or required to be maintained under this permit.

(22) The Clean Water Act provides that any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Clean Water Act is subject to a civil penalty not to exceed $25,000 per day of such violation. Any person who willfully or negligently violates permit conditions implementing Sections 301, 302, 306, 307, 308, 318 or 405 of the Clean Water Act is subject to a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than one year, or both.
Additional penalties for violating these sections of the Clean Water Act are identified in 40 CFR 122.41 (a)(2) and (3).

(23) The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000, or by imprisonment for not more than 2 years, or both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment is a fine of not more than $20,000 per day of violation, or by imprisonment of not more than 4 years, or both.

(24) The Clean Water 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 non-compliance 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.

(25) Collected screening, slurries, sludges, and other solids shall be disposed of in such a manner as to prevent entry of those wastes (or runoff from the wastes) into waters of the State. The proper authorization for such disposal shall be obtained from the Agency and is incorporated as part hereof by reference.

(26) In case of conflict between these standard conditions and any other condition(s) included in this permit, the other condition(s) shall govern.

(27) The permittee shall comply with, in addition to the requirements of the permit, all applicable provisions of 35 Ill. Adm. Code, Subtitle C, Subtitle D, Subtitle E, and all applicable orders of the Board or any court with jurisdiction.

(28) The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit is held invalid, the remaining provisions of this permit shall continue in full force and effect.

(Rev. 7-9-2010 bah)

United States Environmental Protection Agency | Office of Enforcement and Compliance Assurance | September 2015

Final NPDES Electronic Reporting Rule

On 24 September 2015, Administrator Gina McCarthy signed the final National Pollutant Discharge Elimination System (NPDES) Electronic Reporting Rule for publication in the Federal Register. The publication of this rule is the latest step in an extensive multi-year outreach effort with EPA's state, tribal and territorial partners. This rule will replace most paper-based Clean Water Act (CWA) NPDES permitting and compliance monitoring reporting requirements with electronic reporting.

Purpose of the Final Rule

This final rule is designed to save authorized state, tribe, or territorial NPDES programs considerable resources, make reporting easier for NPDES-regulated entities, streamline permit renewals, ensure full exchange of basic NPDES permit data between states and EPA, improve environmental decision-making, and better protect human health and the environment.

This final rule requires that NPDES regulated entities electronically submit the following permit and compliance monitoring information instead of using paper reports:

- Discharge Monitoring Reports (DMRs);
- Notices of Intent to discharge in compliance with a general permit; and
- Program reports.

Authorized NPDES programs will also electronically submit NPDES program data to EPA to ensure that there is consistent and complete reporting nationwide, and to expedite the collection and processing of the data, thereby making it more accurate and timely. Importantly, while the rule changes the method by which information is provided (i.e., electronic rather than paper-based), it does not increase the amount of information required from NPDES regulated entities facilities under existing regulations.

Overview of Benefits

EPA anticipates that the final rule will save significant resources for states, tribes, and territories as well as EPA and NPDES permittees, while resulting in a more complete, accurate, and nationally-consistent set of data about the NPDES program. With full implementation (5 years after the effective date), the anticipated savings are:

- Authorized State NPDES programs: $22.6 million annually,
- NPDES regulated entities: $0.5 million annually, and
- EPA: $1.2 million annually.

As an example demonstrating the benefits of electronic reporting is the State of Ohio's electronic reporting program for Discharge Monitoring Reports, which has a 99.9 percent adoption rate. This program has increased data quality and improved environmental protection, while also saving significant time and resources (e.g., Ohio was able to shift resources from five full-time staff to less than one to support the DMR program). The benefits of this final rule should allow NPDES-authorized programs in states, tribes, and territories to shift precious resources from data management activities to those more targeted to solving water quality issues.

Separate from this rulemaking, to promote transparency and accountability, EPA intends to make this more complete set of data available to the public, providing communities and citizens with information on facility and government performance. This can serve to elevate the importance of permitting and compliance information and environmental performance within regulated entities, providing opportunities for them to quickly address any potential environmental problems.

The final rule will also lighten the reporting burden currently placed on the states. Upon successful implementation, the final rule would provide states with regulatory relief from reporting associated with the Quarterly Non-Compliance Report, the Annual Non-Compliance Report, the Semi-Annual Statistical Summary Report, and the biosolids information required to be submitted to EPA annually by states.

Implementation

EPA will phase in the requirements of the rule over a five year period following the effective date of the final rule.

Phase 1 – One year after effective date of final rule

In Phase 1, EPA will begin to electronically receive information from authorized states, tribes, and territories regarding inspections, violation determinations, and enforcement actions. EPA, states, tribes, and territories will electronically receive Discharge Monitoring Report (DMR) information from NPDES permittees – the largest volume of data for the NPDES program. Also included in Phase 1 are the Sewage Sludge/Biosolids Annual Program Reports for the 42 states where EPA implements the Federal Biosolids Program.

Additionally, one year after the effective date of the final rule, authorized NPDES programs will submit an implementation plan for meeting the Phase 2 data requirements for EPA to review.

Phase 2—Five years after effective date of final rule

For Phase 2, EPA and authorized state NPDES programs have five years to begin electronically collecting, managing, and sharing the remaining set of NPDES program information. This information includes: general permit reports (e.g. Notice of Intent to be covered (NOI); Notice of Termination (NOT); No Exposure Certification (NOE); Low Erosivity Waiver and Other Waivers from Stormwater Controls (LEW)); Sewage Sludge/Biosolids Annual Program Report (where the state is

the authorized NPDES biosolids program); and all other remaining NPDES program reports. These program reports include:

- Sewage Sludge/Biosolids Annual Program Reports [40 CFR 503] (for the 8 states that implement the Federal Biosolids Program)
- Concentrated Animal Feeding Operation (CAFO) Annual Program Reports [40 CFR 122.42(e)(4)]
- Municipal Separate Storm Sewer System (MS4) Program Reports [40 CFR 122.34(g)(3) and 122.42(c)]
- Pretreatment Program Reports [40 CFR 403.12(i)]
- Significant Industrial User Compliance Reports in Municipalities Without Approved Pretreatment Programs [40 CFR 403.12(e) and (h)]
- Sewer Overflow/Bypass Event Reports [40 CFR 122.41(l)(4), (l)(6) and (7), (m)(3)]
- CWA Section 316(b) Annual Reports [40 CFR 125 Subpart J]

How the final rule addresses comments

In response to concerns about implementation raised during the comment periods, the final rule provides authorized NPDES programs more flexibility to implement the final rule by providing them up to three additional years to electronically collect, manage, and share their data. Authorized NDPES Programs will also have more flexibility in how they can grant electronic reporting waivers.

Further Information

For additional information, please contact Messrs. John Dombrowski, Director, Enforcement Targeting and Data Division (202-566-0742) or Carey A. Johnston (202-566-1014), Office of Compliance (mail code 2222A), Environmental Protection Agency, 1200 Pennsylvania Avenue, N.W., Washington, DC, 20460; e-mail addresses: dombrowkski.john@epa.gov or johnston.carey@epa.gov.

Useful Final Rule Link:

Email sign up for outreach events
https://public.govdelivery.com/accounts/USAEPAOECA/subscriber/new?

Appendix A.2-B

PROPOSED APPROACH TO CHEM P DOSE AND COST EVALUATION

PROJECT MEMORANDUM

PHOSPHORUS REMOVAL FEASIBILITY STUDIES FOR THE KIRIE AND EGAN WATER RECLAMATION PLANTS (16-RFP-21)

Date: December 7, 2017
Project No.: 10789A00

Metropolitan Water Reclamation District of Greater Chicago

Prepared By:	Shantanu Agrawal; Cari Ishida, PhD, P.E., ENV SP
Reviewed By:	John Fraser, P.E.; Matt Larson, P.E.
Subject:	Proposed Approach to Chemical Phosphorus Removal Dose and Cost Evaluation

Objective

The objective of this project memorandum (PM) is to summarize the proposed approach to developing the chemical phosphorus (chem P) dose and cost evaluation for the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC or District) Phosphorus Removal Feasibility Study for Kirie and Egan Water Reclamation Plants (WRPs).

Introduction

Task A.2: Conduct a Long-Term Phosphorus Reduction Feasibility Study for Contract No. 16-RFP-21 requires the evaluation of chem P for phosphorus reduction. This PM summarizes Carollo's proposed approach to developing the chem P evaluation in the following steps:

1. **Review previous studies.** Review available literature related to previous chem P analyses conducted by the MWRDGC to date.
2. **Select chemical.** Select either alum or ferric chloride ($FeCl_3$) as the preferred chemical for further evaluation based on discussions with District staff.
3. **Jar testing.** Provide District staff with chem P jar testing protocols if jar test results are desired by District staff.
4. **Cost evaluations.** Proceed with chem P cost evaluations based on either:
   a. Recent jar test data, or
   b. Results of previous studies.

These steps are discussed in the following sections.

Review Previous MWRDGC Chem P Studies

This section summarizes the information available to estimate chem P dosing requirements for the Kirie and Egan WRPs. The studies reviewed included previous phosphorus removal studies provided by District staff and available on the District's website. Attachment A shows the calculations based on the data shown in the previous MWRDGC chem P studies to determine the equivalent chem P doses evaluated.

Water Environment Research Foundation (WERF) Sustainable Technology for Achieving Very Low Nitrogen and Phosphorus Effluent Levels

Published in 2009, this study was completed by Dr. Krishna Pagilla and Meltem Urgun-Demirtas from the Illinois Institute of Technology to investigate whether it is possible to achieve and sustain low total nitrogen (TN) and low total phosphorus (TP) concentrations in wastewater treatment plant effluents. The study included evaluation of several United States and international WRPs, including the Egan WRP.

Nitrogen removal was demonstrated using step-feed configuration with 1, 2 and 3 anoxic zones and 2 step feed points.

A full-scale chem P demonstration study was conducted at the Egan WRP to achieve TP removal with minimal capital modifications from January through May 2005 (Winter Period) and July through October 2005 (Summer Period). Ferric chloride was already available for use at the Egan WRP and was used to precipitate P in the mixed liquor (ML) at the downstream end of Pass 3 of the aeration tank to achieve P removal.

The test objective was to achieve target effluent limits of less than 0.5 mg/L TP. Test results showed that an average chemical dosing rate of 14.8 mg $FeCl_3$ / mg Sol-P used during winter yielded secondary effluent of 0.10 mg TP/L, and an average chemical dosing rate of 12 mg $FeCl_3$ / mg Sol-P during summer yielded secondary effluent of 0.43 mg TP/L.

Final Report on Phosphorus Reduction at the John E. Egan Water Reclamation Plant

Published in December 2010, this study was conducted by the MWRDGC Monitoring and Research Department (M&R) to evaluate the effects of P reduction at the Egan WRP. Chemical dosing was conducted in two phases:

- Phase I had a chemical feed point at the ML at end of each aeration tank.
- Phase II had a chemical feed point at the effluent chamber of the aerated grit tanks before primary settling tanks.

To achieve effluent TP concentrations of less than 0.5 mg/L (final effluent 0.44 mg/L), $FeCl_3$ was added using a chemical loading of 11.5 mg $FeCl_3$ / mg Sol-P (Phase I) and 12 mg $FeCl_3$ / mg Sol-P (Phase II).

Presentation: Tracking Sources of Phosphorus and the District's Action Plan for Sustainable Phosphorus Management

This presentation was by given by Kuldip Kumar and Brett Garelli during M&R Seminar on February 24, 2012. It discussed the various sources of P in the District's wastewater and their contributions to the P load at the three large WRPs (Stickney, Calumet & O'Brien). The presentation also discussed the associated costs of chemicals and sludge production due to the use of ferric chloride to meet effluent target limits of 0.5 and 1 mg TP/L.

To achieve target effluent TP limits of 0.5 mg/L and 1 mg/L at Stickney, Calumet, and O'Brien WRPs, a chemical dosing rate of 10.5 mg $FeCl_3$ / mg Sol-P was assumed to analyze sludge and chemical costs for chem P removal.

Summary of Chem P Dosing Studies

Table 1 summarizes the equivalent chem P doses and target effluent concentrations based on the calculations shown in Attachment A.

Table 1 Summary of Equivalent Chem P Doses and Target Effluent P Concentrations

Final Effluent P Targeted or Measured (mg/L)	Equivalent Dose (mg $FeCl_3$/mg Sol-P)	Notes
0.5 and 1.0	10.5	Based on presentation for O'Brien, Calumet, and Stickney WRPs
0.44	11.5-12.0	Based on full-scale tests at Egan WRP
0.43 (secondary effluent)	12	Based on WERF study at Egan WRP during summer months
0.28 (secondary effluent)	12.5	Based on WERF study at Egan WRP during summer months
0.1 (secondary effluent)	14.8	Based on WERF study at Egan WRP during winter months

Figure 1 compares the theoretical Chemical P Removal Dose Curve (trendline for a scatter plot) using ferric chloride[1] to the chemical doses found in previous MWRDGC Chem P Studies, as summarized in the table above. The MWRDGC data points align with the theoretical dose curve for final effluent P levels greater than 0.3 mg/L. Below 0.3 mg/L, the District measured data are lower than the theoretical dose curve.

It is important to note that at very low, residual P levels (less than 0.2 mg/L), the dose variability is due to water chemistry differences (e.g. alkalinity, pH, and the carbonate equilibria, as well as physical differences at each plant (e.g. number and locations of chemical application points, type and degree of mixing, contact time, etc.). For these reasons, more detailed jar and full-scale testing would help to hone in on the most appropriate ferric chloride dose to target low effluent P limits, such as the 0.1 mg/L P limit for design purposes.

[1] Based on Figure 8.3 in WEF Manual of Practice No. 37.

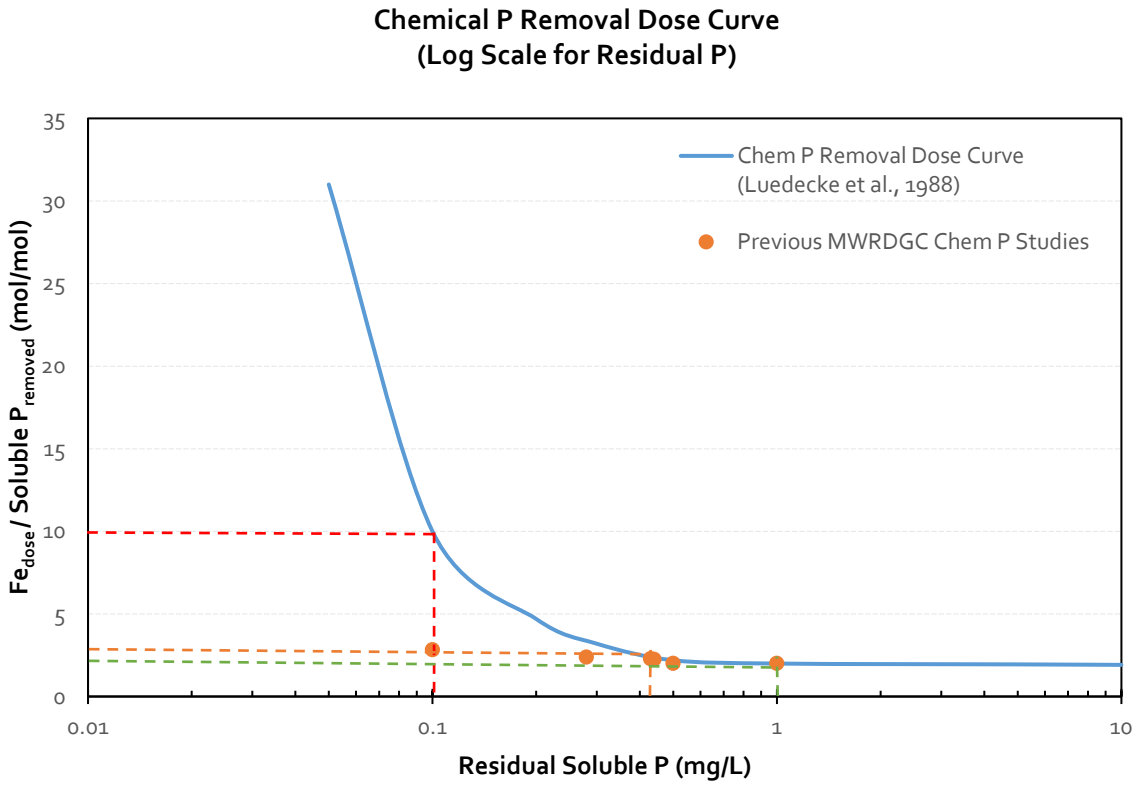

Figure 1 Comparison of Theoretical Chemical P Removal Dose (WEF MOP No. 37) and Results of MWRDCG Chem P Studies

Select Chemical

For the WERF Egan WRP study, $FeCl_3$ was preferred over alum for P removal using chemical precipitation as $FeCl_3$ was already being used at Egan for struvite control in its post-digestion dewatering system. Studies of side-by-side testing of different chemicals were not available. Since $FeCl_3$ seems to be the preferred chemical, it is assumed that costs will be based upon $FeCl_3$ addition.

Jar Testing

If District staff prefers to perform jar tests to determine chemical doses, particularly for the lowest P limit of 0.1 mg/L, an example jar testing protocol is included in Attachment B. Supplemental jar testing forms from EPA guidance documents are included in Attachment C.

District staff may also elect to perform jar tests to evaluate alum doses if chem P cost estimates for alum are desired.

Recommendations for Cost Evaluations

Based on the studies reviewed, Carollo recommends proceeding with the following assumed $FeCl_3$ doses for cost estimate development in the Kirie & Egan WRP Feasibility Studies:

- 10.5 mg $FeCl_3$ / mg Sol-P for meeting 1.0 mg/L TP.
- 12 mg $FeCl_3$ / mg Sol-P for meeting 0.5 mg/L TP.
- 52.4 mg $FeCl_3$ / mg Sol-P for meeting 0.1 mg/L TP.

Based on the review of previous studies, effluent TP limits of 1.0 mg/L can be easily achieved using a chemical dosing rate of 10.5 mg $FeCl_3$ / mg Sol-P (Fe/P molar ratio of 2). To achieve effluent TP limits of 0.5 mg/L, an optimal chemical dosing rate of 12 mg $FeCl_3$ / mg Sol-P can be used (Fe/P molar ratio of 2.3). These recommended chemical dosing rates to reach effluent TP limits of 1.0 mg/L and 0.5 mg/L also match very well with the suggested dosing rates based upon theoretical Chemical P Removal Dose Curve.

Although increased chemical dosing rate of 15 mg $FeCl_3$ / mg Sol-P has been shown to achieve TP limits of 0.1 mg/L in the secondary effluent alone, the dose is much less than the theoretical value shown in the figure above. For budgetary cost estimating purposes, the theoretical Chemical P Removal Dose Curve will be assumed for the purposes of the Kirie and Egan Feasibility Studies. Based on the theoretical curve, effluent TP limits of 0.1 mg/L should be achieved using a chemical dosing rate of 52.4 mg $FeCl_3$ / mg Sol-P (Fe/P molar ratio of 10). TP levels in the secondary effluent can be further reduced by the presence of tertiary filters, as is the case with Egan WRP, thus creating a potential to achieve final effluent TP levels of less than 0.1 mg/L.

Additional jar or full-scale tests can be performed at a later date if District staff desire to evaluate $FeCl_3$ and/or alum doses specific to Kirie and Egan WRPs, particularly related to very low TP effluent limits (0.1 mg/L).

References

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Luedecke, C.; Hermanowicz, S.W.; Jenkins, D. (1989) Precipitation of Ferric Phosphate in Activated Sludge: A Chemical Model and Its Verification. *Water Science and Technology* (Vol. 21, pp. 325-337).

Pagilla, K.R.; Urgum-Demirtas, M. (2009) Sustainable technology for achieving very low nitrogen and phosphorus effluent levels. *WERF.*

Water Environment Federation. 2013. Operation of Nutrient Removal Facilities, Manual of Practice 37.

Zhang, H.; Wasik, J.; Patel, K.; Tian, G. (2010) Final report on phosphorus reduction at the John E. Egan water reclamation plant. *Metropolitan Water Reclamation District of Greater Chicago.*

Attachment A

CALCULATIONS TO DETERMINE EQUIVALENT CHEM P DOSES BASED ON PREVIOUS MWRDGC STUDIES

Project Name: Phosphorus Removal Feasibility Study for the Kirie and Egan Water Reclamation Plants (16-RFP-21)
Facility: Egan WRP and Kirie WRP
Design Stage: Planning
Date: 2-Nov-17
Purpose: To use data from previous MWRDGC study to calculate equivalent ferric chloride doses for P removal

Project Number: 10789A.00
Prepared By: Shantanu Agrawal
Reviewed By: Cari Ishida

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Legend	
	Inputs
	Given Related Information
	Calculations
	Estimated Chemical Dosing Rate

F

WERF Egan Study - Calculation Worksheet[1]

Avg Conc. of Total P in final effluent at Egan with no enhanced P removal in the plant (mg/L) ("A")	2.93

Final TP achived using $FeCl_3$ during demonstration period (mg/L) ("B")	Total P removed (mg Sol-P/L) ("C" = A - B)	$FeCl_3$ loading used (mg/L) ("D")	mg $FeCl_3$ / mg Sol-P (D/C)	Notes
0.1	2.83	42	14.8	winter
0.43	2.5	30	12.0	summer
0.28	2.65	33	12.5	summer

Final Report on Phosphorus Reduction at the John E. Egan Water Reclamation Plant - Calculation Worksheet[2]

Molar Mass of $FeCl_3$ (g)	162.2
Molar Mass of P (g)	30.97
Final effluent TP (mg/L)	0.44

Fe:Sol-P molar ratio used to achieve effluent TP of 0.5 mg/L (Given) ("E")	Molar to mass ratio conversion factor (mg $FeCl_3$ / mg Sol=P) (Calculated) ("F")	mg $FeCl_3$ / mg Sol-P (E*F)	Notes
2.2	5.24	11.5	Phase I, $FeCl_3$ added at the end of aeration tanks
2.3	5.24	12.0	Phase II, $FeCl_3$ added into the influent of Primary Settling Tanks

Presentation: Tracking Sources of Phosphorus and the District's Action Plan for Sustainable Phosphorus Management - Calculation Worksheet[3]

Target effluent P (mg/L)	0.5 and 1
Assumed Ferric Dosing (mg $FeCl_3$ / mg Sol-P) ("G")	10.5

WRP	Flow (MGD)	Influent P (mg/L)
O'Brien	225	3.39
Calumet	253	6.64
Stickney	680	7.06

Notes:

(1) Pagilla, K.R.; Urgum-Demirtas, M. (2009) Sustainable technology for achieving very low nitrogen and phosphorus effluent levels. WERF.
(2) Zhang, H.; Wasik, J.; Patel, K.; Tian, G. (2010) Final report on phosphorus reduction at the John E. Egan water reclamation plant. Metropolitan Water Reclamation District of Greater Chicago.
(3) Kumar, K.; Garelli, B. (2012) Tracking sources of phosphorus and the district's action plan for sustainable phosphorus management. M&R Seminar. Metropolitan Water Reclamation District of Greater Chicago. In this reference, chemical dosing rate for ferric chloride was assumed to calculate sludge and chemical cost estimations.
(4) Basic reaction is as: $Fe^{+3} + H_nPO_4^{n-3} \Rightarrow FePO_4\,(s) + nH^+$

Attachment B

PROTOCOL FOR CONDUCTING BENCH-SCALE CHEMICAL PHOSPHORUS REMOVAL STUDIES

PROTOCOL FOR CONDUCTING BENCH-SCALE CHEMICAL PHOSPHORUS REMOVAL STUDIES

December 6, 2017

Objective

The primary objective of the bench-scale evaluation is to determine optimal coagulant dose for chemical phosphorus removal.

Coagulants

Ferric Chloride or alum

Equipment

- Two 5-gallon plastic buckets
- Phipps and Bird six paddle gang stirrer with 2-liter jars
- Hach 2100N turbidimeter with sample cells
- pH meter
- Sampling bottles for BOD and PO_4 analysis
- One 1-liter plastic volumetric flasks (for preparing stock/working solutions)
- Pipettes
- Distilled/De-ionized water

Procedure

1. Collect raw wastewater from grit chamber in 5-gal carboys and bring back to the laboratory.
2. Prepare 20 mg/mL working solution of ferric chloride using 40 percent w/v ferric chloride stock solution or 10,000 ppm alum. Typical coagulant doses can range from 0 to 100 mg/L, but doses as high as 150 mg/L are sometimes tested.
3. Pour wastewater into the six jars to the 2-liter mark. Add coagulant to each jar and turn on gang stirrer to 300 rpm for 60 seconds. For a control, no coagulant should be added to one of the jars (control jar is subject to mixing only).
4. At the end of 1st minute (rapid mixing) tum the mixing intensity to 30 rpm and continue mixing for 20 minutes (flocculation). At the end of 20 minutes mixing turn the stirrers off and allow the coagulated water to settle. Collect turbidity samples after 10 and 20 minutes of settling.
5. Conduct water quality analysis on the collected settled water: pH, alkalinity, turbidity, BOD and PO_4.
6. The procedure in steps 3 through 5 can be repeated for different coagulant doses with different mixing speeds. The mixing speeds can be varied from initial of 40 rpm to a maximum of 300 rpm. Based on the square geometry of the jars and the rpm paddle speed one can determine the actual mixing intensity in units of "G".

Attachment C

EPA EXAMPLE JAR TEST GUIDELINE & FORMS

Appendix L
Example Jar Test Guideline

JAR TEST PROCEDURE (page 1)

TEST CONDITIONS

Facility	Date	Time	Turbidity	Temperature	pH	Alkalinity	

Water Source	Coagulant	Coagulant Aid	

PREPARING STOCK SOLUTIONS

Step 1 — Select desired stock solution concentration (see Table 1).
Choose a stock solution concentration that will be practical for transferring chemicals to jars.

Table 1

Stock Solution (%)	Concentration (mg/L)	mg/L dosage per mL of stock solution added to 2 liter jar
0.01	100	0.05
0.05	500	0.25
0.1	1,000	0.5
0.2	2,000	1.0
0.5	5,000	2.5
1.0	10,000	5.0
1.5	15,000	7.5
2.0	20,000	10.0

Desired Stock Solution (%)	Coagulant	Coag. Aid	

Step 2 — Determine chemical amount to add to 1 liter flask.
If using dry products, see Table 2. If using liquid products, go to step 3.

Table 2

Stock Solution (%)	Conc. (mg/L)	mg of alum added to 1 liter flask
0.01	100	100
0.05	500	500
0.1	1,000	1,000
0.2	2,000	2,000
0.5	5,000	5,000
1.0	10,000	10,000
1.5	15,000	15,000
2.0	20,000	20,000

Desired Amount in 1 liter flask (mL)	Coagulant	Coag. Aid	

Step 3 — Determine liquid chemical amount to add to volumetric flask.
For liquid chemicals, use the equation below -

$$\text{mL coagulant} = \frac{\text{(stock solution \%) x (flask volume, mL) x (8.34 lb/gal)}}{\text{100 x (chemical strength, lb/gal)}}$$

	Coagulant	Polymer	
Chemical Strength (lb/gal)[1]			
Stock Solution Volume (mL)			
Desired Volume of Chemical to add to Flask (mL)			

[1] Note: Chemical Strength = chemical density x % strength

JAR TEST PROCEDURE (page 2)

JAR SETUP

Set up individual jar doses based on desired range of test.
Determine amount of stock solution by dividing dose by mg/L per mL (see Table 1).

Coagulant - Jar #	1	2	3	4	5	6	
Dose (mg/L)							
Stock Solution (mL)							

Coagulant Aid - Jar #	1	2	3	4	5	6	
Dose (mg/L)							
Stock Solution (mL)							

	1	2	3	4	5	6	
Dose (mg/L)							
Stock Solution (mL)							

TEST PROCEDURE

Step 1 — Set rapid mix time equal to rapid mix detention time.
To determine rapid mix time, use the following equation -

$$\text{Rapid mix time (min)} = \frac{\text{(rapid mix volume, gal) x (1,440 min/day) x (60 sec/min)}}{\text{(plant flow rate, gal/d)}}$$

Mix Volume (gal)	
Plant Flow Rate (gal/day)	
Mix Time (sec)	

Step 2 — Set total flocculation time equal to total flocculation detention time in plant.
To determine total flocculation time, use the following equation -

$$\text{Floc time (min)} = \frac{\text{(flocculator volume, gal) x (1,440 min/day)}}{\text{(plant flow rate, gal/d)}}$$

Floc Volume (gal)			
Floc Time (min)			

Step 3 — Use Figure 1 to determine the jar mixing energy values (rpm) that correspond to the approximate flocculator mixing energy values (G). Flocculator mixing energy can be estimated from plant design information (O&M manual) or can be calculated from the equation described in Appendix F - B.1. Flocculation.

Flocculator Stage	1st	2nd	3rd	
Flocculator Mixing (G)				
Jar Mixing (rpm)				

Step 4 — Set sample time based on particle settling velocity. Use the equation below to determine sample time when using 2 liter gator jars as described in Figure 1.

$$\text{Sample time (min)} = \frac{\text{(10 cm) x (surface area, ft}^2\text{) x (1,440 min/day) x (7.48 gal/ft}^3\text{)}}{\text{(plant flow rate, gal/d) x (30.48 cm/ft)}}$$

Sedimentation Surface Area (ft²)	
Plant Flow Rate (gal/day)	
Sample Time (min)	

JAR TEST PROCEDURE (page 3)

TEST RESULTS

Record test results in the table below.

	1	2	3	4	5	6	
Settled Turbidity (NTU)							
Settled pH							
Filtered Turbidity (NTU)							

Comments:

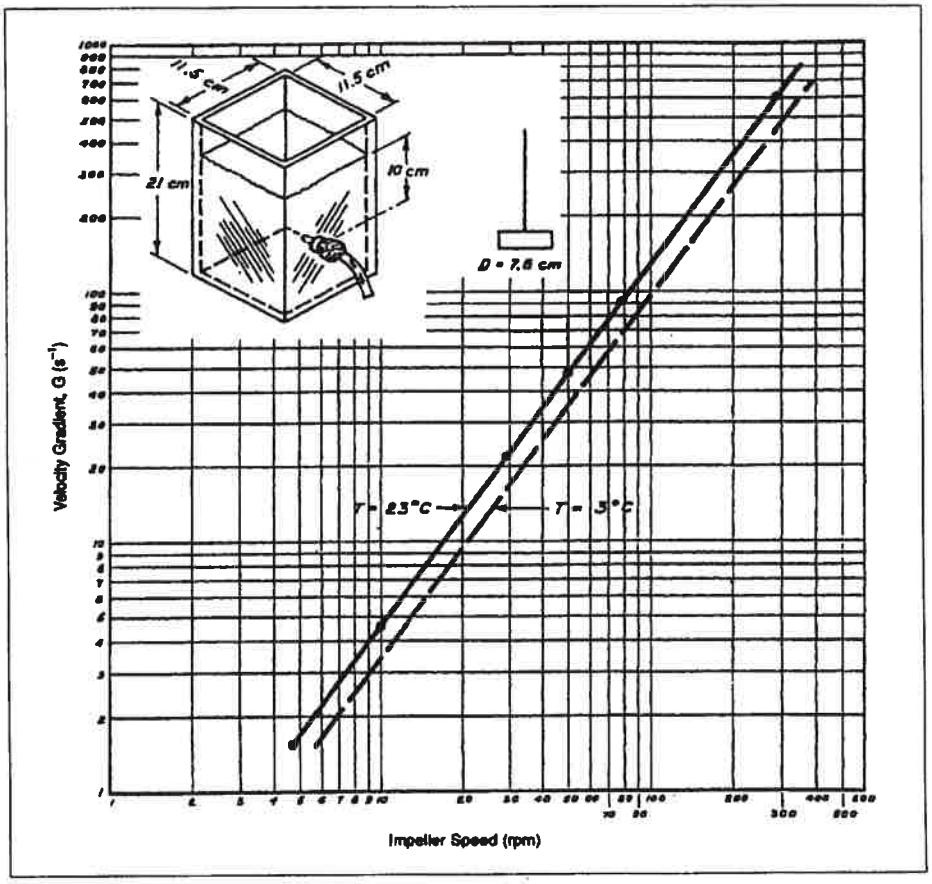

Figure 1. Laboratory G Curve for Flat Paddle in 2 Liter Gator Jar

Appendix A.2-C

DETAILED COST ESTIMATES FOR CURRENT FLOWS

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Baffle Walls		
Flow:	Current Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Baffle Walls Capital Improvements

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Baffle Walls					
Quantity	12				
Length, ft	25.5				
Width, ft	1				
Height, ft	15.5				
	Concrete - Baffle Walls	cu yd	176	$3,000	$527,000
	Demo Termprary Baffle Walls				$40,000
Subtotal for Baffle Walls					$567,000
Subtotal 1					**$567,000**
Yard Piping		0%			$0
Paving/Grading		0%			$0
Coatings		0%			$0
Electrical		0%			$0
Instrumentation		0%			$0
Total Direct Cost					**$567,000**
Estimating Contingency (30%)					$170,000
General Conditions (10%)					$57,000
GC OH (10%)					$57,000
GC P (10%)					$57,000
Total Estimated Bid Day Cost					**$908,000**
Construction Contingency (5%)					$45,000
Total Estimated Construction Cost					**$953,000**
Eng, Leg & Admin (30%)					$285,900
Total Project Cost					**$1,239,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	1st Pass Aeration Diffusers		
Flow:	Current Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

1st Pass Aeration Diffusers Capital Improvements

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
1st Pass Aeration Diffusers					
Quantity	12				
	1st Pass Aeration Diffusers	cu yd	2,580	$50	$129,000
	Pipes and Valves	%	1	50%	$64,500
	Labor	%	1	25%	$48,375
Subtotal for 1st Pass Aeration Diffusers					$242,000
Subtotal 1					**$242,000**
Yard Piping		0%			$0
Paving/Grading		0%			$0
Coatings		0%			$0
Electrical		12%			$29,000
Instrumentation		8%			$19,000
Total Direct Cost					**$290,000**
Estimating Contingency (30%)					$87,000
General Conditions (10%)					$29,000
GC OH (10%)					$29,000
GC P (10%)					$29,000
Total Estimated Bid Day Cost					**$464,000**
Construction Contingency (5%)					$23,000
Total Estimated Construction Cost					**$487,000**
Eng, Leg & Admin (30%)					$146,100
Total Project Cost					**$633,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	1st Pass Aeration Diffusers		
Flow:	Current Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

1st Pass Aeration Diffusers O&M Cost

Description		Units	Quantity	Unit Cost	Cost
O&M Cost					
Maintenance and Replacement Costs					
	Maintenace	LS	1	$24,400	$24,400
	Replacement Parts	LS	1	$968	$968
Subtotal per Year - Maintenance and Replacement					**$25,368**
Total - 1st Pass Aeration Diffusers Annual O&M Cost					**$25,368**
20 year Net Present Value for O&M Cost					
	1st Pass Aeration Diffusers	LS	1	$507,350	$507,350
Total - 1st Pass Aeration Diffusers 20 year O&M Net Present Value					**$507,350**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Large Bubble Mixers		
Flow:	Current Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Large Bubble Mixers Capital Improvements

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Large Bubble Mixers					
Quantity	10				
	Mixers	LS	1	$355,350	$355,350
	Compressor	LS	1	$20,000	$20,000
	Labor (Installation)	LS	1	$71,070	$71,070
Subtotal for Large Bubble Mixers					$447,000
Subtotal 1					**$447,000**
Yard Piping		0%			$0
Paving/Grading		0%			$0
Coatings		3%			$13,000
Electrical		8%			$36,000
Instrumentation		7%			$31,000
Total Direct Cost					**$527,000**
Estimating Contingency (30%)					$158,000
General Conditions (10%)					$53,000
GC OH&P (10%)					$53,000
GC P (10%)					$53,000
Total Estimated Bid Day Cost					**$844,000**
Construction Contingency (5%)					$42,000
Total Estimated Construction Cost					**$886,000**
Eng, Leg & Admin (30%)					$265,800
Total Project Cost					**$1,152,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Large Bubble Mixers		
Flow:	Current Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Large Bubble Mixers O&M Cost

Description		Units	Quantity	Unit Cost	Cost
O&M Cost					
Power Costs					
	Large Bubble Mixers	kW-h/yr	313,023	$0.0663	$20,753
Subtotal per Year - Power					**$20,753**
Maintenance and Replacement Costs					
	Maintenace	LS	1	$24,400	$24,400
	Replacement Parts	LS	1	$1,877	$1,877
Subtotal per Year - Maintenance and Replacement					**$26,277**
Total - Large Bubble Mixers Annual O&M Cost					**$47,030**
20 year Net Present Value for O&M Cost					
	Large Bubble Mixers	LS	1	$940,603	$940,603
Total - Large Bubble Mixers 20 year O&M Net Present Value					**$940,603**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Globe Valves (Aeration Control)		
Flow:	Current Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Globe Valves Capital Improvements

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Globe Valves					
Quantity	24				
	Globe Valves	EA	24	$6,000	$144,000
Subtotal for Globe Valves					$144,000
Subtotal 1					**$144,000**
Yard Piping		0%			$0
Paving/Grading		0%			$0
Coatings		0%			$0
Electrical		8%			$12,000
Instrumentation		7%			$10,000
Total Direct Cost					**$166,000**
Estimating Contingency (30%)					$50,000
General Conditions (10%)					$17,000
GC OH&P (10%)					$17,000
GC P (10%)					$17,000
Total Estimated Bid Day Cost					**$267,000**
Construction Contingency (5%)					$13,000
Total Estimated Construction Cost					**$280,000**
Eng, Leg & Admin (30%)					$84,000
Total Project Cost					**$364,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Globe Valves (Aeration Control)		
Flow:	Current Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Globe Valves O&M Cost

Description		Units	Quantity	Unit Cost	Cost
O&M Cost					
Maintenance and Replacement Costs					
	Maintenace	LS	1	$2,730	$2,730
	Replacement Parts	LS	1	$4,550	$4,550
Subtotal per Year - Maintenance and Replacement					**$7,280**
Total - Globe Valves O&M Cost					**$7,280**
20 year Net Present Value for O&M Cost					
	Globe Valves	LS	1	$145,600	$145,600
Total - Globe Valves 20 year O&M Net Present Value					**$145,600**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Chemical Storage Area and Tanks		
Flow:	Current Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Chemical Storage Area and Tanks Capital Improvements

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Chemical Containment Room					
Quantity	1				
	Demo	LS	1	$ 25,000	$25,000
	Concrete - Wall, Foundation, and Floor	cu yd	44	$ 3,000	$131,610
	CMU Block Wall	sq ft	580	$ 18.42	$10,684
	Door	LS	1	$ 1,500	$1,500
Chemical Storage Tanks (For All Tiers)					
Quantity	2				
	Double Walled 8,000 gallon Storage Tanks	EA	2	$30,850	$61,700
	Labor (Installation)	EA	2	$6,170	$12,340
Chemical Fill Station					
	Chemical Fill Station	LS	1	$50,000	$50,000
Subtotal for Chemical Storage Area and Tanks					$293,000
Subtotal 1					**$293,000**
Yard Piping		0%			$0
Paving/Grading		0%			$0
Coatings		5%			$15,000
Electrical		12%			$35,000
Instrumentation		8%			$23,000
Total Direct Cost					**$366,000**
Estimating Contingency (30%)					$110,000
General Conditions (10%)					$37,000
GC OH (10%)					$37,000
GC P (10%)					$37,000
Total Estimated Bid Day Cost					**$587,000**
Construction Contingency (5%)					$29,000
Total Estimated Construction Cost					**$616,000**
Eng, Leg & Admin (30%)					$184,800
Total Project Cost					**$801,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Chemical Pumps and Dosage - Tier 1		
Flow:	Current Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Chemical Pumps and Dosage - Tier 1

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Chemical Pumps and Dosage - Tier 1					
Quantity	1				
	Pump Skid Tier 1	LS	1	$125,000	$125,000
	Labor Installation	LS	1	$25,000	$25,000
Subtotal for Chemical Pumps and Dosage - Tier 1					$150,000
Subtotal 1					**$150,000**
Yard Piping		0%			$0
Paving/Grading		0%			$0
Coatings		0%			$0
Electrical		12%			$18,000
Instrumentation		8%			$12,000
Total Direct Cost					**$180,000**
Estimating Contingency (30%)					$54,000
General Conditions (10%)					$18,000
GC OH (10%)					$18,000
GC P (10%)					$18,000
Total Estimated Bid Day Cost					**$288,000**
Construction Contingency (5%)					$14,000
Total Estimated Construction Cost					**$302,000**
Eng, Leg & Admin (30%)					$90,600
Total Project Cost					**$393,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Chemical Pumps and Dosage - Tier 1		
Flow:	Current Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Chemical Pumps and Dosage - Tier 1 O&M Cost and LCC

Description		Units	Quantity	Unit Cost	Cost
O&M Cost and LCC					
Chemicals Costs					
	Ferric Chloride Dosing	$/gal	365	$0.72	$263
Subtotal per Year - Chemical					**$263**
Power Costs					
	Pumps Skid Tier 1	kW-h/yr	8,322	$0.0663	$552
Subtotal per Year - Power					**$552**
Maintenance and Replacement Costs					
	Maintenace	LS	1	$6,400	$6,400
	Replacement Parts	LS	1	$2,100	$2,100
	Truck Delivery Testing	EA	1	$55	$55
Subtotal per Year - Maintenance and Replacement					**$8,555**
Total - Chemical Pumps and Dosage - Tier 1 Annual O&M Cost					**$9,370**
20 year Net Present Value for O&M Cost					
	Chemical Pumps and Dosage - Tier 1	LS	1	$298,991	$298,991
Total - Chemical Pumps and Dosage - Tier 1 20 year O&M Net Present Value					**$298,991**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Chemical Pumps and Dosage - Tier 2		
Flow:	Current Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Chemical Pumps and Dosage - Tier 2

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Chemical Pumps and Dosage - Tier 2					
Quantity	1				
	Pump Skid Tier 2	LS	1	$150,000	$150,000
	Labor Installation	LS	1	$30,000	$30,000
Subtotal for Chemical Pumps and Dosage - Tier 2					$180,000
Subtotal 1					**$180,000**
Yard Piping		0%			$0
Paving/Grading		0%			$0
Coatings		0%			$0
Electrical		12%			$22,000
Instrumentation		8%			$14,000
Total Direct Cost					**$216,000**
Estimating Contingency (30%)					$65,000
General Conditions (10%)					$22,000
GC OH (10%)					$22,000
GC P (10%)					$22,000
Total Estimated Bid Day Cost					**$347,000**
Construction Contingency (5%)					$17,000
Total Estimated Construction Cost					**$364,000**
Eng, Leg & Admin (30%)					$109,200
Total Project Cost					**$473,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Chemical Pumps and Dosage - Tier 2		
Flow:	Current Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Chemical Pumps and Dosage - Tier 2 O&M Cost and LCC

Description		Units	Quantity	Unit Cost	Cost
O&M Cost and LCC					
Chemicals Costs					
	Ferric Chloride Dosing	$/gal	10,585	$0.72	$7,621
Subtotal per Year - Chemical					**$7,621**
Power Costs					
	Pumps Skid Tier 2	kW-h/yr	8,322	$0.0663	$552
Subtotal per Year - Power					**$552**
Maintenance and Replacement Costs					
	Maintenace	LS	1	$6,400	$6,400
	Replacement Parts	LS	1	$2,850	$2,850
	Truck Delivery Testing	LS	3	$55	$165
Subtotal per Year - Maintenance and Replacement					**$9,415**
Total - Chemical Pumps and Dosage - Tier 2 Annual O&M Cost					**$17,588**
20 year Net Present Value for O&M Cost					
	Chemical Pumps and Dosage - Tier 2	LS	1	$460,359	$460,359
Total - Chemical Pumps and Dosage - Tier 2 20 year O&M Net Present Value					**$460,359**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Chemical Pumps and Dosage - Tier 3		
Flow:	Current Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Chemical Pumps and Dosage - Tier 3

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Chemical Pumps and Dosage - Tier 3					
Quantity	1				
	Pump Skid Tier 3	LS	1	$200,000	$200,000
	Labor Installation	LS	1	$40,000	$40,000
Subtotal for Chemical Pumps and Dosage - Tier 3					$240,000
Subtotal 1					**$240,000**
Yard Piping		0%			$0
Paving/Grading		0%			$0
Coatings		0%			$0
Electrical		12%			$29,000
Instrumentation		8%			$19,000
Total Direct Cost					**$288,000**
Estimating Contingency (30%)					$86,000
General Conditions (10%)					$29,000
GC OH (10%)					$29,000
GC P (10%)					$29,000
Total Estimated Bid Day Cost					**$461,000**
Construction Contingency (5%)					$23,000
Total Estimated Construction Cost					**$484,000**
Eng, Leg & Admin (30%)					$145,200
Total Project Cost					**$629,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Chemical Pumps and Dosage - Tier 3		
Flow:	Current Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Chemical Pumps and Dosage - Tier 3 O&M Cost and LCC

Description		Units	Quantity	Unit Cost	Cost
O&M Cost and LCC					
Chemicals Costs					
	Ferric Chloride Dosing	$/gal	279,955	$0.72	$201,568
Subtotal per Year - Chemical					**$201,568**
Power Costs					
	Pumps Skid Tier 3	kW-h/yr	16,331	$0.0663	$1,083
Subtotal per Year - Power					**$1,083**
Maintenance and Replacement Costs					
	Maintenace	LS	1	$7,000	$7,000
	Replacement Parts	LS	1	$4,500	$4,500
	Truck Delivery Testing	LS	64	$55	$3,520
Subtotal per Year - Maintenance and Replacement					**$15,020**
Total - Chemical Pumps and Dosage - Tier 3 Annual O&M Cost					**$217,670**
20 year Net Present Value for O&M Cost					
	Chemical Pumps and Dosage - Tier 3	LS	1	$4,623,407	$4,623,407
Total - Chemical Pumps and Dosage - Tier 3 20 year O&M Net Present Value					**$4,623,407**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Chemical Feed Piping & Mixing		
Flow:	Current Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Chemical Feed Piping & Mixing

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Chemical Feed Piping	Double Wall Piping to all Dosage Points	LF	8,035	$66	$530,310
Chemical Mixing	Flash Mixing System	EA	6	$50,000	$300,000
Subtotal for Chemical Feed Piping & Mixing					$831,000
Subtotal 1					**$831,000**
Yard Piping		0%			$0
Paving/Grading		0%			$0
Coatings		0%			$0
Electrical		0%			$0
Instrumentation		0%			$0
Total Direct Cost					**$831,000**
Estimating Contingency (30%)					$249,000
General Conditions (10%)					$83,000
GC OH (10%)					$83,000
GC P (10%)					$83,000
Total Estimated Bid Day Cost					**$1,329,000**
Construction Contingency (5%)					$66,000
Total Estimated Construction Cost					**$1,395,000**
Eng, Leg & Admin (30%)					$418,500
Total Project Cost					**$1,814,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Tertiary Filtration (Tier 3)		
Flow:	Current Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Tertiary Filtration

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Tertiary Filtration (Tier 3)					
	Disc Filters	LS	1	$17,187,500	$17,187,500
	Miscellaneous Building Rehabilitation	%	1	10%	$1,718,750
Subtotal for Tertiary Filtration (Tier 3)					$18,907,000
Filtration Support System					
	Pumps Rehabilitation	5%			$859,000
	Piping & Valves	10%			$1,719,000
	Chemical Feed	3%			$516,000
	HVAC	10%			$172,000
Subtotal for Filtration Support Systems					$3,266,000
Subtotal					**$22,173,000**
Yard Piping		1%			$222,000
Paving/Grading		1%			$222,000
Coatings		5%			$163,000
Electrical		4%			$798,000
Instrumentation		2%			$532,000
Total Direct Cost					**$24,110,000**
Estimating Contingency (30%)					$7,233,000
General Conditions (10%)					$2,411,000
GC OH (10%)					$2,411,000
GC P (10%)					$2,411,000
Total Estimated Bid Day Cost					**$38,576,000**
Construction Contingency (5%)					$1,929,000
Total Estimated Construction Cost					**$40,505,000**
Eng, Leg & Admin (30%)					$12,151,500
Total Project Cost					**$52,657,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Tertiary Filtration (Tier 3)		
Flow:	Current Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Tertiary Filtration O&M Cost

Description		Units	Quantity	Unit Cost	Cost
O&M Cost					
Power Costs					
	Filter Pumps	kW-h/yr	3,303,727	$0.0663	$219,037
Subtotal per Year - Power					**$219,037**
Maintenance and Replacement Costs					
	Maintenace and Replacement Costs	LS	1	$76,061	$76,061
Subtotal per Year - Maintenance and Replacement					**$76,061**
Total - Tertiary Filtration (Tier 3) Annual O&M Cost					**$295,098**
20 year Net Present Value for O&M Cost					
	Tertiary Filtration (Tier 3)	LS	1	$5,901,967	$5,901,967
Total - Tertiary Filtration (Tier 3) 20 year O&M Net Present Value					**$5,901,967**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Additional Bio P and Chem P Monitoring		
Flow:	Current Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Additional Bio P and Chem P Monitoring O&M Cost

Description		Units	Quantity	Unit Cost	Cost
O&M Cost					
Miscellaneous Costs					
	Additional P Monitoring at Kirie WRP	$/day	365	180	$65,700
Total - Additional Bio P and Chem P Monitoringl O&M Cost					**$65,700**
20 year Net Present Value for O&M Cost					
	Additional P Monitoring at Kirie WRP	LS	1	$1,314,000	$1,314,000
Total - Additional Aeration 20 year O&M Net Present Value					**$1,314,000**

Appendix A.2-D

DETAILED COST ESTIMATES FOR RATED CAPACITY

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Baffle Walls		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Baffle Walls Capital Improvements

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Baffle Walls					
Quantity	20				
Length, ft	25.5				
Width, ft	1				
Height, ft	15.5				
	Concrete - Baffle Walls	cu yd	293	$3,000	$878,333
	Demo Termprary Baffle Walls				$40,000
Subtotal for Baffle Walls					$919,000
Subtotal 1					**$919,000**
Yard Piping		0%			$0
Paving/Grading		0%			$0
Coatings		0%			$0
Electrical		0%			$0
Instrumentation		0%			$0
Total Direct Cost					**$919,000**
Estimating Contingency (30%)					$276,000
General Conditions (10%)					$92,000
GC OH (10%)					$92,000
GC P (10%)					$92,000
Total Estimated Bid Day Cost					**$1,471,000**
Construction Contingency (5%)					$74,000
Total Estimated Construction Cost					**$1,545,000**
Eng, Leg & Admin (30%)					$463,500
Total Project Cost					**$2,009,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	1st Pass Aeration Diffusers		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

1st Pass Aeration Diffusers Capital Improvements

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
1st Pass Aeration Diffusers					
Quantity	20				
	1st Pass Aeration Diffusers	cu yd	4,300	$50	$215,000
	Pipes and Valves	%	1	50%	$107,500
	Labor	%	1	25%	$80,625
Subtotal for 1st Pass Aeration Diffusers					$404,000
Subtotal 1					**$404,000**
Yard Piping		0%			$0
Paving/Grading		0%			$0
Coatings		0%			$0
Electrical		12%			$48,000
Instrumentation		8%			$32,000
Total Direct Cost					**$484,000**
Estimating Contingency (30%)					$145,000
General Conditions (10%)					$48,000
GC OH (10%)					$48,000
GC P (10%)					$48,000
Total Estimated Bid Day Cost					**$773,000**
Construction Contingency (5%)					$39,000
Total Estimated Construction Cost					**$812,000**
Eng, Leg & Admin (30%)					$243,600
Total Project Cost					**$1,056,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	1st Pass Aeration Diffusers		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

1st Pass Aeration Diffusers O&M Cost

Description		Units	Quantity	Unit Cost	Cost
O&M Cost					
Maintenance and Replacement Costs					
	Maintenace	LS	1	$37,200	$37,200
	Replacement Parts	LS	1	$1,613	$1,613
Subtotal per Year - Maintenance and Replacement					**$38,813**
Total - 1st Pass Aeration Diffusers Annual O&M Cost					**$38,813**
20 year Net Present Value for O&M Cost					
	1st Pass Aeration Diffusers	LS	1	$776,250	$776,250
Total - 1st Pass Aeration Diffusers 20 year O&M Net Present Value					**$776,250**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Large Bubble Mixers		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Large Bubble Mixers Capital Improvements

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Large Bubble Mixers					
Quantity	18				
	Mixers	LS	1	$639,630	$639,630
	Compressor	LS	1	$20,000	$20,000
	Labor (Installation)	LS	1	$127,926	$127,926
Subtotal for Large Bubble Mixers					$788,000
Subtotal 1					**$788,000**
Yard Piping		0%			$0
Paving/Grading		0%			$0
Coatings		3%			$24,000
Electrical		8%			$63,000
Instrumentation		7%			$55,000
Total Direct Cost					**$930,000**
Estimating Contingency (30%)					$279,000
General Conditions (10%)					$93,000
GC OH&P (10%)					$93,000
GC P (10%)					$93,000
Total Estimated Bid Day Cost					**$1,488,000**
Construction Contingency (5%)					$74,000
Total Estimated Construction Cost					**$1,562,000**
Eng, Leg & Admin (30%)					$468,600
Total Project Cost					**$2,031,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Large Bubble Mixers		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Large Bubble Mixers O&M Cost

Description		Units	Quantity	Unit Cost	Cost
O&M Cost					
Power Costs					
	Large Bubble Mixers	kW-h/yr	563,441	$0.0663	$37,356
Subtotal per Year - Power					**$37,356**
Maintenance and Replacement Costs					
	Maintenace	LS	1	$37,200	$37,200
	Replacement Parts	LS	1	$3,298	$3,298
Subtotal per Year - Maintenance and Replacement					**$40,498**
Total - Large Bubble Mixers Annual O&M Cost					**$77,854**
20 year Net Present Value for O&M Cost					
	Large Bubble Mixers	LS	1	$1,557,086	$1,557,086
Total - Large Bubble Mixers 20 year O&M Net Present Value					**$1,557,086**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Globe Valves (Aeration Control)		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Globe Valves Capital Improvements

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Globe Valves					
Quantity	40				
	Globe Valves	EA	40	$6,000	$240,000
Subtotal for Globe Valves					$240,000
Subtotal 1					**$240,000**
Yard Piping		0%			$0
Paving/Grading		0%			$0
Coatings		0%			$0
Electrical		8%			$19,000
Instrumentation		7%			$17,000
Total Direct Cost					**$276,000**
Estimating Contingency (30%)					$83,000
General Conditions (10%)					$28,000
GC OH&P (10%)					$28,000
GC P (10%)					$28,000
Total Estimated Bid Day Cost					**$443,000**
Construction Contingency (5%)					$22,000
Total Estimated Construction Cost					**$465,000**
Eng, Leg & Admin (30%)					$139,500
Total Project Cost					**$605,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Globe Valves (Aeration Control)		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Globe Valves O&M Cost

Description		Units	Quantity	Unit Cost	Cost
O&M Cost					
Maintenance and Replacement Costs					
	Maintenace	LS	1	$4,538	$4,538
	Replacement Parts	LS	1	$7,563	$7,563
Subtotal per Year - Maintenance and Replacement					**$12,100**
Total - Globe Valves O&M Cost					**$12,100**
20 year Net Present Value for O&M Cost					
	Globe Valves	LS	1	$242,000	$242,000
Total - Globe Valves 20 year O&M Net Present Value					**$242,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Chemical Storage Area and Tanks		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Chemical Storage Area and Tanks Capital Improvements

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Chemical Containment Room					
Quantity	1				
	Demo	LS	1	$ 25,000	$25,000.00
	Concrete - Wall, Foundation, and Floor	cu yd	44	$ 3,000	$131,610.22
	CMU Block Wall	sq ft	580	$ 18.42	$10,683.60
	Door	LS	1	$ 1,500	$1,500.00
Chemical Storage Tanks (For All Tiers)					
Quantity	2				
	Double Walled 8,000 gallon Storage Tanks	EA	2	$30,850	$61,700
	Labor (Installation)	EA	2	$6,170	$12,340
Chemical Fill Station					
	Chemical Fill Station	LS	1	$50,000	$50,000
Subtotal for Chemical Storage Area and Tanks					$293,000
Subtotal 1					**$293,000**
Yard Piping		0%			$0
Paving/Grading		0%			$0
Coatings		5%			$15,000
Electrical		12%			$35,000
Instrumentation		8%			$23,000
Total Direct Cost					**$366,000**
Estimating Contingency (30%)					$110,000
General Conditions (10%)					$37,000
GC OH (10%)					$37,000
GC P (10%)					$37,000
Total Estimated Bid Day Cost					**$587,000**
Construction Contingency (5%)					$29,000
Total Estimated Construction Cost					**$616,000**
Eng, Leg & Admin (30%)					$184,800
Total Project Cost					**$801,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Chemical Pumps and Dosage - Tier 1		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Chemical Pumps and Dosage - Tier 1

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Chemical Pumps and Dosage - Tier 1					
Quantity	1				
	Pump Skid Tier 1	LS	1	$125,000	$125,000
	Labor Installation	LS	1	$25,000	$25,000
Subtotal for Chemical Pumps and Dosage - Tier 1					$150,000
Subtotal 1					**$150,000**
Yard Piping		0%			$0
Paving/Grading		0%			$0
Coatings		0%			$0
Electrical		12%			$18,000
Instrumentation		8%			$12,000
Total Direct Cost					**$180,000**
Estimating Contingency (30%)					$54,000
General Conditions (10%)					$18,000
GC OH (10%)					$18,000
GC P (10%)					$18,000
Total Estimated Bid Day Cost					**$288,000**
Construction Contingency (5%)					$14,000
Total Estimated Construction Cost					**$302,000**
Eng, Leg & Admin (30%)					$90,600
Total Project Cost					**$393,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Chemical Pumps and Dosage - Tier 1		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Chemical Pumps and Dosage - Tier 1 O&M Cost and LCC

Description		Units	Quantity	Unit Cost	Cost
O&M Cost and LCC					
Chemicals Costs					
	Ferric Chloride Dosing	$/yr	1	$2,365	$2,365
Subtotal per Year - Chemical					**$2,365**
Power Costs					
	Pumps Skid Tier 1	kW-h/yr	8,322	$0.0663	$552
Subtotal per Year - Power					**$552**
Maintenance and Replacement Costs					
	Maintenace	LS	1	$6,400	$6,400
	Replacement Parts	LS	1	$2,100	$2,100
	Truck Delivery Testing	EA	1	$55	$55
Subtotal per Year - Maintenance and Replacement					**$8,555**
Total - Chemical Pumps and Dosage - Tier 1 Annual O&M Cost					**$11,472**
20 year Net Present Value for O&M Cost					
	Chemical Pumps and Dosage - Tier 1	LS	1	$341,039	$341,039
Total - Chemical Pumps and Dosage - Tier 1 20 year O&M Net Present Value					**$341,039**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Chemical Pumps and Dosage - Tier 2		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Chemical Pumps and Dosage - Tier 2

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Chemical Pumps and Dosage - Tier 2					
Quantity	1				
	Pump Skid Tier 2	LS	1	$150,000	$150,000
	Labor Installation	LS	1	$30,000	$30,000
Subtotal for Chemical Pumps and Dosage - Tier 2					$180,000
Subtotal 1					**$180,000**
Yard Piping		0%			$0
Paving/Grading		0%			$0
Coatings		0%			$0
Electrical		12%			$22,000
Instrumentation		8%			$14,000
Total Direct Cost					**$216,000**
Estimating Contingency (30%)					$65,000
General Conditions (10%)					$22,000
GC OH (10%)					$22,000
GC P (10%)					$22,000
Total Estimated Bid Day Cost					**$347,000**
Construction Contingency (5%)					$17,000
Total Estimated Construction Cost					**$364,000**
Eng, Leg & Admin (30%)					$109,200
Total Project Cost					**$473,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Chemical Pumps and Dosage - Tier 2		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Chemical Pumps and Dosage - Tier 2 O&M Cost and LCC

Description		Units	Quantity	Unit Cost	Cost
O&M Cost and LCC					
Chemicals Costs					
	Ferric Chloride Dosing	$/yr	1	$13,666	$13,666
Subtotal per Year - Chemical					**$13,666**
Power Costs					
	Pumps Skid Tier 2	kW-h/yr	8,322	$0.0663	$552
Subtotal per Year - Power					**$552**
Maintenance and Replacement Costs					
	Maintenace	LS	1	$6,400	$6,400
	Replacement Parts	LS	1	$2,850	$2,850
	Truck Delivery Testing	LS	5	$55	$275
Subtotal per Year - Maintenance and Replacement					**$9,525**
Total - Chemical Pumps and Dosage - Tier 2 Annual O&M Cost					**$23,742**
20 year Net Present Value for O&M Cost					
	Chemical Pumps and Dosage - Tier 2	LS	1	$583,447	$583,447
Total - Chemical Pumps and Dosage - Tier 2 20 year O&M Net Present Value					**$583,447**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Chemical Pumps and Dosage - Tier 3		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Chemical Pumps and Dosage - Tier 3

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Chemical Pumps and Dosage - Tier 3					
Quantity	1				
	Pump Skid Tier 3	LS	1	$200,000	$200,000
	Labor Installation	LS	1	$40,000	$40,000
Subtotal for Chemical Pumps and Dosage - Tier 3					$240,000
Subtotal 1					**$240,000**
Yard Piping		0%			$0
Paving/Grading		0%			$0
Coatings		0%			$0
Electrical		12%			$29,000
Instrumentation		8%			$19,000
Total Direct Cost					**$288,000**
Estimating Contingency (30%)					$86,000
General Conditions (10%)					$29,000
GC OH (10%)					$29,000
GC P (10%)					$29,000
Total Estimated Bid Day Cost					**$461,000**
Construction Contingency (5%)					$23,000
Total Estimated Construction Cost					**$484,000**
Eng, Leg & Admin (30%)					$145,200
Total Project Cost					**$629,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Chemical Pumps and Dosage - Tier 3		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Chemical Pumps and Dosage - Tier 3 O&M Cost and LCC

Description		Units	Quantity	Unit Cost	Cost
O&M Cost and LCC					
Chemicals Costs					
	Ferric Chloride Dosing	$/yr	1	$185,011	$185,011
Subtotal per Year - Chemical					**$185,011**
Power Costs					
	Pumps Skid Tier 3	kW-h/yr	16,331	$0.0663	$1,083
Subtotal per Year - Power					**$1,083**
Maintenance and Replacement Costs					
	Maintenace	LS	1	$7,000	$7,000
	Replacement Parts	LS	1	$4,500	$4,500
	Truck Delivery Testing	LS	59	$55	$3,245
Subtotal per Year - Maintenance and Replacement					**$14,745**
Total - Chemical Pumps and Dosage - Tier 3 Annual O&M Cost					**$200,839**
20 year Net Present Value for O&M Cost					
	Chemical Pumps and Dosage - Tier 3	LS	1	$4,286,779	$4,286,779
Total - Chemical Pumps and Dosage - Tier 3 20 year O&M Net Present Value					**$4,286,779**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Chemical Feed Piping & Mixing		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Chemical Feed Piping & Mixing

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Chemical Feed Piping	Double Wall Piping to all Dosage Points	LF	8,035	$66	$530,310
Chemical Mixing	Flash Mixing System	EA	6	$50,000	$300,000
Subtotal for Chemical Feed Piping & Mixing					$831,000
Subtotal 1					**$831,000**
Yard Piping		0%			$0
Paving/Grading		0%			$0
Coatings		0%			$0
Electrical		0%			$0
Instrumentation		0%			$0
Total Direct Cost					**$831,000**
Estimating Contingency (30%)					$249,000
General Conditions (10%)					$83,000
GC OH (10%)					$83,000
GC P (10%)					$83,000
Total Estimated Bid Day Cost					**$1,329,000**
Construction Contingency (5%)					$66,000
Total Estimated Construction Cost					**$1,395,000**
Eng, Leg & Admin (30%)					$418,500
Total Project Cost					**$1,814,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Tertiary Filtration (Tier 1 and Tier 2)		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Tertiary Filtration (Tier 1 and Tier 2)

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Tertiary Filtration (Tier 1 and Tier 2)					
	Disc Filters	LS	1	$13,750,000	$13,750,000
	Miscellaneous Building Rehabilitation	%	1	10%	$1,375,000
Subtotal for Tertiary Filtration (Tier 1 and Tier 2)					$15,125,000
Filtration Support System					
	Pumps Rehabilitation	5%			$688,000
	Piping & Valves	10%			$1,375,000
	Chemical Feed	3%			$413,000
	HVAC	10%			$138,000
Subtotal for Filtration Support Systems					$2,614,000
Subtotal					**$17,739,000**
Yard Piping		1%			$177,000
Paving/Grading		1%			$177,000
Coatings		5%			$131,000
Electrical		4%			$639,000
Instrumentation		2%			$426,000
Total Direct Cost					**$19,289,000**
Estimating Contingency (30%)					$5,787,000
General Conditions (10%)					$1,929,000
GC OH (10%)					$1,929,000
GC P (10%)					$1,929,000
Total Estimated Bid Day Cost					**$30,863,000**
Construction Contingency (5%)					$1,543,000
Total Estimated Construction Cost					**$32,406,000**
Eng, Leg & Admin (30%)					$9,721,800
Total Project Cost					**$42,128,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Tertiary Filtration (Tier 3)		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Tertiary Filtration (Tier 3)

Description		Units	Quantity	Unit Cost	Cost
CONSTRUCTION COSTS					
Tertiary Filtration (Tier 3)					
	Disc Filters	LS	1	$17,187,500	$17,187,500
	Miscellaneous Building Rehabilitation	%	1	10%	$1,718,750
Subtotal for Tertiary Filtration (Tier 3)					$18,907,000
Filtration Support System					
	Pumps Rehabilitation	5%			$859,000
	Piping & Valves	10%			$1,719,000
	Chemical Feed	3%			$516,000
	HVAC	10%			$172,000
Subtotal for Filtration Support Systems					$3,266,000
Subtotal					**$22,173,000**
Yard Piping		1%			$222,000
Paving/Grading		1%			$222,000
Coatings		5%			$163,000
Electrical		4%			$798,000
Instrumentation		2%			$532,000
Total Direct Cost					**$24,110,000**
Estimating Contingency (30%)					$7,233,000
General Conditions (10%)					$2,411,000
GC OH (10%)					$2,411,000
GC P (10%)					$2,411,000
Total Estimated Bid Day Cost					**$38,576,000**
Construction Contingency (5%)					$1,929,000
Total Estimated Construction Cost					**$40,505,000**
Eng, Leg & Admin (30%)					$12,151,500
Total Project Cost					**$52,657,000**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Tertiary Filtration (Tier 1 and Tier 2)		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Tertiary Filtration (Tier 1 and Tier 2) O&M Cost

Description		Units	Quantity	Unit Cost	Cost
O&M Cost					
Power Costs					
	Filter Pumps	kW-h/yr	3,303,727	$0.0663	$219,037
Subtotal per Year - Power					**$219,037**
Maintenance and Replacement Costs					
	Maintenace and Replacement Costs	LS	1	$60,849	$60,849
Subtotal per Year - Maintenance and Replacement					**$60,849**
Total - Tertiary Filtration (Tier 1 and Tier 2) Annual O&M Cost					**$279,886**
20 year Net Present Value for O&M Cost					
	Tertiary Filtration (Tier 1 and Tier 2)	LS	1	$5,597,722	$5,597,722
Total - Tertiary Filtration (Tier 1 and Tier 2) 20 year O&M Net Present Value					**$5,597,722**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Tertiary Filtration (Tier 3)		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Tertiary Filtration (Tier 3) O&M Cost

Description		Units	Quantity	Unit Cost	Cost
O&M Cost					
Power Costs					
	Filter Pumps	kW-h/yr	3,303,727	$0.0663	$219,037
Subtotal per Year - Power					**$219,037**
Maintenance and Replacement Costs					
	Maintenace and Replacement Costs	LS	1	$76,061	$76,061
Subtotal per Year - Maintenance and Replacement					**$76,061**
Total - Tertiary Filtration (Tier 3) Annual O&M Cost					**$295,098**
20 year Net Present Value for O&M Cost					
	Tertiary Filtration (Tier 3)	LS	1	$5,901,967	$5,901,967
Total - Tertiary Filtration (Tier 3) 20 year O&M Net Present Value					**$5,901,967**

Project:	P Removal Feasibility Study for the Kirie WRP	Prepared by:	SA
Location:	Kirie WRP	Date:	9/9/2018
Element:	Additional Bio P and Chem P Monitoring		
Flow:	Rated Capacity	Checked by:	JF
Job Number:	10789A.00	Date:	11/10/2018

Additional Bio P and Chem P Monitoring O&M Cost

Description		Units	Quantity	Unit Cost	Cost
O&M Cost					
Miscellaneous Costs					
	Additional P Monitoring at Kirie WRP	$/day	365	180	$65,700
Total - Additional Bio P and Chem P Monitoringl O&M Cost					**$65,700**
20 year Net Present Value for O&M Cost					
	Additional P Monitoring at Kirie WRP	LS	1	$1,314,000	$1,314,000
Total - Additional Aeration 20 year O&M Net Present Value					**$1,314,000**